

GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Work Plan Addendum 1

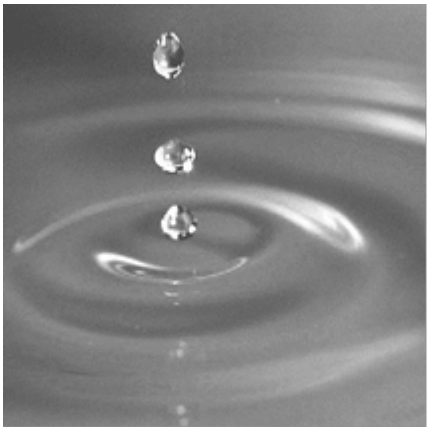
Paerdegat Basin

Brooklyn, New York

Submitted to:
National Grid USA
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Hicksville, NY 11801

Submitted by:
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March 2015
129600-1-1108



Work Plan Addendum 1
Paerdegat Basin
Brooklyn, New York
March 2015

CERTIFICATION

I, Barry Giroux certify that I am currently a Qualified Environmental Professional, as defined in 6 NYCRR Part 375, and that this Work Plan was prepared in accordance with all applicable statutes and regulations and in general conformance with the DER Technical Guidance for Site Investigations and Remediation (DER-10).

Introduction

This Work Plan Addendum 1 was prepared by GEI Consultants, Inc., P.C. (GEI) for National Grid (NG). It outlines the scope of work for an assessment to determine if a release of gas condensate has impacted structures associated with the New York City Department of Environmental Protection (NYCDEP) combined sewer overflow (CSO) facility in Paerdegat Basin and structures associated with the sewers in Paerdegat Avenue North. Paerdegat Basin is located in Brooklyn, New York as indicated in Fig. 1.

This work plan is an addendum to the original Work Plan dated October 22, 2012 and revised as of April 2, 2013 that was approved by the New York State Department of Environmental Conservation (NYSDEC) on April 2, 2013.

This scope of work described in this work plan is for the sampling and analysis of the following:

- Wooden tide gates.
- Concrete CSO bulkheads.
- Sanitary and storm sewer structures.

Background

Information regarding the gas condensate release is provided in the original Work Plan. The results of the investigations completed under the original Work Plan are presented in the Daft Site Characterization Data Report prepared by GEI and dated September 2013. This Work Plan Addendum has been prepared to address concerns raised by the NYCDEP regarding potential impacts to tide gates at their CSO facility and sewer structures near the release area at the corner of Seaview Avenue and Paerdegat Avenue North, and to determine the extent of impacts to the concrete bulkhead at the CSO facility. During the initial investigation two samples of the concrete bulkhead at the CSO facility were collected and PCBs were detected at 7.78 mg/kg at location PB-PS-CSO-01 and 146.6 mg/kg at PB-PS-CSO-02. These previous sample locations are indicated in Fig. 2.

In addition to the gas condensate release, there are other sources of PCBs discharges to Paerdegat Basin. Beginning in the early 1900s and ending in the 1930s, Paerdegat Basin was dredged to 16 feet below mean low water (MLW) and bulkheads were placed along shoreline resulting in in its present configuration. The current CSO retention facility went online in 2011. Prior to 2011 there was no treatment of the combined sewer overflows to Paerdegat Basin other than the removal of gross solids. Prior to 1935, when the Coney Island sewage treatment plant was built, sewage was likely discharged directly with no treatment. The presence of PCBs and other chemicals in the CSO discharges is well documented by sediment chemical analytical results, which indicate a long history of untreated industrial sewage discharges to Paerdegat Basin. Current discharges to the CSO are significantly cleaner that they were historically due to

pretreatment of industrial discharges, but still likely contain low levels of PCBs and other chemicals.

Proposed Field Investigations

The proposed field investigation includes the collection of seven wood samples from the tide gates, an initial twelve concrete samples from the bulkhead, and four wipe samples from the sewer structures. Additional concrete bulkhead samples will be taken as necessary to define the extent of PCB-impacted concrete. All samples will be analyzed for PCBs by Aroclor. Actual sample locations may have to be adjusted based on field conditions at the time the field work is done. GEI will conduct the sampling activities on behalf of National Grid. Proposed sample locations are indicated on Figs. 2 and 3 and a summary of the proposed investigations is provided in the Table 1.

Sample Locations and Rationale

The objective of this sampling task is to determine the extent of PCB impacts to the tide gates, concrete bulkhead, and sewer structures. Proposed sample locations at the CSO structure are indicated on Fig. 2 and at the sewer structures in Fig. 3. A summary of the proposed investigation is provided in Table 1.

The tide gates, bulkheads, and sewer structures to be sampled will be inspected for oil-like staining. Proposed sample locations on concrete and wood will be adjusted to locations where oil-staining is observed indicating suspected impact from the gas condensate release. If no oil-staining is observed, samples of the outer surface of the CSO structures and tide gates in contact with the surface water will be collected as indicated in Fig. 3. It may not be possible to collect samples from some locations for safety reasons or due to accessibility.

Wipe samples of the sewer structures will be collected at the locations with the highest likelihood of having been impacted by the release.

Tide Gates

There are 28 tide gates arranged in eight sets at the NYCDEP Paerdegat Basin CSO Facility. Two sets are at the head of the basin and six sets are along the southern side of the basin. The tide gates are as follows starting at the southeast portion of the CSO facility along the southwestern side of the basin to the northwest corner at the head of the basin:

- Four sets of three tide gates.
- One set of two tide gates.
- One set of three tide gates.
- One set of two tide gates.

- One set of five tide gates.

One wood sample will be collected from one tide gate in each set of tide gates except for from the set of five at the northwest corner at the head of the basin. In addition, a reference wood sample will be collected from one of the tide gates at an elevation above the extreme high tide level, which is above the elevation likely to have been impacted by the condensate release. This is a total of eight samples that will be chemically analyzed.

Samples are not proposed to be collected from the tide gates at the northwest corner at the head of the basin because of access limitations and safety concerns. At this location the tide gates are approximately 40 ft from the entrance at the bulkhead, the width of the access tunnels is very narrow, there is metal cribbing present that limits access and the structural condition of the access tunnels is suspect.

The deeper part of the access tunnels appear to be the original CSO outfall structures that were in place prior to construction of the CSO retention facility in 2011. Structures associated with the original CSO outfalls will not be tested – these structures could have been impacted historically by wastewaters containing PCBs.

Concrete Bulkhead

There are long concrete bulkheads at the head of the basin along the two sets of tide gates and along the four sets of tide gates along the southwestern side of the basin. In addition, there are short lengths of bulkhead at the other two sets of tide gates. Concrete samples will be collected at approximate 100-ft intervals along the bulkheads as indicated in Fig. 2 (eight samples). In addition, vertical delineation samples will be collected at the two locations where PCBs were previously detected (four samples). We anticipate the PCB impacts to the concrete are limited to vertical locations that were in contact with surface water at the time of the spill. The elevation range during the release and cleanup time period ranged from low to high tide elevations. In addition, wave action could have caused locations higher than the normal water surface to have been impacted. We will attempt to collect concrete samples at above high tide elevations and below low tide elevations at each of the two locations previously sampled. Based on the results of the previous investigation, additional samples will be collected at approximate 50-ft intervals to define the full extent of PCB impacts.

Sanitary Manholes

There are a number of sanitary sewer manholes and storm sewer catch basins along Paerdegat Avenue North. Information provided herein and in Fig. 3 on sanitary and storm water flow directions is based on observations and dye tests conducted during the initial release response and drawings provided by the NYCDEP, which are provided in Attachment A. The sanitary flow starts at the manhole at the corner of Paerdegat Avenue North and Seaview Avenue. It then flows westerly along Paerdegat Avenue North to the CSO structure holding tanks at the head of

the basin. The first two manholes from Seaview Avenue are the only ones likely to have been impacted by the condensate release. The two sanitary manholes to be sampled are indicated as SMH-1 and SMH-2 in Fig. 3. The storm water flow starts in a catch basin on the east side of Seaview Avenue. It then flows westerly to two catch basins on the corner of Seaview Avenue and Paerdegat Avenue North, then continues in a westerly direction to the intersection of Paerdegat Avenue North and Paerdegat 13th Street. At that point it travels southerly and discharges into Paerdegat Basin. The two storm sewer catch basins to be sampled are indicated as CB-1 and CB-2 in Fig. 3. The NYCDEP indicated that these two catch basins are the ones they are concerned may have been impacted by the release and not fully decontaminated.

Wipe samples will be collected from the manhole covers and catch basin grate covers at each of the locations indicated in Fig. 3.

Sampling Methods

Shallow bulk samples of wood and concrete will be collected from surfaces using USEPA sampling protocols for collection of porous materials for PCB analysis (USEPA, May 2011). A wood chisel, sharp knife or handheld rotary drill with a corer attachment will be used to collect surface samples from wooden tide gates. Samples of concrete from the bulkheads will be collected using a vibratory hammer drill and a carbide bit. The depth of sampling will not exceed 1/2 inch into the surface sampled. Samples collected from the tide gates and bulkhead, which are exposed to daily tidal fluctuations, will be comprised of a composite of three subsamples collected during low tide from three locations representative of depth approximate heights of the low tide, mid tide and high tide. The concrete samples to be collected from above high tide elevations and below low tide elevations at each of the two locations sampled during the previous 2013 investigation and the reference wood sample location will be discrete samples. The sample location holes will be patched with a wood filler or patching cement, as applicable.

A primary boat able to access the vicinity of the sample locations at low tide, in conjunction with a small non-motorized or electric motor satellite boat will be used to access most of the sample locations. Some of the bulkhead sample locations may be accessed by walking along the mudflats present at low tide. Site conditions will be evaluated, to determine if direct access via mud flats or boat access is required. All samples will be placed in laboratory provided sampling jars for PCB analysis.

Wipe samples from the manholes will be collected in accordance with USEPA sampling protocols in 40 CFR 761.123. A gauze pad or glass wool saturated in hexane will be used to swap a 100 square centimeter area. All wipe samples will be placed in laboratory provided sampling jars for transport to the laboratory for PCB analysis.

Equipment Decontamination

After any cleaning required by the QAPP and NYSDEC DER-10 protocol each piece of equipment that could potentially be contaminated by PCBs will be rinsed or swabbed with hexane to meet the applicable decontamination standards in 40 CFR 761.79(c). Hexane is an approved performance-based organic decontamination fluid (PODF) under the self-implementing decontamination standards in 40 CFR 761.79(c).

Proposed Sample Analysis

Based upon analytical results of the condensate oil collected from the standpipe, the condensate contained PCBs, volatile organic compounds (VOCs) and semivolatile organic compounds. The highest concentration constituent is PCB Aroclor 1242. Given that VOC and SVOC concentrations detected during the initial investigation were not detected above levels of concern, PCBs are the only constituents of concern related to the condensate release to be analyzed under the scope of work described in this work plan. The tide gates may have also been impacted from CSO releases; therefore, a select subset of samples will also be tested for substances associated with CSO outfalls. All analyses will be done on a normal turn-around-time basis.

Concrete samples, wood samples, and wipe samples will be analyzed for PCB Aroclors according to USEPA Method 8082A. In addition two wood samples and the reference wood sample from the tide gates will also be analyzed for the following substances associated with CSO outfalls:

- VOCs according to USEPA Method 8260.
- SVOC according to USEPA Method 8270.
- Total Petroleum Hydrocarbons according to USEPA Method 8015.

Samples will be archived with the potential for future analysis of PCB congeners according to USEPA Method 1668A to support forensic evaluations.

Investigation-Derived Waste

Wastewaters produced during decontamination will be collected and contained within 55-gallon, Unites States Department of Transportation (USDOT) drums. National Grid will arrange for the disposal of the investigation-derived wastes after they have been characterized. All appropriate documentation for waste characterization and disposal will be included in the final report.

Sampling Schedule

Upon NYSDEC approval of the work plan, GEI estimates approximately five days to mobilize for the field work. Dependent upon weather conditions and access, GEI estimates that the initial field program can be conducted in approximately two work weeks. Most of the sampling needs to be completed at and about low tide; therefore, the number of samples collected per day will be limited. During most days samples of wood from the tide gates and concrete from the bulkheads will be collected. Attached is a Gantt chart (Fig. 4), which depicts the proposed project schedule. Our intended daily work schedule for the field work is as follows:

- Day 1 – Start structure sampling
- Day 2 – Continue structure sampling
- Day 3 – Continue structure sampling
- Day 4 – Continue structure sampling
- Day 5 – Continue structure sampling
- Day 6 – Continue structure sampling
- Day 7 – Continue structure sampling
- Day 8 and 9 – Complete any unfinished sampling or tasks, demobilize
- Day 2 to 29 – Chemical analysis
- Day 30 to 35 – Re-mobilize to collect supplemental concrete structure samples, if necessary
- Day 36, 37, and 38 – Collect supplemental concrete structure samples
- Day 36 to 48 – Chemical analysis
- Day 10 to 68 – Prepare draft report

Report

GEI will prepare a report summarizing the investigation work. A preliminary table of contents for this report is as follows:

- Executive Summary
- Introduction
- Field Investigations
- Analytical Results
- Findings and Conclusions
- Recommendations

The report will include figures indicating the sample locations, tables with a summary of the analytical results, and photographs.

Health and Safety

The site-specific health and safety plan was prepared and approved for the initial work and it has been updated to address sampling of the tide gates. The tide gate sampling activities will involve a confined space entry and include a work zone air monitoring program. A copy of the updated plan is provided in Attachment B.

Quality Assurance

A Quality Assurance Project Plan (QAPP) has been prepared for this work and is provided in the initial work plan, which has been approved by the NYSDEC. The new activities in the scope of work in this work plan are the collection of wipe samples for PCB analysis and analysis of some samples for SVOCs and TPH. A copy of the updated QAPP is provided in Attachment C.

Table

Table 1. Summary of Proposed Sampling and Analysis Program

Sample Type	Rationale	Parameters		
		PCBs (mass analysis)	PCBs (wipe test)	CSO Reference substances[1]
Tide Gates				
Wood structure	To assess if tide gates were impacted by the condensate release	7	---	2
Wood background/ reference	To evaluate impacts to structures from CSO discharges	1	---	1
Concrete Bulkhead Structures				
Concrete structure, initial investigation	To assess the extent of PCB impacts to the concrete structures	8	---	---
Concrete structure at previous sample locations	To establish the vertical extent of PCB impacts	4	---	---
Concrete structure, supplemental investigation, if required	To assess the extent of PCB impacts to the concrete structures	4 to 8 (estimated)	---	---
Sanitary Manholes				
Steel Manhole Cover	To assess if the manhole or catch basin covers were impacted by the condensate release	---	4	---
Steel Catch Basin Grate		---	4	---

1. CSO reference substances include VOC, SVOC and TPH

Figures



SOURCE:

WORLD IMAGERY (ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY) ACCESSED VIA ARCGIS ONLINE ON 5/22/14.

0 300 600 1200

SCALE: 1" = 600'

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Paerdegat Basin
Brooklyn, New York

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Project 129600

SITE LOCATION

March 2015 Fig. 1

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NG-PB-PS-CSO-01

NG-PB-PS-CSO-02

48" S.

186", 168", AND 90" STORM SEWER OUTLET

2 - 84" (PER SEWER R...

12" GAS

16" GAS

20" WATER

FIRE

0 50 100

SCALE: 1:50

LEGEND:

△ EXISTING STRUCTURES SAMPLE

▲ PROPOSED CONCRETE STRUCTURE SAMPLE

⌀ PROPOSED TIDE GATE SAMPLE

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Brooklyn, New York

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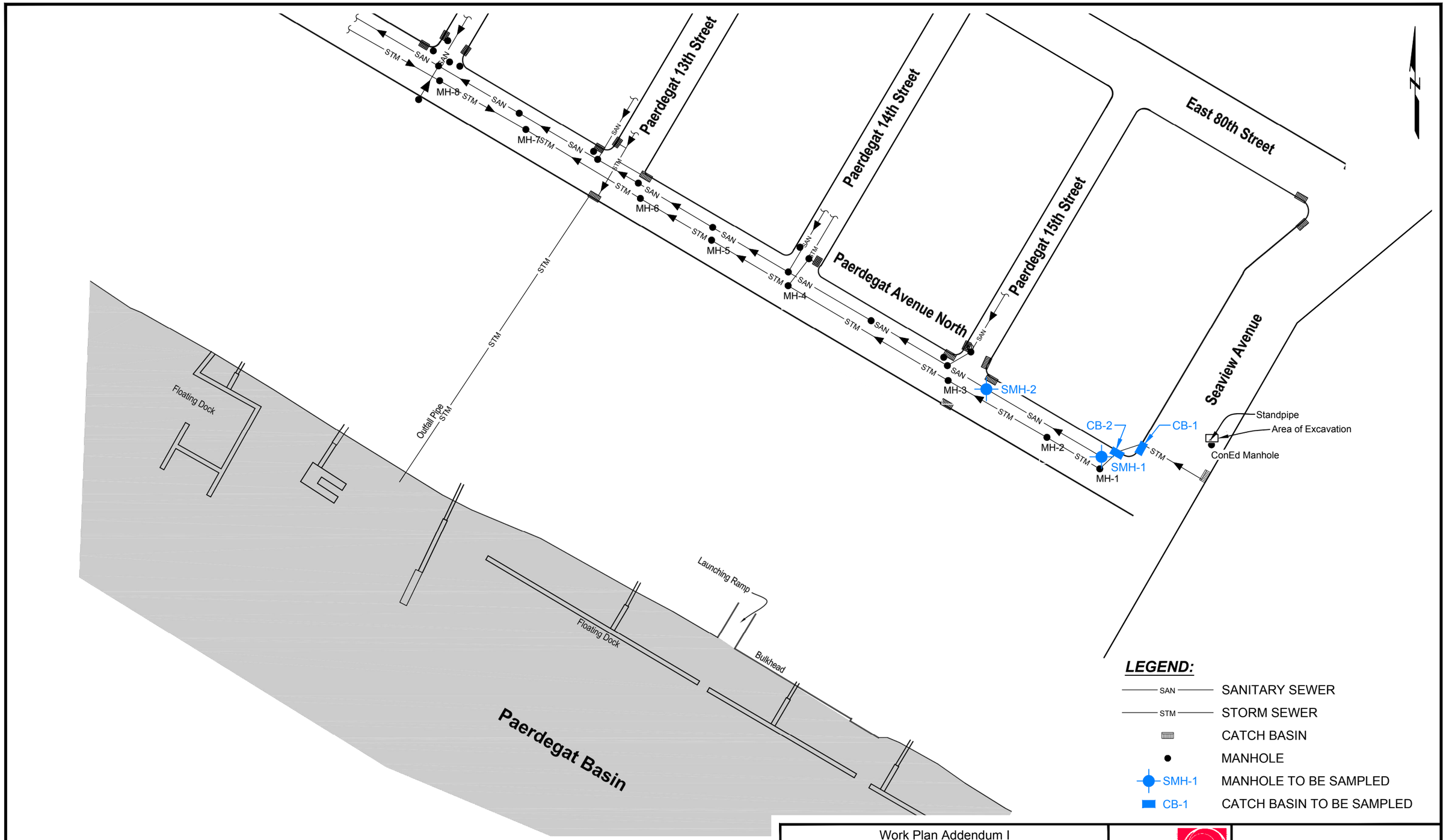
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Project 129600

STRUCTURE (TIDE GATES AND CONCRETE BULKHEAD) SAMPLE LOCATIONS

March 2015 Fig. 2

\\gtb1v-fs01\ I:\Project\National Grid\Paerdegat Basin\Work Plan Addendum I\Drawings\Paerdegate-WPAI Figures_03-2015.dwg - 3/9/2015



SOURCE:
GAS CONDENSATE RELEASE, 80TH AVENUE & SEAVIEW AVENUE, PREPARED FOR NATIONAL GRID, PREPARED BY H2M ARCHITECTS + ENGINEERS, SCALE: 1" = 200', DATE: 10/01/12.

0 60 120 240
SCALE: 1" = 120'

Work Plan Addendum I
Paerdegat Basin
Brooklyn, New York

nationalgrid

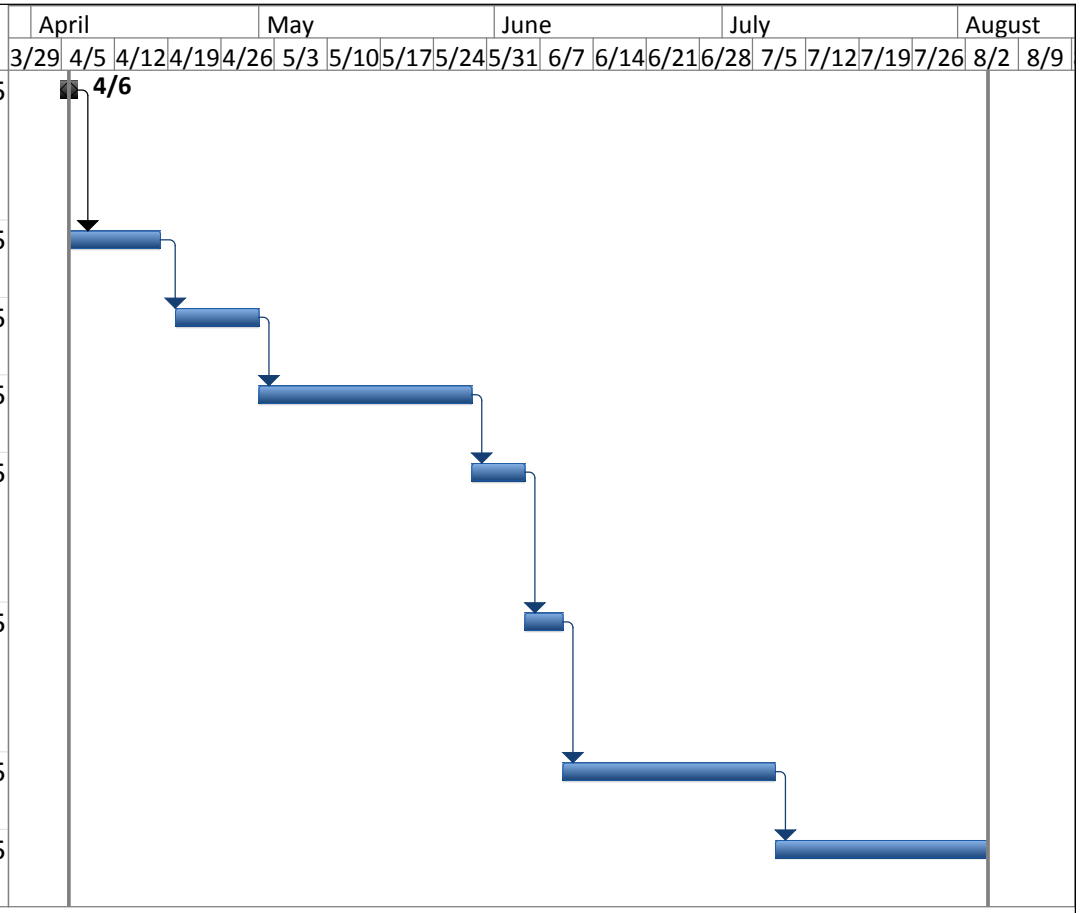
GEI Consultants

SANITARY SEWER SAMPLE LOCATIONS

Project 129600 | March 2015 | Fig. 3

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ID	Task Name	Duration	Start	Finish
1	NYSDEC Approval of Work Plan	0 days	4/6/15	4/6/15
2	Mobilization	10 days	4/6/15	4/17/15
3	Structure Sampling	9 days	4/20/15	4/30/15
4	Chemical Analysis	20 days	5/1/15	5/28/15
5	Mobilization for Supplemental Sampling	5 days	5/29/15	6/4/15
6	Collect Supplemental Samples	3 days	6/5/15	6/9/15
7	Chemical Analysis	20 days	6/10/15	7/7/15
8	Prepare Draft Report	20 days	7/8/15	8/4/15



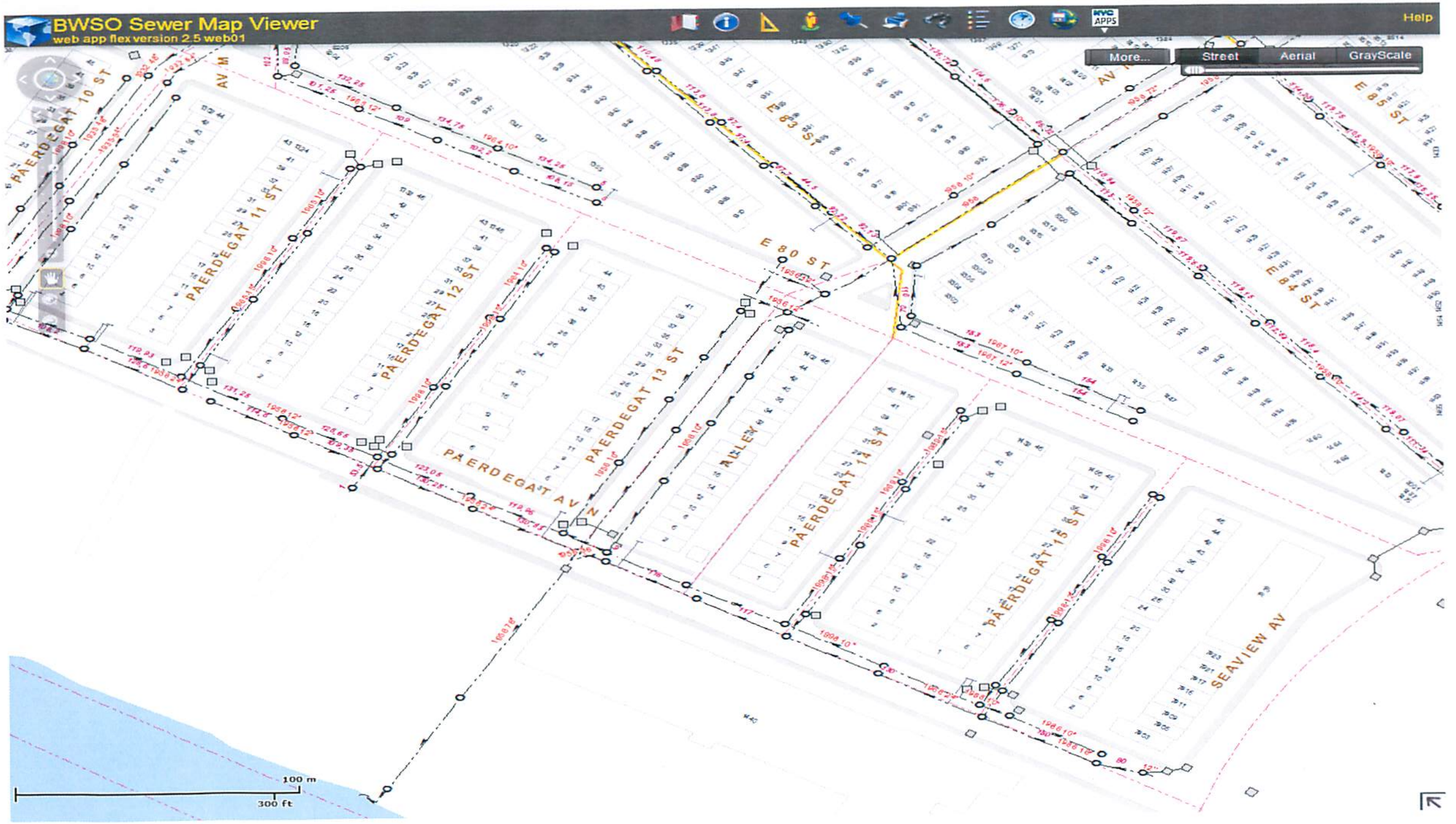
Project: Figure 4 - Schedule
Date: 3/9/15

Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Deadline
External Tasks	Duration-only	Progress

Attachment A

NYCDEP Sewer Drawings

1


BWSO Sewer Map Viewer
web app flex version 2.5 web01
Help
More...
Street
Aerial
GrayScale
PAERDEGAT 10 ST
PAERDEGAT 11 ST
PAERDEGAT 12 ST
PAERDEGAT 13 ST
PAERDEGAT 14 ST
PAERDEGAT 15 ST
PAERDEGAT AV N
E 80 ST
E 83 ST
E 84 ST
E 85 ST
AV M
AV N
ALLEY
SEAVIEW AV
100 m
300 ft

Attachment B

Health and Safety Plan



GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Health and Safety Plan

Paerdegat Basin
Brooklyn, NY

Prepared For:
National Grid
287 Maspeth Avenue
Brooklyn, NY 11211

Submitted by:
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455 Winding Brook Drive
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March 2015

Project No. 129600-1-1108

Barry Giroux, P.E.
Project Manager

Steven Hawkins, CSP
Regional Health and Safety Officer

Table of Contents

1. Emergency Contact Information 1

2. Background Information 2
2.1 General 2
2.2 Project Description 2
2.3 Site Description 3

3. Statement of Safety and Health Policy 5

4. Hazard/Risk Analysis 6
4.1 Personal Safety 6
4.2 Activity Hazard Analysis 7
4.2.1 Working in Confined Spaces 11
4.2.2 Fire and Explosion 11
4.2.3 Heat Stress 11
4.2.4 Noise 12
4.2.5 Hand and Power Tools 12
4.2.6 Slips, Trips, and Falls 12
4.2.7 Manual Lifting 12
4.2.8 Projectile Objects and Overhead Dangers 13
4.2.9 Cuts and Lacerations 13
4.2.10 Sewage and Bacterial Impacted Sediments 13
4.2.11 Working Near Water 13
4.2.12 Boating Safety 14
4.2.12.1 Person Overboard 14
4.2.12.2 Severe Weather 15
4.2.12.3 Abandon Ship 15
4.3 Chemical Hazards 16
4.3.1 Volatile Organic Compounds (VOCs) 16
4.3.2 Oil Products 16
4.3.3 Heavy Metals 17
4.3.4 Asbestos-Containing Materials 17
4.3.5 Polychlorinated Biphenyls 17
4.3.6 Hydrogen Sulfide 18
4.3.7 Evaluation of Organic Vapor Exposure 18
4.3.8 Evaluation of Skin Contact and Absorption 19
4.4 Biological Hazards 26
4.4.1 Poisonous Plants 26
4.4.2 Ticks 27
4.4.2.1 Lyme Disease 27
4.4.2.2 Rocky Mountain Spotted Fever 27

4.4.2.3 Prevention 28
4.4.3 Mosquito- Borne Disease – West Nile Virus 29
4.4.4 Wasps and Bees 29
4.4.5 Sun Exposure 30

5. Personal Protective Equipment 31
5.1 OSHA Requirements for PPE 32

6. Key Project Personnel/Responsibilities and Lines of Authority 33
6.1 GEI Personnel 33
6.1.1 GEI Project Manager 33
6.1.2 GEI Corporate Health and Safety Officer 34
6.1.3 GEI Site Safety Officer 34
6.1.4 GEI Field Personnel 35
6.1.5 Lines of Authority will be as follows: 36
6.2 Subcontractors 36

7. Training Program 37
7.1 HAZWOPER Training 37
7.2 Annual 8-Hour Refresher Training 37
7.3 Supervisor Training 37
7.4 Site-Specific Training 37
7.5 On-Site Safety Briefings 38
7.6 First Aid and CPR 38

8. Medical Surveillance Program 39

9. Monitoring 40

10. Site Control Measures 42
10.1 Site Zones 42
10.2 Buddy System 43
10.3 Sanitation for Temporary Work Sites 43
10.4 Illumination 43

11. Accident Reporting 44

12. Decontamination Procedures 45
12.1 Personnel Decontamination Station 45
12.2 Decontamination Equipment Requirements 46

13. Supplemental Contingency Plan Procedures 47
13.1 Hazard Communication Plan 47
13.2 Fire 47
13.3 Medical Support 47

13.4 Severe Weather 47
13.5 Spills or Material Release 48
13.6 Alcohol and Drug Abuse Prevention 48

14. Health and Safety Plan Sign-Off 49

Tables

1. Emergency Contact Information
2. Activity Hazard Analysis
3. Chemical Data
4. Summary of PPE by Level
5. OSHA Standards for PPE
6. Real-Time Work Zone Air Monitoring Action Levels

Appendices

A. Map to Hospital and Occupational Health Clinic
B. Safety Data Sheets
C. Heat and Cold Stress Guidelines
D. Forms
E. GEI Health and Safety SOPs
F. GEI Confined Space Entry Program
G. NYCDEP EAP, Evacuation Drawings & Emergency Contact List
H. NYCDEP Confined Space Entry Program
I. NYCDEP Extreme Hot & Cold Weather Guide
J. NYCDEP Hearing Conservation
K. NYCDEP Sanitation, Disease Prevention, and Hygiene
L. NYCDEP PCB Management
M. NYCDEP Personal Protective Equipment

1. Emergency Contact Information

Emergency contact information is provided in Table 1 below and in Appendix G – NYCDEP EAP, Evacuation Drawings & Contact List

Table 1. Emergency Information

Important Phone Numbers		Directions to Hospital
Local Police:	911	To Hospital and Occupational Health Clinic: See Attached Maps and Directions in Appendix A
Fire Department:	911	
Ambulance:	911	
State Police or County Sheriff:	911	
Brookdale University Hospital and Medical Center One Brookdale Plaza Brooklyn, New York 11212	(718) 240-5000	
Health Care First Medical Pc *Occupational Medicine* 9621 Rockaway Blvd Ozone Park, NY 11417	(718) 738-6771	
Project Manager: Barry Giroux	(860) 368-5340 office (860) 608-9723 cell	
Corporate Health and Safety Officer : Robin B. DeHate, Ph.D.	(813) 774-6564 office (813) 323-6220 cell	
Regional Health and Safety Officer Steven Hawkins	(860) 368-5348 office (860) 916-4167 cell	
Client Contact: William Ryan	(516) 545-2586 office (516) 790-1660 cell	
Nearest Telephone Location: On-site cellular		

2. Background Information

2.1 General

Engineer GEI Consultants, Inc. (GEI)
455 Winding Brook Drive
Suite 201
Glastonbury, CT 06033

Project Name Paerdegat Basin – National Grid
Brooklyn, NY

This Health and Safety Plan (HASP) establishes policies and procedures to protect GEI personnel from the potential hazards posed by the activities at the Paerdegat Basin in Brooklyn, New York. Reading of the HASP is required of on-site GEI personnel and will be reviewed by GEI subcontractors. Subcontractors will prepare their own Site-specific HASP and may use this as a guide. The plan identifies measures to minimize accidents and injuries, which may result from project activities or during adverse weather conditions. A copy of this HASP will be maintained on site for the duration of the work.

Included in Section 1 and Appendix A is a route to the nearest medical facility from the Site with directions and contact information. Safety data sheets (formerly known as Material Safety Data Sheets [MSDS]), specific to chemicals that may be encountered while working at the Site, are in Appendix B. Appendix C details the signs, symptoms, care and procedures to both heat and cold stress. Appendix D includes the Tailgate Safety Briefing form, the Project Safety Briefing form, the Accident/Incident Report Form and the Near Miss Reporting Form. Appendix E contains the GEI Health and Safety (H&S) Standard Operating Procedures (SOPs) that apply to this project.

2.2 Project Description

The project involves the release of a polychlorinated biphenyl (PCB)-contaminated liquid to Paerdegat Basin on Jamaica Bay in Brooklyn, NY. A gas condensate release was caused when a contractor was abandoning a 24" transmission line with flowable fill/concrete. The concrete displaced the condensate liquids from the line and caused a release through a standpipe that pooled on the ground surface and ultimately discharged to the adjacent water body. Reported release volume to the waterway was approximately 1,400 gallons.

The primary objectives of the project are to conduct a presence/absence assessment of Aroclor 1242 in structures associated with the New York City Department of Environmental

Protection (NYCDEP) combined sewer overflow (CSO) Facility in Paerdegat Basin and structures associated with the sewers in Paerdegate Avenue North. Aroclor 1242 was previously documented by analysis as the only Aroclor (a commercial mixture of PCBs) in the condensate liquid released. Therefore, the approach would be to investigate whether Aroclor 1242 is detected in the following structures by the collection of wood samples from the wooden tide gates, concrete samples from the concrete CSO bulkheads, and wipe samples from the sanitary and storm sewer structures. If Aroclor 1242 is detected, a congener analyses will be conducted as part of a forensic comparison of the sample media to the source sample.

Samples of wood and concrete will be collected from the surface using USEPA sampling protocols for collection of porous materials for PCB analysis (USEPA, May 2011). A wood chisel, sharp knife or handheld rotary drill with a corer attachment will be used to collect surface samples from wooden tide gates. Samples of concrete from the bulkheads will be collected using a vibratory hammer drill and a carbide bit.

A primary boat able to access the vicinity of the sample locations at low tide, in conjunction with a small non-motorized or electric motor satellite boat will be used to access most of the sample locations. All samples will be placed in laboratory provided sampling jars for PCB analysis.

Wipe samples from the manholes will be collected in accordance with USEPA sampling protocols in 40 CFR 761.123. A gauze pad or glass wool saturated in hexane will be used to swap a 100 square centimeter area. All wipe samples will be placed in laboratory provided sampling jars for transport to the laboratory for PCB analysis.

2.3 Site Description

Paerdegat Basin is a channel that connects to Jamaica Bay on the southern end of Brooklyn, New York, United States. It is located on the west side of the Canarsie area. It connects to Jamaica Bay to the south, and the north end of the basin is adjacent to the intersection of Ralph Avenue and Flatlands Avenue. NYCDEP operates the CSO facility and associated sewer structures located and the north end of the basin where the investigations are planned.

There are 28 tide gates arranged in eight sets at the NYCDEP Paerdegat Basin CSO Facility. Two sets are at the head of the basin and six sets are along the southern side of the basin.

There are long concrete bulkheads at the head of the basin along the two sets of tide gates and along the four sets of tide gates along the southwestern side of the basin. In addition, there are short lengths of bulkhead at the other two sets of tide gates.

There are a number of sanitary sewer manholes and storm sewer catch basins along Paerdegat Avenue North. The first two manholes from Seaview Avenue are the only ones likely to have been impacted by the condensate release. The two storm sewer catch basins to be sampled are located at the north western corner of the Seaview Avenue and Paerdegat Avenue North intersection. The NYCDEP indicated that these two catch basins are the ones they are concerned may have been impacted by the release.

3. Statement of Safety and Health Policy

GEI is committed to providing a safe and healthy work environment for its employees. To maintain a safe work environment, GEI has established an organizational structure and a Corporate Health and Safety Program to promote the following objectives:

- Reduce the risk of injury, illness, and loss of life to GEI employees.
- Maintain compliance with federal, state, and other applicable safety regulations; and minimize GEI employees' work exposure to potential physical, chemical, biological, and radiological hazards.

Safety policy and procedure on any one project cannot be administered, implemented, monitored, and enforced by any one individual. The total objective of a safe, accident free work environment can only be accomplished by a dedicated, concerted effort by every individual involved with the project from management down to all employees.

Each GEI employee must understand their value to the company; the costs of accidents, both monetary, physical, and emotional; the objective of the safety policy and procedures; the safety rules that apply to the safety policy and procedures; and what their individual role is in administering, implementing, monitoring, and compliance of their safety policy and procedures. This allows for a more personal approach to compliance through planning, training, understanding, and cooperative effort, rather than by strict enforcement. If for any reason an unsafe act persists, strict enforcement will be implemented.

4. Hazard/Risk Analysis

Physical hazards associated with working on a boat, using hand and power tools, and working around the heavy equipment that will be used to lift the vault covers. Some of the hazards associated with this equipment include crushing of limbs, slipping, tripping, or falling, drowning, and heavy lifting.

Smoking is prohibited at or in the vicinity of hazardous operations or materials. Where smoking is permitted, safe receptacles will be provided for smoking materials. The hazards for this operation are listed in the following Activity Hazard Analysis and Site Hazards sections.

4.1 Personal Safety

Field activities have the potential to take employees into areas which may pose a risk to personal safety. The following websites (sources) have been researched to identify potential crime activity in the area of the project:

- www.crimereports.com: No crimes identified in the past 30 days within a mile of the Site. Seven sex offenders are identified in the vicinity of Paerdegat Basin.
- www.cityrating.com/crimestatistics.asp: The crime rate in New York for 2014 is expected to be lower than in 2010 when the state violent crime rate was higher than the national violent crime rate average by 37.22% and the state property crime rate was lower than the national property crime rate average by 13.47%.
- www.crimemapping.com: No crimes identified in the past 30 days within a mile of the Site.

To protect yourself, take the following precautions:

- If deemed necessary by the PM, use the buddy system (teams of a minimum of two persons present);
- Let the Site Safety Officer (SSO) know when you begin work in these areas and when you leave;
- Call in regularly;
- Pay attention to what is going on around you; and
- If you arrive in an area and it does not look safe to get out of your vehicle, lock the doors and drive off quickly but safely.

Employees must not knowingly enter into a situation where there is the potential for physical and violent behaviors to occur. If employees encounter hostile individuals or a confrontation develops in the work area, suspend work activities, immediately leave the area of concern, and contact local 911 for assistance. Notify the SSO and Corporate Health and Safety Officer (CHSO) of any incidents once you are out of potential danger.

In the event of an emergency, prompt communications with local emergency responders is essential. At least one charged and otherwise functioning cell phone to facilitate emergency communications will be on-site. Confirmation of cellular phone operation will be confirmed at the start of each working day.

4.2 Activity Hazard Analysis

The potential hazards for this project associated with site conditions and activity hazards associated with GEI on-site activities have been identified in Table 2. General hazards and control measures that are applicable to all site activities are identified in the General Hazards section. The site-specific tasks, potential hazards, and control measures established to reduce the risk of injury or illness are identified in the Activity Hazard section of Table 2. Health and Safety SOPs for routine hazards and common site conditions are referenced in the table below and included in Appendix E.

Table 2. Activity Hazard Analysis

General Hazards These Hazards Apply to All Site Activities	Control Measure
Chemical / Contaminant Exposure – Skin and eye injury/irritation	• Wear protective coveralls (e.g. Tyvek ®) with shoe covers, safety glasses, face shield, Nitrile gloves. • Dispose of gloves after use and wash hands. • Avoid contact with pooled liquids and limit contact with contaminated soils/groundwater.
Contaminated Sewage Exposure	• Personal protective equipment as identified in the site-specific HASP will be worn to minimize potential exposures. • Employees will follow the decontamination or disposal procedures identified in the HASP. • See SOP HS-001
Noise Exposure – Boat motor and power tools	• Wear proper hearing protection when working near or using equipment that produces loud noise.
Physical Injury – Slips, Trips and Falls	• Wear PPE that properly fits, is in good condition and appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Maintain weed growth in sampling areas, especially on slopes. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to sampling areas, on steeply sloped areas, or where steep areas must be traversed to arrive at sample points.
Inclement Weather	• Listen to local forecasts for warnings about specific weather hazards such as tornados, thunder storms, and flash floods. • If the storms produce thunder and/or lightning, leave the work area immediately and move to a safe area. • Discuss an action plan prior to the severe weather. • Wear appropriate PPE for the type of weather that could be encountered. • Stop work until conditions are suitable. Take cover in vehicles or shelter as appropriate. • See SOP HS-010

General Hazards These Hazards Apply to All Site Activities	Control Measure
Heat stress – Fainting, Fatigue, Heat Stroke	• Increase water intake while working. • Increase number of rest breaks and/or rotate workers in shorter work shifts. Rest in cool, dry areas. • Watch for signs and symptoms of heat exhaustion and fatigue. • Plan work for early morning or evening during hot months. • Use ice vests when necessary. • In the event of heat stroke, bring the victim to a cool environment and initiate first aid procedures. • See Appendix C of the HASP
Insects – Bites, Stings, Allergic Reactions	• Apply insect repellent prior to performing field work and as often as needed throughout the work shift • Wear proper protective clothing (work boots, socks and light colored clothing) • Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many insects are most active (between dawn and dusk). • When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible • Field personnel who may have insect allergies should have bee sting allergy medication on site and should provide this information to the SSO and the CHSO prior to commencing work. • Field personnel should perform a self-check at the end of the day for ticks. • See SOP HS-001
Repetitive Motion Injury - Standing, Squatting, and Bending Over	• Take regular breaks and do not work in unusual positions for long periods of time. • Walk and stretch between tasks.
Vehicular Traffic – Struck by injury, crushing	• Increase visibility of the work area to others by using cones, flags, barricades, proper lighting and caution tape to define work area. • Use a "spotter" to locate oncoming vehicles. • Use vehicle to block work area. • Engage police detail for all work conducted in appropriate areas. • Wear high-visibility, reflective vest at all times. • Maintain minimum DOT defined distances to other traffic lanes. • See SOP HS-016.

Activity: Sample Collection		
Task	**Potential Hazard**	**Control Measures**
Boating/Barge Work	Drowning, fall hazards, pinch points, hypothermia	• Use caution when boarding the boat/barge. • Establish a safe area for boarding and de-boarding. • Do not stand in the boat. Avoid sudden movements. • Stay away from the edge of the boat/barge. • Wear a PDF at all times when on the water. • Have an extra set of clothing in case of drenching/soaking to prevent hypothermia. • See SOP HS-017
Confined Space Entry (General)	Asphyxiation, entrapment, chemical exposure, fire/explosion hazards	• Only trained GEI personnel can enter the space. • The atmosphere in the space must meet GEI entry requirements. • A copy of the permit will be forwarded to the CHSO prior to entry. • A multi-gas meter must be used to characterize the space before entry. • Proper protective equipment must be worn at all times while personnel are in the space.
CSO Entry	Falls, Drowning	• Personnel should be aware of the weather in the region due to the potential for flash floods. If significant rain is reported upstream in the drainage area that may cause the tide gates to open, inspections will cease.
Working near Water	Drowning, hypothermia	• While working near water stay inside guard rails and or barriers. • While working out of out of safety zones a personal flotation device (PFD) must be worn at all times and an approved 30-inch ring buoys will be readily available for emergency rescue operations. • Use appropriate fall protection. • Buddy system shall be in use. • See SOP HS-017
Heavy Lifting	Back injury, knee injury	• Use proper lifting techniques. • Ask fellow worker for help. • Use a mechanical lifting device or a lifting aid where appropriate. • If you must lift, plan the lift before doing it. • Check your route for clearance. • Bend at the knees and use leg muscles when lifting. • Use the buddy system when lifting heavy or awkward objects. • Do not twist your body while lifting.
Hand and Power Tools	Pinch points, electrocution, struck-by flying particles	• Wear appropriate PPE when using tools including safety glasses and gloves. • Avoid using powered tools in wet environments. • A GFCI is required when using tools powered with electrical cords. • Follow manufacturer's instructions when using tools.

Personal Protective Equipment (PPE) is the initial level of protection based on the activity hazards and Site conditions which have been identified. Upgrades to respiratory protection

may be required based on the designated Action Levels found in Section 9. General on-site provisions will include: extra nitrile, leather, and/or Kevlar gloves, extra protective coveralls (e.g. Tyvek®) with boot covers, drinking water and electrolyte fluids, reflective vest, first aid kit, fire extinguisher, hearing protection, and washing facilities.

If Site conditions suggest the existence of a situation more hazardous than anticipated, the Site personnel will evacuate the immediate area. The hazard, the level of precautions, and the PPE will then be reevaluated with the assistance and approval of the CHSO (Robin DeHate) and the Project Manager (PM) Barry Giroux.

4.2.1 Working in Confined Spaces

Work in confined spaces will be performed in accordance with 29 CFR 1910.146 (effective April 15, 1993), GEI's Permit Required Confined Space Entry program located in Appendix F, and NYCDEP's confined space entry program located in Appendix H. The PM will work with the CHSO to address confined space issues as applicable prior to the start of the project. A confined space entry number will be obtained from the CHSO before entering space. The PM will contact local emergency responders to make arrangements for potential rescue. This correspondence will be documented and submitted to the CHSO. Copies of the standards will be kept on file in GEI's main office. Confined space work will not be performed without first notifying and receiving approval from the CHSO.

Entry into the CSO structures will be conducted in accordance with the above referenced regulations and programs. The atmosphere in the structure will be evaluated remotely with a four-gas meter prior to entry and continuously while the sampling is conducted. Entry into the structure will be made via support boat powered with an electric motor or manually with oars. The support boat will be attached to a rescue line from a larger boat in the event assistance is needed to exit the CSO structure.

4.2.2 Fire and Explosion

When conducting excavating activities, the opportunity for encountering fire and explosion hazards exists from contamination in soil and the possibility of free product in underground structures and pipelines. Additionally, the use of diesel-powered excavating equipment could present the possibility of encountering fire and explosion hazards.

4.2.3 Heat Stress

Employees may be exposed to the hazards associated with heat stress when ambient temperatures exceed 70ºF. Employees should increase water intake while working in conditions of high heat. Enough water should be available so that each employee can consume 1 quart of water per hour. In addition, they should increase number of rest breaks

and/or rotate employees in shorter work shifts. Employees should rest in cool, dry, shaded areas for at least 5 minutes. Employees should not wait until they feel sick to cool down. Watch for signs and symptoms of heat exhaustion and fatigue. In the event of heat stroke, bring the victim to a cool environment, call for help, and initiate first aid procedures

The procedures to be followed regarding avoiding heat stress are provided in Appendix C – Heat Stress Guidelines, in GEI's Heat Stress program, and in NYCDEP's Extreme Hot & Cold Weather Guide in Appendix I.

4.2.4 Noise

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps, and generators. Employees who will perform suspected or established high noise tasks and operations for short durations (less than 1-hour) will wear hearing protection and adhere to procedures in the NYCDEP's Hearing Conservation requirements in Appendix J. If deemed necessary by the SSO, the CHSO will be consulted on the need for additional hearing protection and the need to monitor sound levels for Site activities. Other employees who do not need to be in proximity of the noise should distance themselves from the equipment generating the noise.

4.2.5 Hand and Power Tools

In order to complete the various tasks for the project, personnel may use hand and power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. Work gloves, safety glasses, and hard hats will be worn by the operating personnel when using hand and power tools and Ground Fault Indicator (GFI)-equipped circuits will be used for power tools.

4.2.6 Slips, Trips, and Falls

Working in and around the Site may pose slip, trip, and fall hazards due to slippery and uneven surfaces. GEI employees will wear proper foot gear and will employ good work practice and housekeeping procedures to minimize the potential for slips, trips, and falls.

4.2.7 Manual Lifting

Manual lifting of objects and equipment may be required. Failure to follow proper lifting technique can result in back injuries and strains. Employees should use a buddy system and/or power equipment to lift heavy loads whenever possible and should evaluate loads before trying to lift them (i.e., they should be able to easily tip the load and then return it to its original position). Carrying heavy loads with a buddy and proper lifting techniques

include: 1) make sure footing is solid; 2) make back straight with no curving or slouching; 3) center body over feet; 4) grasp the object firmly and as close to your body as possible; 5) lift with legs; and 6) turn with your feet, don't twist.

4.2.8 Projectile Objects and Overhead Dangers

Overhead dangers, including but not limited to falling debris and equipment, can occur while sampling inside the CSO structure. Proper PPE will be worn during these types of activities including approved safety footwear and hard hats.

4.2.9 Cuts and Lacerations

The sampling program may require employees to use powered cutting tools (battery powered drill), a knife, or chisel to collect the sample. Safety box cutters will be utilized for routine operations such as opening boxes of supplies or cutting rope or string. When using cutting tools, follow the safety precautions listed below:

- Keep free hand out of the way.
- Secure work if cutting through thick material.
- Use only sharp blades; dull blades require more force that results in less knife control.
- Pull the knife toward you; pulling motions are easier to manage.
- Do not put the knife in your pocket.
- Wear leather or Kevlar® gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.

4.2.10 Sewage and Bacterial Impacted Sediments

Paerdegat Basin has served as a combined sewer overflow and consequently has received untreated sanitary sewage from numerous outfalls. Decomposed sewage will potentially be encountered within sediments. Bacteria associated with sewage and can cause illness if ingested or through direct contact. Personal protective equipment as specified in Section 5.0 will be worn to minimize potential exposures. Personnel will use decontamination procedures identified in Section 12.0 and comply with the procedures in the NYCDEP's Sanitation, Disease Prevention and Hygiene requirement in Appendix K.

4.2.11 Working Near Water

The buddy system will be used when working near water, in which two persons operate as a single unit in order to monitor and assist each other in performing tasks. Personnel must be

attired in a United States Coast Guard (USCG)-approved Type III or Type V work vest. The vest must be properly sized for the individual and must be secured. A throwable rescue device (Type IV personal flotation device [PFD] flotation aid) along with whatever equipment (i.e., ladders, lifting gear, or rescue boat) necessary will 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 CHSO. Waders may be worn in still waters and in water depths up to the waist, if bottom conditions are firm and well understood. Waders should never be worn aboard a watercraft.

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. Employees should limit access to areas where these slip/fall hazards exists, especially in locations containing tidal water flow.

4.2.12 Boating Safety

4.2.12.1 Person Overboard

If someone falls overboard, the remaining personnel on the vessel will:

- Immediately throw anything that floats overboard to mark the position of the person.
- Throw a life ring (Type IV PFD) overboard as close to the person as possible.
- Notify the captain "Man Overboard" and on which side of the vessel.
- Post a lookout to keep the person in sight. This person should try to make their way to the captain to assist him in bringing the vessel to the person in the water.
- Maneuver the vessel to pick up the person in the water. When the captain has the person in sight, he will release the deckhand to rig the rescue ladder.
- Have the life ring with line attached ready to throw near the person so they may be pulled to the boat.
- Notify boats in the area by radio on that you have a person in the water.
- Have a crew member attach a safety line to themselves and stand by to go in the water (ONLY IF NECESSARY).
- If the person is not located immediately, radio the USCG and other vessels in the area.

- Continue search until relieved by the USCG.

4.2.12.2 Severe Weather

If severe weather is approaching, the decision to return to a pier or secure location at the shore of the creek will be made in a manner as to allow adequate time for the boat to return and personnel to evacuate. The location where the boat will dock is to be determined by its location in the body of water and the severity of the weather. The person in command of the vessel will make the final decision regarding movement of the boat. Equipment will be lashed securely to the deck of the boat and personnel will evacuate the boat to a place of safety. The vessel captain will make the final decision for actions taken due to changing weather conditions.

The captain is responsible for:

- Closing watertight and weather-tight doors, hatches and windows to prevent taking on water.
- Keeping bilges dry to prevent loss of stability.
- Keeping passengers seated and evenly distributed.
- Clearing deck drains and securing lines from washing overboard.

4.2.12.3 Abandon Ship

The captain and SSO:

- NEVER abandon ship unless actually forced to do so.
- In the event the vessel has to be abandoned the captain and SSO will insure that nearby boats and the USCG have been contacted with the locations.
- Crew members will assist passengers and instruct them in what to do with respect to donning life jackets.
- Life jackets are distributed throughout the vessel in plain view.
- Life rings are on the side of the pilot house of the steel boat.
- If near or after dark, attach water lights to rafts and life rings.

4.3 Chemical Hazards

The characteristics of compounds at the Site are discussed below for information purposes. Adherence to the safety and health guidelines in this HASP should reduce the potential for exposure to the compounds discussed below.

4.3.1 Volatile Organic Compounds (VOCs)

Volatile organic chemicals (VOCs), such as benzene, toluene, ethyl benzene, and xylene (BTEX) may be present within Jamaica Bay sediments and potentially within subsurface soils adjacent to Paerdegat Basin and Jamaica Bay. In some cases, the chemical components may be present in non-aqueous phase liquids (NAPL) such as fuels, oils, or tar within sediments and within subsurface soils adjacent to the Bay. These compounds generally have a depressant effect on the central nervous system (CNS), may cause chronic liver and kidney damage, and some are suspected human carcinogens. Benzene is a known human carcinogen. Acute exposure may include headache, dizziness, nausea, and skin and eye irritation. The primary route of exposure to VOCs is through inhalation and therefore air monitoring and respiratory protection is the primary control against exposure to VOCs. Air monitoring will be completed as specified in Section 8.0 to minimize airborne exposures. Exposure through direct contact is possible and will be minimized through the use of PPE as prescribed in Section 9.0.

4.3.2 Oil Products

Petroleum products that may have been associated with the gas condensate spill contain semi-volatile organic compounds (SVOCs). SVOCs consist of a mixture of acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(e)pyrene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methyl naphthalene, naphthalene, phenanthrene, phenols, and pyrene.

Petroleum products such as those listed above may cause contact dermatitis. Direct contact can be irritating to the skin and produce itching, burning, swelling and redness. Direct contact or exposure to the vapors may be irritating to the eyes. Conjunctivitis may result from prolonged exposure. Coal tar is considered to be very toxic, if ingested. High levels of exposure to coal tar, though not anticipated during work activities conducted during this project, may increase the risk of cancer including lung, kidney, and skin cancer. Naphthalene is also an eye and skin irritant and can cause nausea, headache, fever anemia, liver damage, vomiting convulsions, and coma. Poisoning may occur by ingestion of large doses, inhalation, or skin absorption.

The major route of exposure of SVOCs during work activities to be conducted at this Site is through direct contact. Exposure is most likely when handling sediment, soil, and water samples. Exposure through direct contact is possible and will be minimized through the use of PPE as prescribed in Section 9.0. Inhalation of SVOCs may occur when the soil is disturbed causing respirable and nuisance dust particles to become airborne or through the volatilization of naphthalene. Air monitoring will be completed as specified in Section 7.0 to minimize airborne exposures.

4.3.3 Heavy Metals

Paerdegat Basin and Jamaica Bay soils and sediments may contain elevated levels of metals including: arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc; typical of industrialized urban estuaries.

As with SVOCs, the primary route of metal exposure is through inhalation of dust particles when soils or sediments are disturbed and become airborne. The primary route of exposure is through inhalation of dust particles when subsurface soils are disturbed and become airborne. Air monitoring will be completed as specified in Section 7.0 to minimize airborne exposures during subsurface soil investigations.

4.3.4 Asbestos-Containing Materials

Asbestos containing materials (ACM) can be present at investigation sites in the form of demolition debris, ACM pipe insulation, and asbestos cement pipe. Chronic exposure to asbestos may cause asbestosis and mesothelioma. The primary route of exposure for asbestos is inhalation during the disturbance and/or removal of asbestos from the pipe insulation and cement pipes. Any ACM encountered within sediments will be saturated with water and will likely not be friable and thus should not be a concern for inhalation.

Asbestos is strictly regulated under OSHA 29 CFR 1910.1001/1926.1101. Employees that may be potentially exposed to ACM must participate in a medical surveillance program, have specific training in the hazards and controls of exposure to asbestos and wear respirators with high efficiency particulate (HEPA) filters. All work must be conducted in demarcated regulated areas to minimize the amount of people within the exposure area. Employers must conduct air sampling and provide signs and labels regarding the presence of asbestos.

4.3.5 Polychlorinated Biphenyls

The gas condensate released into Paerdegat Basin is known to contain polychlorinated biphenyls (PCBs) which may be encountered during sampling activities. PCBs have historically been used from a number of sources including, but not limited to; electrical

systems, hydraulic oils, lubricants, cutting oils, printers ink, and asphalt. Exposure to PCBs can occur through unbroken skin without immediate pain or irritation. Acute affects of PCB exposure can include eye, skin, nose, and throat irritation. Chronic effects of PCB exposure can include skin swelling and redness, gastro-intestinal disturbances, and neurological effects such as headache, dizziness, nervousness and numbness of extremities. PCBs are suspected human carcinogens that can cause liver cancer. PCBs can accumulate in fatty tissues and result in health effects after the initial exposure has occurred. The primary route of exposure for PCBs is inhalation, dermal contact, and ingestion. PCB containing materials will be managed in accordance with the NYCDEP PCB Management procedures in Appendix L

4.3.6 Hydrogen Sulfide

Hydrogen sulfide is a by associated with the breakdown of sewage by bacteria. Exposure to lower concentrations can result in eye irritation, a sore throat and cough, shortness of breath, and fluid in the lungs. These symptoms usually go away in a few weeks. Long-term, low-level exposure may result in fatigue, loss of appetite, headaches, irritability, poor memory, and dizziness. Breathing very high levels (>800 ppm) of hydrogen sulfide can cause death within just a few breaths. The primary route of exposure is through inhalation, and therefore respiratory protection is the primary control against exposure to hydrogen sulfide.

4.3.7 Evaluation of Organic Vapor Exposure

Air monitoring reduces the risk of overexposure by indicating when action levels have been exceeded and when PPE must be upgraded or changed. Action Levels for VOCs and associated contingency plans for the work zone are discussed within Section 9 of this HASP.

Exposure to organic vapors will be evaluated and/or controlled by:

- Monitoring air concentrations for organic vapors in the breathing zone with a photoionization detector (PID) or a flame ionization detector (FID).
- When possible, engineering control measures will be utilized to suppress the volatile organic vapors. Engineering methods can include utilizing a fan to promote air circulation, utilizing volatile suppressant foam, providing artificial ground cover, or covering up the impacted material with a tarp to mitigate volatile odors.
- When volatile suppression engineering controls are not effective and organic vapor meters indicate concentrations above the action levels, then appropriate respiratory protection (i.e., air purifying respirator with organic vapor cartridge) will be employed.

4.3.8 Evaluation of Skin Contact and Absorption

Skin contact by contaminants may be controlled by use of proper hygiene practices, PPE, and good housekeeping procedures. The proper PPE (e.g., Tyvek®, gloves, safety glasses) as described in Section 5 will be worn for activities where contact with potential contaminated media or materials are expected.

SDSs for decontamination chemicals and laboratory reagents that may be used on Site are included in Appendix B. Specific chemical hazards information from the occupational health sources are summarized in Table 3.

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Arsenic	7440-38-2	0.01 mg/m^3	0.01 mg/m^3 A.L. .005mg/m3	Inhalation Skin Absorption Ingestion Skin Contact	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, potential carcinogen	Liver, kidneys, skin, lungs, lymphatic system	Metal: Silver-gray or tin-white, brittle, odorless solid FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm
Asbestos	1332-21-4	0.1 f/cc	0.1 f/cc over 8 hr period or 1.0f/cc over 30 min.	Inhalation Ingestion Skin Contact	Asbestosis (chronic exposure); mesothelioma, breathing difficulty, interstitial fibrosis' restricted pulmonary function, finger clubbing; irritate eyes, potential carcinogen	Respiratory system, eyes	White, greenish, blue, or gray-green fibrous solids FP: NA IP: NA LEL: NA UEL NA VP: 0 mm
Barium	7727-43-7	TWA 10 mg/m3 (total) TWA 5 mg/m3 (resp)	TWA 15 mg/m3 (total) TWA 5 mg/m3 (resp)	Inhalation, skin and/or eye contact	Irritation eyes, nose, upper respiratory system; benign pneumoconiosis (baritosis)	Eyes, respiratory system	Metal: White or yellowish, odorless powder FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm
Benzene	71-43-2	0.5 ppm (Skin)	1 ppm TWA 5 ppm STEL	Inhalation Skin Absorption Ingestion Skin Contact	Irritation of eyes, skin, nose, respiratory system, giddiness, headache, nausea; staggering gait, fatigue, anorexia, weakness, dermatitis, bone marrow depression, potential carcinogen	Eyes, skin, CNS, bone marrow, blood	FP: 12^o F IP: 9.24 eve LEL: 1.2% UEL:7.8% VP: 75 mm
Beryllium	7440-41-7	NIOSH REL: Ca C 0.0005 mg/m3	TWA 0.002 mg/m3 C 0.005 mg/m3 (30 minutes), with a maximum peak of 0.025 mg/m3	Inhalation, skin and/or eye contact	Berylliosis (chronic exposure): anorexia, weight loss, lassitude (weakness, exhaustion), chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation eyes; dermatitis; [potential occupational carcinogen]	Eyes, skin, respiratory system	A hard, brittle, gray-white solid. FP: none LEL:N/A UEL: N/A VP: 0 mm

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Cadmium	7440-43-9 (metal)	CA	TWA 0.005 mg/m^3	Inhalation, ingestion	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]	Respiratory system, kidneys, prostate, blood; **Cancer Site** [prostatic & lung cancer]	Silver-white, blue-tinged lustrous, odorless solid. FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm
Carbon monoxide	630-08-0	35 ppm 200 ppm C	50 ppm	Inhalation, skin and/or eye contact (liquid)	Headache, tachypnea, nausea, lassitude (weakness, exhaustion), dizziness, confusion, hallucinations; cyanosis; depressed S-T segment of electrocardiogram, angina, syncope	Cardiovascular system, lungs, blood, central nervous system	Colorless, odorless gas FP: NA IP: 14.01 eV LEL: 12.5% UEL: 74% VP: >35 atm
Chromium (Chromic Acid and Chromates)	1333-82-0	0.05 mg/m^3	0.1 mg/m^3	Inhalation Ingestion Skin Contact	Irritates respiratory system, nasal, septum perforation, liver and kidney damage, leucocytosis (increased blood leucocytes), leukopenis (reduced blood leucocytes), moncytosis (increased monocytes), Eosinophilia, eye injury, conjunctivitis, skin ulcer, sensitivity dermatitis, potential carcinongen	Blood, respiratory system, liver, kidney, eyes, skin, lung cancer	FP:NA IP:NA VP: Very Low LEL: NA UEL: NA
Copper (as a fume)	1317-38-0	NIOSH REL: TWA 0.1 mg/m3	TWA 0.1 mg/m3	Inhalation, skin and/or eye contact	Irritation eyes, upper respiratory system; metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough, lassitude (weakness, exhaustion); metallic or sweet taste; discoloration skin, hair	Eyes, skin, respiratory system (increased risk with Wilson's disease)	Finely divided black particulate dispersed in air FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Ethylbenzene	100-41-4	100 ppm	100 ppm	Inhalation Ingestion Skin Contact	Eye, skin, mucous membrane irritation; headache; dermatitis, narcosis; coma	Eyes, skin, respiratory system, CNS	FP: 55^{o} F IP: 8.76 eV LEL: 0.8% UEL:6.7% VP: 7 mm
Hydrogen sulfide	7783-06-4	10 ppm TWA, 15 ppm STEL	20 ppm C, 50 ppm [10-min. Maximum peak]	Inhalation Skin/Eye Contact	Irritation eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, fatigue, irritability, insomnia; gastrointestinal disturbance; liquid: frostbite	Eyes, respiratory system, CNS	Colorless gas with a strong odor of rotten eggs. VP: 17.6 atm IP: 10.46 eV
Lead	7439-92-1	0.050 mg/m^3	0.05 mg/m^3 A.L. 0.03 mg/m3	Inhalation Ingestion Skin Contact	Weakness, insomnia; facial pallor; pal eye, anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis of wrist and ankles; irritates eyes, hypo tension	Eyes, GI tract, CNS, kidneys, blood, gingival tissue	A heavy, ductile, soft, gray solid. FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm
Mercury	7439-97-6	0.025 mg/m^3	0.10 mg/m3	Inhalation Ingestion Skin Contact Skin Absorption	Irritates eyes and skin, chest pain, cough, difficulty breathing, bronchitis, pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, Gastrointestinal disturbance, weight loss, proteinuria	Eyes, skin, respiratory tract, central nervous system	Silver-white, heavy odorless liquid FP: NA IP:? LEL: NA UEL:NA VP: 0.0012 mm

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Nickel	7440-02-0 (Metal)	NIOSH REL*: Ca TWA 0.015 mg/m3 [*Note: The REL does not apply to Nickel carbonyl.]	TWA 1 mg/m3 [*Note: The PEL does not apply to Nickel carbonyl.]	Inhalation, ingestion, skin and/or eye contact	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]	Nasal cavities, lungs, skin **Cancer Site: [lung and nasal cancer]**	Metal: Lustrous, silvery, odorless solid FP: none LEL:N/A UEL: N/A VP: 0 mm
PCBs	11097-69-1	0.5 mg/m^3 (Skin)	0.5 mg/m^3 (Skin)	Inhalation Skin Absorption Ingestion Skin Contact	Irritate eyes; chloracne; liver damage;	Skin, eyes, liver, reproductive system	Colorless liquid or solid with a mild, hydro-carbon odor VP = 0.00006 mm
Selenium	7782-49-2	0.2 mg/m^3	0.2 mg/m^3	Inhalation Ingestion Skin Contact	Irritant to eyes, skin, nose and throat, visual disturbance, headache, chills, fever, breathing difficulty, bronchitis, metallic taste, garlic breath, GI disturbance, dermatitis, eye and skin burns,	Eyes, skin, respiratory system, liver, kidneys, blood spleen	Amphorous or crystalline, red to gray solid FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm
Thallium		NIOSH REL: TWA 0.1 mg/m3 [skin]	OSHA PEL: TWA 0.1 mg/m3 [skin]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs	Eyes, respiratory system, central nervous system, liver, kidneys, gastrointestinal tract, body hair	Properties vary depending upon the specific soluble thallium compound.

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Toluene	108-88-3	50 ppm	200 ppm	Inhalation Skin Absorption Ingestion Skin Contact	Eye, nose irritation; fatigue, weakness, confusion, euphoria, dizziness, headache; dilated pupils, tearing of eyes; nervousness, muscle fatigue, insomnia, tingling in limbs; dermatitis	Eyes, skin, respiratory system, CNS, liver, kidneys	FP: 40°F IP: 8.82 eV LEL: 1.1% UEL:7.1% VP: 21 mm
VOCs[1]	NA	0.5 ppm (Skin)	0.5 ppm TWA 2.5 ppm STEL	Inhalation, Skin Absorption, Ingestion, Skin Contact	Irritate eyes and skin; headaches; dizziness; nausea; kidney; liver damage; depress CNS	Skin, eyes, liver, kidney, CNS	Colorless volatile liquid, sometimes with a sweet or solvent odor
Xylene	1330-20-7	100 ppm	100 ppm	Inhalation Skin Absorption Ingestion, Skin Contact	Eye, skin, nose, throat irritation; dizziness, excitement, drowsiness; incoordination, staggering gait; corneal damage; appetite loss, nausea, vomiting, abdominal pain; dermatitis	Eyes, skin, respiratory system, Central Nervous System, GI tract, blood, liver, kidneys	FP: 90°F LEL: 0.9% UEL: 6.7% VP: 9 mm
Zinc	1314-13-2	5 mg/m3 (TWA), 10 mg/m3 (STEL) for zinc oxide fume	10 mg/m3 (TWA), for zinc oxide fume	Inhalation	Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function	Respiratory system	Colorless liquid FP: NA? IP: 11 eV LEL: 7.5% UEL: 12.5% VP: 100 mmHg

Abbreviations:

°F = degrees Fahrenheit
ACGIH = American Conference of Industrial Hygienists
A.L. = Action Level
atm = atmosphere
IP = Ionization Potential
LEL = Lower explosive limit
mg/m^3 = micrograms per cubic meter
min = minute

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data

C = ceiling limit, not to be exceeded
CAS # = chemical abstract services number
CNS = Central Nervous System
CTPV = Coal Tar Pitch Volatiles
CVS = Cardiovascular System
eV = electron volt
f/cc = fibers per cubic centimeter
FP = Flash point
GI = Gastro-intestinal
H2S = Hydrogen Sulfide
HCN = Hydrogen Cyanide
hr = hour
mm = millimeter
mmHg = millimeters of mercury
N/A = not applicable
OSHA = Occupational Safety and Health Administration
PAH = Polycyclic Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PEL = Permissible exposure limit
ppm = parts per million
Skin = significant route of exposure
STEL = Short-term exposure limit (15 minutes)
TWA = Time-weighted average (8 hours)
VP = vapor pressure approximately 68°F in mm Hg

4.4 Biological Hazards

Areas of the Site may be wooded, surrounded with brush, or landscaped. Therefore, employees working on this project should be aware of the potential biological hazards at this Site. Each is discussed in detail below:

4.4.1 Poisonous Plants

Persons working on the Site should be aware of the possible presence of poisonous plants and insects. Poison ivy is a climbing plant with leaves that consist of three glossy, greenish leaflets. Poison ivy has conspicuous red foliage in the fall. Small yellowish-white flowers appear in May through July at the lower leaf axils of the plant. White berries appear from August through November. Poison ivy is typically found east of the Rockies. Poison oak is similar to poison ivy but its leaves are oak-like in form. Poison oak occurs mainly in the south and southwest. Poison sumac typically occurs as a small tree or shrub and may be 6 to 20 feet in height. The bark is smooth, dark and speckled with darker spots. Poison sumac is typically found in swampy areas and east of the Mississippi. The leaves have 7 to 13 smooth-edged leaflets and drooping clusters of ivory-white berries that appear in August and last through spring.



Poison Oak



Poison Ivy



Poison Sumac

The leaves, roots, stems and fruit of these poisonous plants contain urushiol. Contact with the irritating oil causes an intensely itching skin rash and characteristic, blister-like lesions.

The oil can be transmitted on soot particles when burned and may be carried on the fur of animals, equipment, and apparel.

Proper identification of these plants is the key to preventing contact and subsequent dermatitis. Wear long sleeves and pants when working in wooded areas. In areas of known infestation, wear Tyvek® coveralls and gloves. Oils are easily transferred from one surface to another. If you come in contact with these poisonous plants, wash exposed areas immediately with cool water to remove the oils. Some commercial products such as Tecnu's Poison Oak-n-Ivy Cleanser claim to further help with the removal of oils.

4.4.2 Ticks

4.4.2.1 Lyme Disease

Ticks are bloodsuckers, attaching themselves to warm-blooded vertebrates to feed. Deer ticks are associated with the transmission the bacteria that causes Lyme disease. Female deer ticks are about ¼-inch in length and are black and brick red in color. Males are smaller and all black. If a tick is not removed, or if the tick is allowed to remain for days feeding on human blood, a condition known as tick paralysis can develop. This is due to a neurotoxin, which the tick apparently injects while engorging. This neurotoxin acts upon the spinal cord causing incoordination, weakness, and paralysis.

The early stages of Lyme disease, which can develop within a week to a few weeks of the tick bite, are usually marked by one or more of these signs and symptoms:

- Tiredness
- Chills and fever
- Headache
- Muscle and/or join pain
- Swollen lymph glands
- Characteristic skin rash (i.e. bullseye rash)

4.4.2.2 Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is spread by the American dog tick, the lone-star tick, and the wood tick, all of which like to live in wooded areas and tall, grassy fields. The disease is most common in the spring and summer when these ticks are active, but it can occur anytime during the year when the weather is warm.

Initial signs and symptoms of the disease include sudden onset of fever, headache, and muscle pain, followed by development of a rash. Initial symptoms may include fever, nausea, vomiting, severe headache, muscle pain, and/or lack of appetite.

The rash first appears 2 to 5 days after the onset of fever and is often not present or may be very subtle. Most often it begins as small, flat, pink, non-itchy spots on the wrists, forearms, and ankles. These spots turn pale when pressure is applied and eventually become raised on the skin. Later signs and symptoms include rash, abdominal pain, joint pain, and/or diarrhea.

The characteristic red, spotted rash of Rocky Mountain spotted fever is usually not seen until the 6th day or later after onset of symptoms, and this type of rash occurs in only 35% to 60% of patients with Rocky Mountain spotted fever. The rash involves the palms or soles in as many as 50% to 80% of patients; however, this distribution may not occur until later in the course of the disease.

4.4.2.3 Prevention

Tick season lasts from April through October; peak season is May through July. You can reduce your risk by taking these precautions:

- During outside activities, wear long sleeves and long pants tucked into socks. Wear a hat, and tie hair back.
- Use insecticides to repel or kill ticks. Repellents containing the compound n,n-diethyl-meta-toluamide (DEET) can be used on exposed skin except for the face, but they do not kill ticks and are not 100% effective in discouraging ticks from biting. Products containing permethrin kill ticks, but they cannot be used on the skin -- only on clothing. When using any of these chemicals, follow label directions carefully.
- After outdoor activities, perform a tick check. Check body areas where ticks are commonly found: behind the knees, between the fingers and toes, under the arms, in and behind the ears, and on the neck, hairline, and top of the head. Check places where clothing presses on the skin.
- Remove attached ticks promptly. Removing a tick before it has been attached for more than 24 hours greatly reduces the risk of infection. Use tweezers, and grab as closely to the skin as possible. Do not try to remove ticks by squeezing them, coating them with petroleum jelly, or burning them with a match. Keep ticks in a zip-lock baggie in case testing needs to be performed.
- Report any of the above symptoms and all tick bites to the PM and CHSO for evaluation.

4.4.3 Mosquito- Borne Disease – West Nile Virus

West Nile encephalitis is an infection of the brain caused by the West Nile virus, which is transmitted by infected mosquitoes. Following transmission from an infected mosquito, West Nile virus multiplies in the person's blood system and crosses the blood-brain barrier to reach the brain. The virus interferes with normal CNS functioning and causes inflammation of the brain tissue. However, most infections are mild and symptoms include fever, headache, and body aches. More severe infections may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and rarely, death. Persons over the age of 50 have the highest risk of severe disease.

Prevention centers on public health action to control mosquitoes and on individual action to avoid mosquito bites. To avoid being bitten by the mosquitoes that cause the disease, use the following control measures:

If possible, stay inside between dusk and dark. This is when mosquitoes are most active. When outside (between dusk and dark), wear long pants and long-sleeved shirts. Spray exposed skin with an insect repellent, preferably containing DEET.

4.4.4 Wasps 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. Bees are generally more mild-mannered than wasps and are less likely to sting. Bees can only sting once while wasps sting multiple times because their stinger is barbless. Wasps sting when they feel threatened. By remaining calm and not annoying wasps by swatting, you lessen the chance of being stung.

Wasps and bees inject a venomous fluid under the skin when they sting. The venom causes a painful swelling that may last for several days. If the stinger is still present, carefully remove it with tweezers. Some people may develop an allergic reaction (i.e. anaphylactic shock) to a wasp or bee sting. If such a reaction develops, seek medical attention at once. If a GEI employee is allergic to bees or wasps notify the SSO and if, needed, the location of the epi pen.

4.4.5 Sun Exposure

Employees are encouraged to liberally apply sunscreen, with a minimum sun protection factor (SPF) of 15, when working outdoors to avoid sunburn and potential skin cancer, which is associated with excessive sun exposure to unprotected skin. Additionally, employees should wear safety glasses that offer protection from ultraviolet A and B (UVA/UVB) rays.

5. Personal Protective Equipment

The PPE specified in Table 4 represents PPE selection required by 29 CFR 1910.132, and is based on the Activity Hazard Analysis of Section 4 (Table 2). Specific information on the selection rationale activity can be found in the GEI Health and Safety Manual and in the NYCDEP's Personnel Protective Equipment procedures in Appendix M.

The PPE program addresses elements, such as PPE selection based on Site hazards, use and limitations, donning and doffing procedures, maintenance and storage, decontamination and disposal, training and proper fitting, inspection procedures prior to / during / and after use, evaluation of the effectiveness of the PPE program, and limitations during temperature extremes, heat stress, and other appropriate medical considerations. A summary of PPE for each level of protection is in Table 4.

Table 4. Site-Specific PPE

Task	PPE Level	Site-Specific Requirements	Respirator
Mobilization/Demobilization			
Mobilization/Demobilization of Equipment and Supplies	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D – None
Establishment of Site Security, Work Zones, and Staging Area	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D - None
PCB Assessment			
Sampling: Wood, Concrete, Wipe samples	D	Hard hat, safety glasses, steel toe/shank safety boot with overboot as needed, reflective vest, leather work gloves as needed, nitrile gloves, hearing protection as needed, Tyvek as needed, PFD when on boat or near water	D - None

Use of Level A or Level B PPE is not anticipated. If conditions indicating the need for Level A or Level B PPE are encountered, personnel will leave the Site and this HASP will be revised with oversight of the CHSO or GEI personnel will not re-enter the Site until conditions allow.

For most work conducted at the site, Level D PPE will include long pants, hard hats, safety glasses with side shields, and steel toe/shank or EH-rated safety boots.

5.1 OSHA Requirements for PPE

Personal protective equipment used during the course of this field investigation must meet the following OSHA standards:

Table 5. OSHA Standards for PPE

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133	ANSI Z87.1 1968
Respiratory	29 CFR 1910.134	ANSI Z88.1 1980
Head	29 CFR 1910.135	ANSI Z89.1 1969
Foot	29 CFR 1910.136	ANSI Z41.1 1999 or ASTM F-2412-2005, and ASTM F-2413-2005

CRF = Code of Federal Regulations
ANSI = American National Standards Institute
ASTM = American Society For Testing and Materials

On-site GEI personnel who have the potential to don a respirator must have a valid fit test certification and documentation of medical clearance. The CHSO will maintain such information on file for on-site personnel. The PM will obtain such information from the subcontractor's site supervisor prior to the initiation of such work. Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910.134). Air purifying respirators cannot be worn under the following conditions:

- Oxygen deficiency (less than 20.7%).
- Imminent Danger to Life and Health (IDLH) concentrations.
- If contaminant levels exceed designated use concentrations.

6. Key Project Personnel/Responsibilities and Lines of Authority

6.1 GEI Personnel

- Barry Giroux — GEI Project Manager
- John Gondek — GEI Site Safety Officer
- TBD — GEI Field Personnel
- Robin B. DeHate — GEI Corporate Health and Safety Officer
- Steven Hawkins — GEI Regional Health and Safety Officer

The implementation of health and safety at this project location will be the shared responsibility of the PM, the CHSO, the SSO, other GEI personnel implementing the proposed scope of work.

6.1.1 GEI Project Manager

The PM, Barry Giroux, is responsible for confirming that the requirements of this HASP are implemented. Some of the PM's specific responsibilities include:

- Conducting and documenting the Project Safety Briefing for GEI project employees and forwarding the signed form (Appendix D) to the Health and Safety Committee;
- Verifying that the GEI staff selected to work on this program are sufficiently trained for Site activities;
- Assuring that personnel to whom this HASP applies, including subcontractor personnel, have received a copy of it;
- Providing the CHSO with updated information regarding conditions at the Site and the scope of Site work;
- Providing adequate authority and resources to the on-site SSO to allow for the successful implementation of necessary safety procedures;
- Supporting the decisions made by the SSO and CHSO;
- Maintaining regular communications with the SSO and, if necessary, the CHSO;
- Verifying that the subcontractors selected by GEI to work on this program have completed GEI environmental, health and safety requirements and has been deemed acceptable for the proposed scope of work; and

- Coordinating the activities of GEI subcontractors and confirming that they are aware of the pertinent health and safety requirements for this project.

6.1.2 GEI Corporate Health and Safety Officer

The CHSO, Robin DeHate, is the individual responsible for the review, interpretation, and modification of this HASP. Modifications to this HASP which may result in less stringent precautions cannot be undertaken by the PM or the SSO without the approval of the CHSO. Specific duties of the CHSO include:

- Writing, approving, and amending the HASP for this project;
- Advising the PM and SSO on matters relating to health and safety on this Site;
- Recommending appropriate PPE and safety equipment to protect personnel from potential Site hazards;
- Conducting accident investigations; and
- Maintaining regular contact with the PM and SSO to evaluate Site conditions and new information which might require modifications to the HASP.

6.1.3 GEI Site Safety Officer

GEI field staff are responsible for implementing the safety requirements specified in this HASP. However, one person will serve as the SSO. For this program, John Gondek, will serve as the SSO. 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 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:

- Conducting/attending the Project Safety Briefing prior to beginning work, and subsequent safety meetings as necessary;
- Conduct daily Safety Tailgate meeting in accordance with National Grid requirements (can be combined with "pre-entry") briefing for Site-related work;
- Verifying that personnel to whom this HASP applies have attended and participated in the Project Safety Briefing and subsequent safety meetings that are conducted during the implementation of the program;
- Maintaining a high level of health and safety consciousness among employees implementing the proposed activities;

- 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 GEI employees;
- Verifying that PPE and health and safety equipment used by GEI is in good working order;
- Verifying that the selected contractors are prepared with the correct PPE and safety equipment and supplies;
- Notifying the PM of noncompliance situations and stopping work in the event that an immediate danger situation is perceived;
- Monitoring and controlling the safety performance of personnel within the established restricted areas to confirm that required safety and health procedures are being followed;
- Stopping work in the event that an immediate danger situation is perceived; and
- Reporting accident/incident and preparing accident/incident reports, if necessary.

6.1.4 GEI Field Personnel

GEI 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 are as follows:

- Reading and signing the HASP in its entirety prior to the start of on-site work;
- Attending and actively participating in the required Project Safety Briefing prior to beginning on-site work and any subsequent safety meetings that are conducted during the implementation of the program;
- Stopping work in the event that an immediate danger situation is perceived;
- Bringing forth any questions or concerns regarding the content of the HASP to the PM or the SSO, prior to the start of work;
- Reporting accidents, injuries, and illnesses, regardless of their severity, to the SSO, CHSO, and HR; and
- Complying with the requirements of this HASP and the requests of the SSO.

6.1.5 Lines of Authority will be as follows:

On Site – GEI will have responsibility for safety of its employees during the work performed at the Site. GEI's field representative will have a cell phone available to contact the appropriate local authorities, in the event of an emergency. GEI's field representative will be available for communication with the GEI PM and with the National Grid representative.

GEI employees have the authority to stop work activities if an unanticipated hazard is encountered or a potential unsafe condition is observed. The GEI employee should contact the Corporate Health and Safety Officer and the Project Manager to discuss the stop work conditions and potential control methods that can be implemented.

6.2 Subcontractors

Subcontractors to GEI are not currently required to perform this work, however, GEI requires its subcontractors to work in a responsible and safe manner. Subcontractors for GEI projects are required to develop their own HASP for protection of their employees, but, at a minimum, must adhere to applicable requirements set forth in this HASP.

7. Training Program

7.1 HAZWOPER Training

In accordance with OSHA Standard 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response" (HAZWOPER) responders will, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations. At a minimum, the training will have consisted of instruction in the topics outlined in the standard. Personnel who have not met the requirements for initial training will not be allowed to work in any Site activities in which they may be exposed to hazards (chemical or physical). Proof of training will be submitted to the PM or his/her representative prior to the start of field activities.

7.2 Annual 8-Hour Refresher Training

Annual 8-hour refresher training will be required of hazardous waste site field personnel in order to maintain their qualifications for fieldwork. The training will cover a review of 29 CFR 1910.120 requirements and related company programs and procedures. Proof of current 8-hour refresher training will be submitted to the PM or his/her representative prior to the start of field activities.

7.3 Supervisor Training

Personnel acting in a supervisory capacity will have received 8 hours of instruction in addition to the initial 40-hour training. In addition supervisors will have 1 year of field experience and training specific to work activities (i.e., sampling, construction observation, etc.)

7.4 Site-Specific Training

Prior to commencement of field activities, the PM or the SSO will verify GEI field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the Site operations. It will include Site and facility layout, hazards, and emergency services at the Site, and will highlight the provisions contained within this HASP and applicable GEI H&S SOPs (Appendix E). This training will be documented on the Project Safety Briefing Form Appendix D). The signed form will be forwarded to the Health and Safety Committee at Health&SafetyCommittee@geiconsultants.com. In addition, GEI personnel will sign the plan to document that they understand the hazards and control measures presented and agree

to comply with the procedures established in the HASP. Personnel that have not received project-specific training will not be allowed on-site.

7.5 On-Site Safety Briefings

Other GEI personnel will be given health and safety briefings daily by the SSO or field representative to assist GEI personnel in safely conducting work activities. The briefing will include GEI subcontractors. The briefings can include information on new operations to be conducted, changes in work practices, or changes in the Site's environmental conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. Documentation of these briefings will be recorded in the GEI field book, if the project duration is less than 5 days. If the project is longer than 5 days, the Tailgate Safety Briefing Form (Appendix D) will be used to document briefings. The meetings will also be an opportunity to periodically update the employees on monitoring results.

7.6 First Aid and CPR

The PM will verify that GEI field staff has current certifications in first aid and Cardiopulmonary Resuscitation (CPR), so that emergency medical treatment is available during field activities. The training will be consistent with the requirements of the American Red Cross Association. GEI employees also attend annual Bloodborne Pathogens training in compliance with OSHA regulations.

8. Medical Surveillance Program

GEI maintains a continuous, corporate, medical surveillance program that includes a plan designed specifically for field personnel engaged in work at sites where hazardous or toxic materials may be present. Robin DeHate is GEI's CHSO and is responsible for the administration and coordination of medical evaluations conducted for GEI's employees at branch office locations. Comprehensive examinations are given to GEI field personnel on an annual or biennial basis (as determined to be appropriate by the CHSO) participating in hazardous waste operations. The medical results of the examinations aid in determining the overall fitness of employees participating in field activities.

Under the CHSO's supervision, field personnel undergo a complete initial physical examination, including a detailed medical and occupational history, before they participate in hazardous waste site investigations. Extensive annual/biennial reexaminations are also performed. Upon completion of these tests, personnel are certified by an occupational health physician as to whether they are fit for field work in general, and fit to use respiratory protection.

If a GEI employee or other project worker shows symptoms of exposure to a hazardous substance and wishes to be rechecked, he/she will be directed to the nearest area hospital or medical facility.

GEI subcontractor personnel that will enter any active waste handling or other active non-"clean" area must certify that they are participating in a medical surveillance program that complies with OSHA regulations for hazardous waste operations (i.e., 29 CFR 1910.120 and 29 CFR 1926.65). Proof of medical clearance will be submitted to the GEI PM or SSO prior to the start of field activities.

9. Monitoring

Air monitoring will be performed to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of worker protection needed on-site.

Air monitoring will be conducted remotely through the vault openings in the CSO structure above the tide gates prior to entry into the CSO structure for sample collection. GEI will monitor and document daily Site conditions and operations and inform field representatives of results. If Action Levels are exceeded, the SSO will immediately implement Site action(s) according to Table 6 below and notify the PM and CHSO.

GEI will provide the following equipment for health and safety monitoring of on-site GEI personnel:

- PID with 10.6 eV lamp or equivalent;
- 4-Gas meter consisting of a: Combustible Gas Indicator (CGI): LEL / Oxygen (O_2) / hydrogen sulfide (H_2S) / Carbon Monoxide (CO) meter;

Air monitoring equipment will be calibrated and maintained in accordance with manufacturer's requirements. Calibrations will be recorded in the project notes daily or on a daily calibration form.

Organic vapor concentrations will be measured using a PID during intrusive activities. During project operations, organic vapor concentrations will be measured continuously. The SSO will interpret monitoring results using professional judgment and according to the alert and Action Limits set forth in the associated Site Work Plan.

A CGI meter will be used to monitor for combustible gases and O_2 content in the work zone during sampling activities. The CGI will also be equipped with an H_2S sensor and a CO sensor.

Table 6 provides a summary of real time air monitoring Action Levels and contingency plans for work zone activities. The below Action Levels are determined by halving the Permissible Exposure Limits (PELs) or Threshold Limit Values (TLVs) as set forth by OSHA and the American Conference of Government Industrial Hygienists (ACGIH). O_2 values are based on the maximum use limits of a full face respirator if oxygen were being displaced by a chemical.

Table 6. Real-Time Work Zone Air Monitoring Action Levels

Air Monitoring Instrument	Monitoring Location	Action Level (above background)	Site Action
PID	Work Zone	0 – 50 ppm	No respiratory protection is required if benzene or naphthalene is not present.
		50 – 100 ppm	Stop work, withdraw from work area, allow area to ventilate, if levels persist, upgrade to Level C.
		> 100 ppm	Stop work, withdraw from work area, notify PM and CHSO.
O_2 Meter	Work Zone	< 20.7%	Stop work, withdraw from work area, ventilate area, notify PM and CHSO.
		> 21.1%	Stop work, withdraw from work area, notify PM and CHSO.
H_2S Meter	Work Zone	< 5.0 ppm	No respiratory protection is required.
		> 5.0 ppm	Stop work, withdraw from work area, allow area to ventilate, notify PM and CHSO.
CGI	Work Zone	< 10% LEL	Investigate possible causes, allow area ventilate, use caution during procedures.
		> 10% LEL	Stop work, allow area to ventilate to < 10% LEL, if ventilation does not result in a decrease to < 10% LEL, withdraw from work area, notify PM and CHSO.
CO Meter	Work Zone	> 35 ppm	Stop work; withdraw from the work area; allow area to ventilate; notify SSO, PM, & CHSO.

10. Site Control Measures

10.1 Site Zones

Site zones are intended to control the potential spread of contamination and to assure that only authorized individuals are permitted into potentially hazardous areas. A three-zone approach will be utilized. It will include an Exclusion Zone (EZ), Contamination Reduction Zone (CRZ) and a Support Zone (SZ). Specific zones will be established on the work site by the Contractor when operations begin for each task requiring such delineation.

This project is being conducted under the requirements of 29 CFR 1910.120, and any personnel working in an area where the potential for exposure to Site contaminants exists, will only be allowed access after proper training and medical documentation.

The following will be used for guidance in revising these preliminary zone designations, if necessary.

Support Zone – The SZ is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for medical emergency. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone.

Contamination Reduction Zone – The CRZ is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides an area for decontamination of personnel and portable hand-held equipment, tools and heavy equipment. A personnel decontamination area will be prepared at each exclusion zone. The CRZ will be used for EZ entry and egress in addition to access for heavy equipment and emergency support services.

Exclusion Zone – Activities which may involve exposure to Site contaminants, hazardous materials, and/or conditions should be considered an EZ. This zone will be clearly delineated by cones, tapes, or other means. The Contractor may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ will be determined by the Contractor allowing adequate space for the activity to be completed, field members, and emergency equipment.

These zones will be constructed, maintained, and enforced as deemed necessary by the SSO.

10.2 Buddy System

GEI personnel should be in line-of-site or communication contact with another on-site person. The other on-site person should be aware of his or her role as a "buddy" and be able to provide assistance in the event of an emergency. A copy of this plan will be given to any person acting as a GEI "buddy" for informational purposes.

10.3 Sanitation for Temporary Work Sites

Temporary sanitary facilities including toilets will be available nearby.

10.4 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. Activities planned for the Site are anticipated to occur outside during daylight hours. However, if yard areas are used after dark, they will be equipped with illumination that meets or exceeds requirements specified in OSHA Standard 29 CFR 1926.56 "Illumination." Employees will not work on sites that are not properly lighted.

11. Accident Reporting

GEI will report incidents involving GEI personnel or subcontractor personnel, such as: lost time injuries, injuries requiring medical attention, near miss incidents, fires, fatalities, accidents involving the public, and property damage. The report will be made to the PM verbally within 2 hours of the incident. The PM will immediately inform the CHSO, Human Resources, and the National Grid Representative of the incident.

A GEI Accident Report Form will be completed and submitted to the CHSO and Human Resources within 12 hours of the incident. The CHSO will complete and submit the National Grid Accident Report form to National Grid within 24 hours of the incident.

The Accident/Incident Report Form and the Near Miss Reporting Form can be found in Appendix D, the GEI Health and Safety smartphone app, or on the Health and Safety page of the GEI Intranet.

12. Decontamination Procedures

12.1 Personnel Decontamination Station

A personnel decontamination station where employees can drop equipment and remove PPE will be established. It will be equipped trash bag(s) or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.)

The following specific decontamination procedure will be used as necessary by GEI personnel or subcontractor personnel wearing PPE from Level D through Level C.

- ***Step 1 –*** Equipment drop (respirator, tools, monitoring equipment, etc.) Decontaminate as appropriate (per GEI's field representative's instructions).
- ***Step 2 –*** Boot wash/rinse (wash with non-foaming detergent, rinse with fresh water spray). Remove boots. If inner and outer gloves are worn, wash outer gloves, remove and save for later use, or remove and discard outer gloves and place in trash bag/can provided in the decontamination area.
- ***Step 3 –*** Hard hat removal; wash if visibly contaminated (use same wash as in Step 2).
- ***Step 4 –*** If Tyvek® (or equivalent) suit was worn and is visibly contaminated, remove and place in trash bag/can provided in the decontamination area or decontaminate (wash) and store for reuse. Contaminated washable coveralls should be removed and bagged for washing.
- ***Step 5 –*** Respirator and/or eye protection removal (as applicable). Wash (per Step 2) to remove visible contamination.
- ***Step 6 –*** Remove outer gloves.
- ***Step 7 –*** Wash potentially exposed skin (use water and soap at indoor sink).
- ***Step 8 –*** Disinfect respirator per manufacturer's recommendations.

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate containers) and disposed of in an approved facility.

Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with applicable state and federal regulations.

12.2 Decontamination Equipment Requirements

The following equipment, if required, should be in sufficient supply to implement decontamination procedures for GEI's equipment.

- Buckets
- Alconox™ detergent concentrate
- Hand pump sprayers
- Long handled soft bristle brushes
- Large sponges
- Cleaning wipes for respirators
- Bench or stool(s)
- Methanol and/or Nitric Acid
- Liquid detergent and paper towels
- Plastic trash bags

13. Supplemental Contingency Plan Procedures

13.1 Hazard Communication Plan

GEI personnel have received hazard communication training as part of their annual health and safety training and new employee health and safety orientation training. Hazardous materials used on the Site will be properly labeled, stored, and handled. SDS will be available to potentially exposed employees.

13.2 Fire

In the event of a fire personnel will evacuate the area. GEI's field representative will contact the local fire department with jurisdiction and report the fire. Notification of evacuation will be made to the PM and the CHSO. The field representative will account for GEI personnel and subcontractor personnel and report their status to the PM.

13.3 Medical Support

In case of minor injuries, on-site care will be administered with the Site first aid kit. For serious injuries, call 911 and request emergency medical assistance. Seriously injured persons should not be moved, unless they are in immediate danger. Notify the PM and the CHSO of the emergency.

Section 1 and Table 1 of this HASP contain detailed emergency information, including directions to the nearest hospital, and a list of emergency services and their telephone numbers. In addition, Appendix A includes maps to the hospital and/or occupational health clinic. GEI field personnel will carry a cellular telephone.

13.4 Severe Weather

The contingency plan for severe weather includes reviewing the expected weather to determine if severe weather is in the forecast. Severe weather includes high winds over 30 miles per hour (mph), heavy rains or snow squalls, thunderstorms, tornados, and lightning storms. If severe weather is approaching, the decision to evacuate GEI personnel and subcontractor personnel from the Site will be the responsibility of GEI's field representative. Notification of evacuation will be made to the PM and the CHSO. The field representative will account for GEI personnel and subcontractor personnel and report their status to the PM. If safe, work can resume 30 minutes after the last clap of thunder or flash of lightening.

13.5 Spills or Material Release

If a hazardous waste spill or material release occurs, if safe, the SSO or their representative will immediately assess the magnitude and potential seriousness of the spill or release based on the following:

- SDS for the material spilled or released;
- Source of the release or spillage of hazardous material;
- An estimate of the quantity released and the rate at which it is being released;
- The direction in which the spill or air release is moving;
- Personnel who may be or may have been in contact with the material, or air release, and possible injury or sickness as a result;
- Potential for fire and/or explosion resulting from the situation; and
- Estimates of area under influence of release.

If the spill or release is determined to be within the on-site emergency response capabilities, the SSO will verify implementation of the necessary remedial action. If the release is beyond the capabilities of the Site personnel, personnel will be evacuated from the immediate area and the local fire department will be contacted. The SSO will notify the PM and the CHSO.

13.6 Alcohol and Drug Abuse Prevention

Alcohol and drugs will not be allowed on the work Site. Project personnel under the influence of alcohol or drugs will not be allowed to enter the Site.

14. Health and Safety Plan Sign-Off

GEI personnel conducting site activities will be familiar with the information in this HASP. After reviewing this plan, please sign the copy in the project files, and bring a copy of the plan with you to the Site.

Site Name: Paerdegat Basin

Investigation: CSO Structure PCB Investigation

GEI Project No: 129600-1-1108

Print Name	Signature
Project Manager: Barry Giroux	

Appendix A

Map to Hospital and Occupational Health Clinic

Brookdale Hospital

Drive 2.7 miles, 9 min

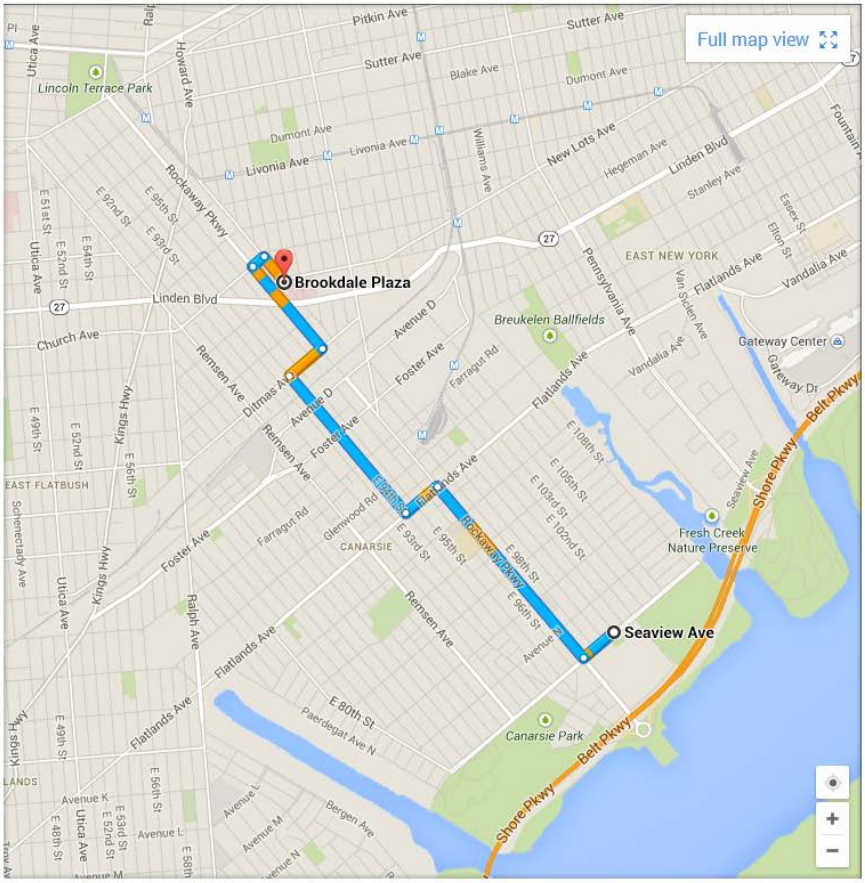
Seaview Ave
Brooklyn, NY

- Take Rockaway Pkwy to E 94th St — 1.2 mi / 4 min
- Turn right at the 3rd cross street onto E 94th St — 0.7 mi / 3 min
- Turn right onto Ditmas Ave — 0.2 mi / 38 s
- Drive to E 98th St — 0.2 mi / 43 s
  - 7. Turn right onto Church Ave — 305 ft
  - 8. Turn right onto E 98th St — 0.1 mi

Brookdale Plaza
Brooklyn, NY 11212

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.

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Health Care First Occupational Clinic

Drive 5.3 miles, 10 min

○ Seaview Ave
Brooklyn, NY

Get on Belt Pkwy/Shore Pkwy from Rockaway Pkwy
0.8 mi / 2 min

Follow Belt Pkwy/Shore Pkwy to Shore Pkwy Service Rd in Queens. Take exit 17 from Belt Pkwy/Shore Pkwy
3.3 mi / 4 min

Take Cross Bay Blvd to Rockaway Blvd
1.3 mi / 4 min

6. Merge onto Shore Pkwy Service Rd
180 ft

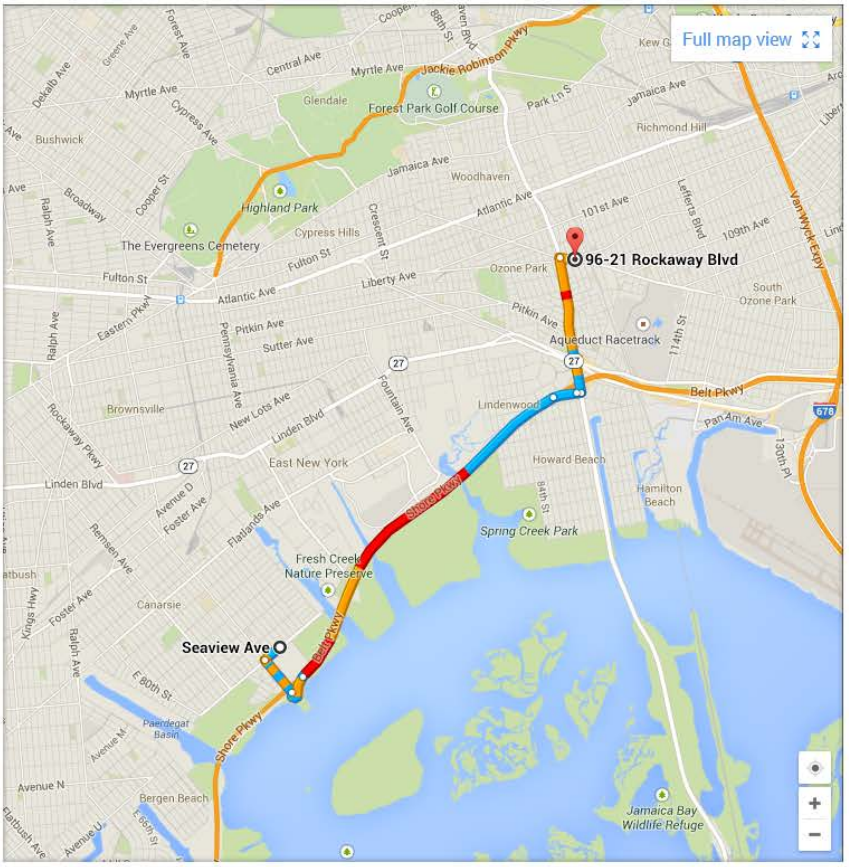
7. Turn left onto Cross Bay Blvd
1.1 mi

8. Turn right onto Rockaway Blvd
Destination will be on the left
0.1 mi

◉ 96-21 Rockaway Blvd
Ozone Park, NY 11417

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.

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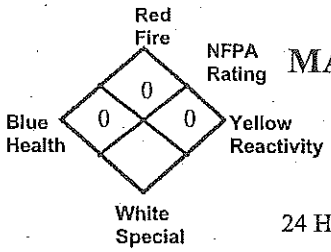


Appendix B

Safety Data Sheets

04-3224
04-3210
S-70112

Alconox ®



MATERIAL SAFETY DATA SHEET

Alconox, Inc.
30 Glenn Street
White Plains, NY 10603

24 Hour Emergency Number – Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 2001
Chemical Family:	Anionic Powdered Detergent
Manufacturer Catalog Numbers for sizes	1104, 1125, 1150, 1101, 1103 and 1112

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.
pH:	9.5 (1%)

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO_2, foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO_2 on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH BUT NO WARRANTY IS EXPRESSED OR IMPLIED.

DATE: 10/23/03 ACCT: 905868001
INDEX: H32951068 CAT NO: A4504 PO NBR: 07695

**** MATERIAL SAFETY DATA SHEET ****

Methanol
14280

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Methanol
Catalog Numbers:
, S75959, S75965, S75965A, S75965HPLC, S75965SPEC, A408-1, A408-4, A408SK-4 A411-20, A411-4, A412-1, A412-20, A412-200, A412-200LC, A412-4, A412-4LC, A412-500, A412-500LC, A412CU1300, A412FB115, A412FB19, A412FB200, A412FB50, A412J500, A412P-4, A412P-4LC, A412POP19, A412POP200, A412POP50, A412POPB19, A412POPB200, A412POPB50, A412RE115, A412RE19, A412RE200, A412RE50, A412RS115, A412RS200, A412RS28, A412RS50, A412SK-4, A412SS-115, A412SS-19, A412SS-200, A413-20, A413-200, A413-4, A413-500, A433F-1GAL, A433P-4, A433P1GAL, A433S-20, A433S-200, A433S-4, A434-20, A450-4, A452-1, A452-4, A452-4LC, A452J1, A452NB219, A452POP19, A452POP200, A452POP28, A452POP50, A452POPN19, A452RS-115, A452RS-19, A452RS-200, A452RS-28, A452RS-50, A452SK-1, A452SK-4, A452SS-115, A452SS-19, A452SS-200, A452SS-50, A453-1, A453-1LC, A453-500, A453J1, A454-1, A454-1LC, A454-4, A454-4LC, A454POP19, A454POP200, A454POP50, A454RS-115, A454RS-19, A454RS-200, A454RS-28, A454RS-50, A454SS-19, A454SS-28, A454SS-50, A455-1, A455POP19, A455POP200, A455POP50, A455SS19, A455SS200, A455SS50, A457-4, A935-4, A935FB200, A935POPB200, A935RB200, A936-1, A936-4, A947-4, A947-4LC, A947POP19, A947POP200, A947POP50, A947RS-115, A947RS-200, A947RS-28, A947SS-115, A947SS-19, A947SS-200, A947SS-28, A947SS-50, BP1105-1, BP1105-4, BP1105POP19, BP1105POP20, BP1105POP50, BP1105RS19, BP1105SS19, BP1105SS28, BP1105SS50, BP2618100, HC400 1GAL, NC9633361, NC9766429, NC9780216, NC9905242, NC9941388, NC9942270, NC9964975, NC9979250, SC95-1, SW2-1, TIA9474, TIA947P200L
Synonyms:
Carbinol; Methyl alcohol; Methyl hydroxide; Monohydroxymethane; Wood alcohol; Wood naptha; Wood spirits; Columbian spirits; Methanol.
Company Identification: Fisher Scientific
1 Reagent Lane
Fairlawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS#
67-56-1	Methanol	>99.0	200-659-6

Hazard Symbols: T F
Risk Phrases: 11 23/24/25 39/23/24/25

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW
Appearance: clear, colorless liquid. Flash Point: 11 deg C.
Danger! Flammable liquid and vapor. Causes respiratory tract irritation. May cause central nervous system depression. Poison! Cannot be made non-poisonous. Causes eye and skin irritation. May be fatal or cause blindness if swallowed. Harmful if swallowed, inhaled, or absorbed through the skin. Vapor harmful.
Target Organs: Eyes, nervous system, optic nerve.

Potential Health Effects
Eye:
Methanol is a mild to moderate eye irritant. Inhalation, ingestion or skin absorption of methanol can cause significant disturbances in vision, including blindness.
Skin:
Causes moderate skin irritation. Harmful if absorbed through the skin. Prolonged and/or repeated contact may cause defatting of the skin and dermatitis. Methanol can be absorbed through the skin, producing systemic effects that include visual disturbances.
Ingestion:
Harmful if swallowed. May be fatal or cause blindness if swallowed. Aspiration hazard. May cause systemic toxicity with acidosis. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure.
Inhalation:
Methanol is toxic and can very readily form extremely high vapor concentrations at room temperature. Inhalation is the most common route of occupational exposure. At first, methanol causes CNS depression with nausea, headache, vomiting, dizziness and incoordination. A time period with no obvious symptoms follows (typically 8-24 hrs). This latent period is followed by metabolic acidosis and severe visual effects which may include reduced reactivity and/or increased sensitivity to light, blurred, double

DATE: 10/23/03 ACCT: 905868001
INDEX: H32951068 CAT NO: A4504 PO NBR: 07695

and/or snowy vision, and blindness. Depending on the severity of exposure and the promptness of treatment, survivors may recover completely or may have permanent blindness, vision disturbances and/or nervous system effects.
Chronic:
Prolonged or repeated skin contact may cause dermatitis. Chronic exposure may cause effects similar to those of acute exposure. Methanol is only very slowly eliminated from the body. Because of this slow elimination, methanol should be regarded as a cumulative poison. Though a single exposure may cause no effect, daily exposures may result in the accumulation of a harmful amount. Methanol has produced fetotoxicity in rats and teratogenicity in mice exposed by inhalation to high concentrations that did not produce significant maternal toxicity.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical aid.
Skin:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.
Ingestion:
Potential for aspiration if swallowed. Get medical aid immediately. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.
Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician:
Effects may be delayed.
Antidote:
Ethanol may inhibit methanol metabolism.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
Containers can build up pressure if exposed to heat and/or fire. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Water may be ineffective. Material is lighter than water and a fire may be spread by the use of water. Flammable liquid and vapor. Vapors are heavier than air and may travel to a source of ignition and flash back. Vapors can spread along the ground and collect in low or confined areas.
Extinguishing Media:
For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. Water may be ineffective. For large fires, use water spray, fog or alcohol-resistant foam. Do NOT use straight streams of water.
Autoignition Temperature:464 deg C (867.20 deg F)
Flash Point: 11 deg C (51.80 deg F)
Explosion Limits, lower:6.0 vol %
Explosion Limits, upper:36.00 vol %
NFPA Rating: (estimated) Health: 1; Flammability: 3; Instability: 0

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Use water spray to disperse the gas/vapor. Remove all sources of ignition. Provide ventilation. A vapor suppressing foam may be used to reduce vapors. Water spray may reduce vapor but may not prevent ignition in closed spaces.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Do not ingest or inhale. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames. Use only with adequate ventilation. Keep away from heat, sparks and flame. Avoid use in confined spaces. Avoid breathing vapor or mist.
Storage:
Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area. Keep containers tightly closed.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Methanol	200 ppm; 250 ppm STEL; skin - potential for cutaneous absorption	200 ppm TWA; 260 mg/m3 TWA 6000 ppm IDLH	200 ppm TWA; 260 mg/m3 TWA

OSHA Vacated PELs:
Methanol:
200 ppm TWA; 260 mg/m3 TWA

Personal Protective Equipment

Eyes:
Wear chemical goggles.
Skin:
Wear appropriate protective gloves to prevent skin exposure.
Clothing:
Wear appropriate protective clothing to prevent skin exposure.
Respirators:
A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Color:	clear, colorless
Odor:	alcohol-like - weak odor
pH:	Not available.
Vapor Pressure:	127 mm Hg @ 25 deg C
Vapor Density:	1.11 (Air=1)
Evaporation Rate:	5.2 (Ether=1)
Viscosity:	0.55 cP 20 deg C
Boiling Point:	64.7 deg C @ 760 mm Hg
Freezing/Melting Point:	-98 deg C
Decomposition Temperature:	Not available.
Solubility in water:	miscible
Specific Gravity/Density:	.7910 g/cm3 @ 20&C
Molecular Formula:	CH4O
Molecular Weight:	32.04

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
High temperatures, ignition sources, confined spaces.
Incompatibilities with Other Materials:
Strong oxidizing agents, strong acids, powdered aluminum, powdered magnesium.
Hazardous Decomposition Products:
Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide, formaldehyde.
Hazardous Polymerization: Will not occur.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 67-56-1: PC1400000
LD50/LC50:
CAS# 67-56-1: Draize test, rabbit, eye: 40 mg Moderate; Draize test, rabbit, eye: 100 mg/24H Moderate; Draize test, rabbit, skin: 20 mg/24H Moderate; Inhalation, rabbit: LC50 = 81000 mg/m3/14H; Inhalation, rat: LC50 = 64000 ppm/4H; Oral, mouse: LD50 = 7300 mg/kg; Oral, rabbit: LD50 = 14200 mg/kg; Oral, rat: LD50 = 5600 mg/kg; Skin, rabbit: LD50 = 15800 mg/kg.
Human LDLo Oral: 143 mg/kg.
Inhalation; 300 ppm caused visual field changes & headache.
LDLo Skin: 393 mg/kg.
experimental animals than humans, because most animal species metabolize methanol differently. Non-primate species do not ordinarily show symptoms of metabolic acidosis or the visual effects

which have been observed in primates and humans.
Carcinogenicity:
Methanol -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No data available.
Teratogenicity:
There is no human information available. Methanol is considered to be a potential developmental hazard based on animal data. In animal experiments, methanol has caused fetotoxic or teratogenic effects without maternal toxicity.
Reproductive Effects:
See actual entry in RTECS for complete information.
Neurotoxicity:
ACGIH cites neuropathy, vision and CNS under TLV basis.
Mutagenicity:
See actual entry in RTECS for complete information.
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Fish: Fathead Minnow: 29.4 g/L; 96 Hr; LC50 (unspecified)Fish: Goldfish: 250 ppm; 11 Hr; resulted in deathFish: Rainbow trout: 8000 mg/L; 48 Hr; LC50 (unspecified)Fish: Rainbow trout: LC50 = 13-68 mg/L; 96 Hr.; 12 degrees CFish: Fathead Minnow: LC50 = 29400 mg/L; 96 Hr.; 25 degrees C, pH 7.63Fish: Rainbow trout: LC50 = 8000 mg/L; 48 Hr.; UnspecifiedBacteria: Phytobacterium phosphoreum: EC50 = 51,000-320,000 mg/L; 30 minutes; Microtox test

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste.
US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: CAS# 67-56-1: waste number U154 (Ignitable waste).

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: METHANOL
Hazard Class: 3
UN Number: UN1230
Packing Group: II
Canadian TDG
Shipping Name: METHANOL
Hazard Class: 3.61
UN Number: UN1230
Other Information: FLASHPOINT 11 C

**** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL
TSCA
CAS# 67-56-1 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
CERCLA Hazardous Substances and corresponding RQs
CAS# 67-56-1: 5000 lb final RQ; 2270 kg final RQ
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 67-56-1: acute, flammable.
Section 313
This material contains Methanol (CAS# 67-56-1, 99.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.
Clean Air Act:
CAS# 67-56-1 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.

DATE: 10/23/03 ACCT: 905868001
INDEX: H32951068 CAT NO: A4504 PO NBR: 07695

None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Methanol can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level:

None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: T F

Risk Phrases:

R 11 Highly flammable.
R 23/24/25 Toxic by inhalation, in contact with skin and if swallowed.
R 39/23/24/25 Toxic : danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.

Safety Phrases:

S 7 Keep container tightly closed.
S 16 Keep away from sources of ignition - No smoking.
S 36/37 Wear suitable protective clothing and gloves.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)

CAS# 67-56-1: 1

United Kingdom Occupational Exposure Limits

CAS# 67-56-1: OES-United Kingdom, TWA 200 ppm TWA; 266 mg/m3 TWA
CAS# 67-56-1: OES-United Kingdom, STEL 250 ppm STEL; 333 mg/m3 STEL

United Kingdom Maximum Exposure Limits

Canada

CAS# 67-56-1 is listed on Canada's DSL List.
This product has a WHMIS classification of B2, D1B, D2B.
CAS# 67-56-1 is listed on Canada's Ingredient Disclosure List.

Exposure Limits

CAS# 67-56-1: OEL-ARAB Republic of Egypt:TWA 200 ppm (260 mg/m3);Skin

**** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 7/21/1999 Revision #11 Date: 10/21/2002

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if the company has been advised of the possibility of such damages.

MATERIAL SAFETY DATA SHEET: CRYSTAL SIMPLE GREEN®

I. PRODUCT & COMPANY INFORMATION

PRODUCT NAME: CRYSTAL SIMPLE GREEN®

OTHER NAMES: CRYSTAL SIMPLE GREEN® - SPECIALIZED CLEANER / DEGREASER
SIMPLE GREEN SAFETY TOWELS (fluid only)

COMPANY NAME: SUNSHINE MAKERS, INC.
15922 Pacific Coast Highway
Huntington Harbour, CA 92649 USA
Telephone: 800-228-0709 • 562-795-6000
Fax: 562-592-3034
Website: www.simplegreen.com

Version No. 4006
Issue Date: January 2002

For 24-hour emergency, call Chem-Tel, Inc.: 800-255-3924

USE OF PRODUCT: A specialized cleaner and degreaser for use in the industrial and institutional workplace..

II. INGREDIENT INFORMATION

The only ingredient of Crystal Simple Green® with established exposure limits is undiluted 2-butoxyethanol (<6%) (Butyl Cellosolve; CAS No. 111-76-2): the OSHA PEL and ACGIH TLV is 25 ppm (skin). Note, however, that Butyl Cellosolve is only one of the raw material ingredients that undergo processing and dilution during the manufacture of Crystal Simple Green®. Upon completion of the manufacturing process, Crystal Simple Green® does not possess the occupational health risks associated with exposure to undiluted Butyl Cellosolve. Verification of this is contained in the independent test results detailed under "Toxicological Information" on Page 3 of this MSDS.

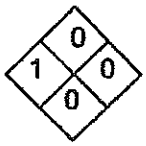
The Butyl Cellosolve in Crystal Simple Green® is part of a chemical category (glycol ethers) regulated by the Emergency Planning and Community Right-to-Know Act (SARA, Title III, section 313); therefore, a reporting requirement exists. Based upon chemical analysis, Crystal Simple Green® contains no known EPA priority pollutants, heavy metals, or chemicals listed under RCRA, CERCLA, or CWA. Analysis by TCLP (Toxicity Characteristic Leaching Procedure) according to RCRA revealed no toxic organic or inorganic constituents.

All components of Crystal Simple Green® are listed on the TSCA Chemical Substance Inventory.

III. HAZARDS IDENTIFICATION

UN Number: Not required
Dangerous Goods Class: Nonhazardous

Hazard Rating (NFPA/HMIS)
Health = 1* Reactivity = 0
Fire = 0 Special = 0



Rating Scale
0 = minimal 1 = slight
2 = moderate 3 = serious
4 = severe

*Mild eye irritant, non-mutagenic and non-carcinogenic. **None of the ingredients in Crystal Simple Green® are regulated or listed as potential cancer agents by Federal OSHA, NTP, or IARC.**

IV. FIRST AID MEASURES

SYMPTOMS OF OVEREXPOSURE AND FIRST AID TREATMENT

Eye contact: Reddening may develop. Immediately rinse the eye with large quantities of cool water; continue 10-15 minutes or until the material has been removed; be sure to remove contact lenses, if present, and to lift upper and lower lids during rinsing. Get medical attention if irritation persists.

Skin contact: Minimal effects, if any; rinse skin with water, rinse shoes and launder clothing before reuse. Reversible reddening may occur in some dermal-sensitive users; thoroughly rinse area and get medical attention if reaction persists.

Swallowing: Essentially non-toxic. Give several glasses of water to dilute; do not induce vomiting. If stomach upset occurs, consult physician.

Inhalation: Non-toxic. Exposures to concentrate-mist may cause mild irritation of nasal passages or throat; remove to fresh air. Get medical attention if irritation persists.

V. FIRE FIGHTING MEASURES

Crystal Simple Green® is stable, not flammable, and will not burn.

Flash Point/Auto-Ignition:	Not flammable.
Flammability Limits:	Not flammable.
Extinguishing Media:	Not flammable/nonexplosive. No special procedures required.
Special Fire Fighting Procedures:	None required.

VI. ACCIDENTAL RELEASE MEASURES

Recover usable material by convenient method; residual may be removed by wipe or wet mop. If necessary, unrecoverable material may be washed to drain with large quantities of water.

VII. HANDLING, STORAGE & TRANSPORT INFORMATION

No special precautions are required. **This product is non-hazardous for storage and transport according to the U.S. Department of Transportation Regulations.** Crystal Simple Green® requires no special labeling or placarding to meet U.S. Department of Transportation requirements.

UN Number:	Not required
Dangerous Goods Class:	Nonhazardous

VIII. EXPOSURE CONTROLS

Exposure Limits: The Crystal Simple Green® formulation presents no health hazards to the user when used according to label directions for its intended purposes. Mild skin and eye irritation is possible (please see Eye contact and Skin contact in Section IV.).

Ventilation: No special ventilation is required during use. Large-scale uses indoors should provide an increased rate of air exchange.

Human Health Effects or Risks from Exposure: Adverse effects on human health are not expected from Crystal Simple Green®, based upon twenty years of use of Simple Green without reported adverse health incidence in diverse population groups, including extensive use by inmates of U.S. Federal prisons in cleaning operations.

Crystal Simple Green® is a mild eye irritant; mucous membranes may become irritated by concentrate-mist.

Crystal Simple Green® is not likely to irritate the skin in the majority of users. Repeated daily application to the skin without rinsing, or continuous contact of Crystal Simple Green® on the skin may lead to temporary, but reversible, irritation.

Medical Conditions Aggravated by Exposure: No aggravation of existing medical conditions is expected; dermal-sensitive users may react to dermal contact by Crystal Simple Green®.

IX. PERSONAL PROTECTION

Precautionary Measures: No special requirements under normal use conditions.
Eye Protection: Caution, including reasonable eye protection, should always be used to avoid eye contact where splashing may occur.
Skin Protection: No special precautions required; rinse completely from skin after contact.
Respiratory Protection: No special precautions required except during large-scale spray applications where spray mist levels are high.
Work and Hygienic Practices: Wash or rinse hands before touching eyes or contact lenses. Follow standard hygienic practices for handling cleaning agents.

X. PHYSICAL AND CHEMICAL PROPERTIES

Appearance/odor::	Clear liquid	Vapor Pressure:	18 mm Hg @ 20 °C; 23.5 mm Hg @ 26 °C
Specific Gravity:	1.020	Vapor Density:	1.3 (air = 1)
pH of concentrate:	9.35	Density:	8.5 lbs./gallon
Evaporation:	>1 (butyl acetate = 1)		
Boiling Point:	100.6 °C (212 °F)		
Freezing Point:	-9 °C (16 °F) If product freezes, it will reconstitute without loss of efficacy when brought back to room temperature and agitated.		

VOC Composite Partial Pressure: 0 mm Hg @ 20 °C
Volatile Organic Compounds (VOCs): 0 g/L per ASTM Method D-2369. Per California AQMD's VOC test method, product must be diluted at least 2 parts of water to 1 part Crystal Simple Green® in order to meet SCAQMD Rule 1171 & Rule 1122 and BAAQMD Regulation 8-16 VOC requirements for solvent cleaning operations.
Water Solubility: Completely soluble in water.
Detection: Crystal Simple Green® has a characteristic odor that is not indicative of any hazardous situation.

XI. STABILITY AND REACTIVITY INFORMATION

Nonreactive. Crystal Simple Green® is stable, even under fire conditions, and will not react with water or oxidizers. Hazardous polymerization will not occur.

XII. TOXICOLOGICAL INFORMATION

The information and conclusions cited in this section are based on data and testing of Simple Green®. The data are directly applicable to Crystal Simple Green® because, except for the fragrance and dyes which have been removed, it contains the same ingredients as Simple Green®.

Nonhuman Toxicity

Acute Mortality Studies:
Oral LD_{50} (rat): >5.0 g/kg body weight // Dermal LD_{50} (rabbit): >2.0 g/kg body weight

Dermal Irritation: Only mild, but reversible, irritation was found in a standard 72-hr test on rabbits. A value of 0.2 (non-irritating) was found on a scale of 8.

Eye Irritation: With or without rinsing with water, the irritation scores in rabbits at 24 hours did not exceed 15 (mild irritant) on a scale of 110.

Subchronic dermal effects: No adverse effects, except reversible dermal irritation, were found in rabbits exposed to Simple Green® (up to 2.0 g/kg/day for 13 weeks) applied to the skin of 25 males and 25 females. Only female body weight gain was affected. Detailed microscopic examination of all major tissues showed no adverse changes.

Fertility Assessment by Continuous Breeding: The Simple Green® formulation had no adverse effect on fertility and reproduction in CD-1 mice with continuous administration for 18 weeks, and had no adverse effect on the reproductive performance of their offspring.

XIII. BIODEGRADABILITY AND ENVIRONMENTAL TOXICITY INFORMATION

Biodegradability:
Like Simple Green®, Crystal Simple Green® is readily decomposed by naturally occurring microorganisms. The biological oxygen demand (BOD), as a percentage of the chemical oxygen demand (COD), after 4, 7, and 11 days was 56%, 60%, and 70%, respectively. Per OECD Closed Bottle Test, Crystal Simple Green® meets OECD and EPA recommendations for ready biodegradability.

In a standard biodegradation test with soils from three different countries, Butyl Cellosolve reached 50% degradation in 6 to 23 days, depending upon soil type, and exceeded the rate of degradation for glucose, which was used as a control for comparison.

Environmental Toxicity Information:
Crystal Simple Green® is considered practically non-toxic per EPA's aquatic toxicity scale.

XIV. DISPOSAL CONSIDERATIONS

Crystal Simple Green® is fully water soluble and biodegradable and will not harm sewage-treatment microorganisms if disposal by sewer or drain is necessary. Dispose of in accordance with all applicable local, state, and federal laws.

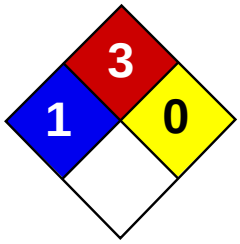
XV. OTHER INFORMATION

Containers:	Crystal Simple Green® residues can be completely removed by rinsing with water; the container may be recycled or applied to other uses.
Contact Point:	Sunshine Makers, Inc., Research and Development Division: 562-795-6000.

***** NOTICE *****

All information appearing herein is based upon data obtained by the manufacturer and recognized technical sources. Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of this information, Sunshine Makers, Inc. or its distributors extends no warranties, makes no representations and assumes no responsibility as to the suitability of such information for application to purchaser's intended purposes or for consequences of its use.







Material Safety Data Sheet
Hexanes MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hexanes

Catalog Codes: SLH2335, SLH2032

CAS#: 110-54-3

RTECS: MN9275000

TSCA: TSCA 8(b) inventory: Hexane

CI#: Not applicable.

Synonym:

Chemical Name: Hexane

Chemical Formula: C6-H14

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
Hexanes	110-54-3	98.5-99.9

Toxicological Data on Ingredients: Hexane: ORAL (LD50): Acute: 25000 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (permeator), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to peripheral nervous system, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

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. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

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. Seek medical attention.

Ingestion:
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 if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 225°C (437°F)

Flash Points: CLOSED CUP: -22.5°C (-8.5°F). (TAG)

Flammable Limits: LOWER: 1.15% UPPER: 7.5%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

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:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards:
Extremely flammable liquid and vapor. Vapor may cause flash fire.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid, insoluble in water. Keep away from heat. Keep away from sources of ignition. 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. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. 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 away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

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:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves (impervious).

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:
TWA: 500 (ppm) from OSHA (PEL) [United States] Inhalation TWA: 1800 (mg/m3) from OSHA (PEL) [United States] Inhalation TWA: 176 (mg/m3) from ACGIH (TLV) [United States] SKIN TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN TWA: 500 STEL: 1000 (ppm) from ACGIH (TLV) [United States] Inhalation TWA: 1760 STEL: 3500 (mg/m3) from ACGIH (TLV) [United States] Inhalation Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Gasoline-like or petroleum-like (Slight.)

Taste: Not available.

Molecular Weight: 86.18g/mole

Color: Clear Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 68°C (154.4°F)

Melting Point: -95°C (-139°F)

Critical Temperature: Not available.

Specific Gravity: 0.66 (Water = 1)

Vapor Pressure: 17.3 kPa (@ 20°C)

Vapor Density: 2.97 (Air = 1)

Volatility: Not available.

Odor Threshold: 130 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.9

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Soluble in diethyl ether, acetone. Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources, incompatibles.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not available.

Special Remarks on Reactivity: Hexane can react vigorously with strong oxidizers (e.g. chlorine, bromine, fluorine)

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 25000 mg/kg [Rat]. Acute toxicity of the gas (LC50): 48000 ppm 4 hours [Rat].

Chronic Effects on Humans:
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: peripheral nervous system, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of ingestion, of inhalation. Hazardous in case of skin contact (permeator). Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects based on animal data. May be tumorigenic based on animal data. May affect genetic material. Passes through the placental barrier in animal.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause mild skin irritation. It can be absorbed through the skin in harmful amounts. Eyes: May cause mild eye irritation. Inhalation: May be harmful if inhaled. Inhalation of vapors may cause respiratory tract irritation. Overexposure may affect, brain, spinal cord, behavior/central and peripheral nervous systems (lightheadness, dizziness, hallucinations, paralysis, blurred vision, memory loss, headache, euphoria, general anesthetic, muscle weakness, numbness of the extremeties, asphyxia, unconciousness and possible death), metabolism, respiration, blood, cardiovascular system, gastrointestinal system (nausea) Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation with abdominal pain and nausea. May also affect the liver, blood, brain, peripheral and central nervous systems. Symptoms of over exposure by ingestion are similar to that of overexposure by inhalation.

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 product itself and its products of degradation are not toxic.

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 3: Flammable liquid.

Identification: : Hexane UNNA: 1208 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hexanes Illinois toxic substances disclosure to employee act: Hexanes Illinois chemical safety act: Hexanes New York release reporting list: Hexanes Rhode Island RTK hazardous substances: Hexanes Pennsylvania RTK: Hexanes Florida: Hexanes Minnesota: Hexanes Massachusetts RTK: Hexanes Massachusetts spill list: Hexanes New Jersey: Hexanes New Jersey spill list: Hexanes Louisiana spill reporting: Hexanes TSCA 8(b) inventory: Hexanes SARA 313 toxic chemical notification and release reporting: Hexanes CERCLA: Hazardous substances.: Hexanes: 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 B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. R38- Irritating to skin. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. R62- Possible risk of impaired fertility. R65- Harmful: may cause lung damage if swallowed. R67- Vapors may cause drowsiness or dizziness. S9- Keep container in a well-ventilated place. S16- Keep away from sources of ignition - No smoking. S29- Do not empty into drains. S33- Take precautionary measures against static discharges. S36/37- Wear suitable protective clothing and gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets. S62- If swallowed, do not induce vomiting: seek medical advice immediately and show this

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves (impervious). Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:19 PM

Last Updated: 06/09/2012 12:00 PM

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Appendix C

Heat Stress and Cold Stress Guidelines

Heat Stress Guidelines

Form	Signs & Symptoms	Care	Prevention[3]
Heat Rash	Tiny red vesicles in affected skin area. If the area is extensive, sweating can be impaired.	Apply mild lotions and cleanse the affected area.	Cool resting and sleeping areas to permit skin to dry between heat exposures.
Heat Cramps	Spasm, muscular pain (cramps) in stomach area and extremities (arms and legs).	Provide replacement fluids with minerals (salt) such as Gatorade.	Adequate salt intake with meals[1]. ACCLIMATIZATION[2]
Heat Exhaustion	Profuse sweating, cool (clammy) moist skin, dizziness, confusion, pale skin color, faint, rapid shallow breathing, headache, weakness, and/or muscle cramps.	Remove from heat, sit or lie down, rest, replace lost water with electrolyte replacement fluids (water, Gatorade) take frequent sips of liquids in amounts greater than required to satisfy thirst.	ACCLIMATIZATION[2] Adequate salt intake with meals[1], only during early part of heat season. Ample water intake, frequently during the day.
Heat Stroke	HOT Dry Skin. Sweating has stopped. Mental confusion, dizziness, nausea, chills, severe headache, collapse, delirium, and/or coma.	HEAT STROKE IS A MEDICAL EMERGENCY • Remove from heat. • COOL THE BODY AS RAPIDLY AS POSSIBLE by immersing in cold (or cool) water, or splash with water and fan. • Call for Emergency Assistance. • Observe for signs of shock.	ACCLIMATIZATION[2] Initially moderate workload in heat (8 to 14 days). Monitor worker's activities.

Footnotes:

1.) American diets are normally high in salt, sufficient to aid acclimatization. However, during the early part of the heat season, (May, June), one extra shake of salt during one to two meals per day may help, so long as this is permitted by your physician. Check with your personal physician.

2.) ACCLIMATIZATION - The process of adapting to heat is indicated by worker's ability to perform hot jobs less fluid loss, lower concentrations of salt loss in sweat, and a reduced core (body) temperature and heart rate.

3.) Method to Achieve Acclimatization - Moderate work or exercise in hot temperatures during early part of heat season. Adequate salt (mineral) and water intake. Gradually increasing work time in hot temperatures. Avoid alcohol. Normally takes 8 to 14 days to achieve acclimatization. Lost rapidly, if removed from strenuous work (or exercise) in hot temperature for more than approximately 5 days.

Cold Stress Guidelines

Stress	Symptoms	What to do
Mild Hypothermia	• Body Temp 98 to 90°F • Shivering • Lack of coordination, stumbling, fumbling hands • Slurred speech • Memory loss • Pale, cold skin	• Move to warm area • Stay active • Remove wet clothes and replace with dry clothes or blankets • Cover the head • Drink warm (not hot) sugary drink
Moderate Hypothermia	• Body temp 90 to 86°F • Shivering stops • Unable to walk or stand • Confused and/or irrational	• All of the above, plus: o Call 911 o Cover all extremities completely o Place very warm objects, such as hot packs on the victim's head, neck, chest, and groin
Severe Hypothermia	• Body temp 86 to 78°F • Severe muscle stiffness • Very sleepy or unconscious • Ice cold skin • Death	• Call 911 • Treat victim very gently • Do not attempt to re-warm
Frostbite	• Cold, tingling, stinging, or aching feeling in the frostbitten area, followed by numbness • Skin color turns red, then purple, then white or very pale skin • Cold to the touch • Blisters in severe cases	• Call 911 • Do not rub the area • Wrap in soft cloth • If help is delayed, immerse in warm (not hot) water
Trench Foot	• Tingling, itching, or burning sensation • Blisters	• Soak feet in warm water, then wrap with dry cloth bandages • Drink a warm (not hot) sugary drink

Appendix D

Forms

NEAR MISS REPORT

A near miss is a potential hazard or incident that has not resulted in any personal injury. Unsafe working conditions, unsafe employee work habits, improper use of equipment, or use of malfunctioning equipment have the potential to cause work related injuries. It is everyone's responsibility to report and/or correct these potential accidents/incidents immediately. Please complete this form as a means to report these near-miss situations. Send a copy of the completed form to the Project Manager, Regional Health and Safety Officer and the Corporate Health and Safety Officer.

Location: _____ Site Name: _____

Date: _____ Time: _____ ☐ a.m. ☐ p.m.

Weather conditions, site operations taking place during near miss. _____

Please check all appropriate conditions:

☐ Unsafe Act ☐ Unsafe equipment

☐ Unsafe Condition ☐ Unsafe use of equipment

Description of incident or potential hazard: _____

Employees or sub-contractors involved if applicable._____

Employee Signature _____ Date _____

Print Name _____

NEAR MISS INVESTGATION

Description of the near-miss condition: _____
Causes (primary & contributing) _____
Corrective action taken (Remove the hazard, replace, repair, or retrain in the proper procedures for the task) _____
Actions not yet taken_____

Signed: _____ Date Completed: _____

Print Name
Not completed for the following reason: _____Date:_____

GEI Consultants

GEI Consultants

Accident/Incident Report Form

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

SECTION A — ACCIDENT/INCIDENT DETAILS

EMPLOYEE INFORMATION:

Name: _____

Home Address: _____
Street Address City State Zip Code

Contact Information: ( ) _____ ( ) _____
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor: _____

OTHER INJURED (IF APPLICABLE):

Name: _____

Home Address: _____
Street Address City State Zip Code

Contact Information: ( ) _____ ( ) _____
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor: _____

Date and Time Accident/Incident	Date and Time Reported
_____ /_____ /_____ Month Day Year	_____ /_____ /_____ Month Day Year
_____ A.M. _____ P.M.	_____ A.M. _____ P.M.

LOCATION OF INCIDENT/ACCIDENT

Project Name: _____

Client and Location: _____

or _____

Office Location: _____

INCIDENT TYPE: (Check All That Applies)

- ☐ **Personal Injury/Illness**
- ☐ **Vehicle Accident**
- ☐ **Property Damage**
- ☐ **Environmental Spill**
- ☐ **Other**

WITNESS INFORMATION

Name: _____

Contact Number: _____

Company: _____

WHAT HAPPENED TO THE INJURED PARTY: ☐ First Aid Administered ☐ Refused Treatment/Transport ☐ Transported to Hospital ☐ Returned to Work ☐ Went Home ☐ Went to Physician ☐ Unknown

Clinic/Hospital or Treating Physician: _____ Phone: _____
Name Street Address City State Zip Code

SECTION B — PERSONAL INJURY

Cause of Injury: _____

Part of Body Injured: _____ Multiple Injuries: ☐ Y ☐ N

Was PPE worn when injured? : ☐ Y ☐ N What PPE was worn? _____

WAS INJURY A RESULT OF THE USE A MOTOR VEHICLE: ☐ **YES** ☐ **NO** **(If yes, complete Section C)**

GEI Consultants

Accident/Incident Report Form

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

SECTION C — AUTO ACCIDENT ONLY

DRIVER/VEHICLE INFORMATION

Name of Insured: _____

Department: _____

Driver's License Number: _____

DOB: ____/____/____ State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model: _____ Year:_____ Color:_____

Owner: _____

Name of Other Driver: _____

Driver's License Number: _____

State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model:_____ Year: _____ Color:_____

Insurance Carrier: _____

Policy Number: _____ Ph. Number:_____

SECTION D — PROPERTY DAMAGE OR CHEMICAL RELEASE ONLY

Type of Damage(s): _____

Cause of Damage(s): _____

Type of Chemical Released (if known): _____

Quantity of Chemical Released: _____

Spill Measures Employed: _____

SECTION E — NATURE OF ACCIDENT/INCIDENT AND EXTENT OF INJURIES/DAMAGES

(Please give a detailed description of what happened. Attach a sketch or picture if applicable)

_____

_____

_____

_____

_____

_____

_____

_____

_____

I hereby certify that the above information is true and correct to my understanding of this accident/incident.

_____ _____

Employee/Preparer's Name **Date and Time**

GEI Consultants

Daily Safety Briefing Log and Site Visitor Sign-In

Project Number:	**Project Name:**
[1]Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents the tailgate briefing conducted in accordance with the site specific HASP. Personnel who perform work operations on site are required to attend each briefing and to acknowledge receipt of each briefing, daily.

TOPICS COVERED (check all those covered):

- ☐ General PPE Usage
- ☐ Hearing Conservation
- ☐ Respiratory Protection
- ☐ Personal Hygiene
- ☐ Exposure Guidelines
- ☐ Decon Procedures
- ☐ Confined Space
- ☐ Slips, Trips, Falls
- ☐ Heat Stress
- ☐ Cold Stresses
- ☐ Site Control
- ☐ Work Zones
- ☐ Lockout/Tagout
- ☐ Excavation Safety
- ☐ Confined Space
- ☐ Traffic Safety
- ☐ Changes to the HASP
- ☐ Initial Review of Hazard Evaluation
- ☐ Emergency Procedures (include route to hospital)
- ☐ Other (Specify):
- ☐ Other (Specify):

Daily Safety Topic Description:

Personnel Sign-in List

Printed Name	Signature	Company Name	Time-In	Time-Out

[1] This form is applicable for *only* 1 day of site activity.

Appendix E

GEI's Health and Safety SOPs

STANDARD OPERATING PROCEDURES
HS-017 Water Safety

1.1 Objective

The purpose of this SOP is to ensure the safe deployment and return of GEI personnel during field activities while aboard a boat or when working near water.

1.2 Execution

Boat safety practices will be conducted in general accordance with guidance provided in the United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM) 385-1-1. Personnel will board the boat at specified locations to be determined and agreed upon prior to field deployment. The following safety practices will be adhered to:

- Boats operated by GEI will comply with Coast Guard regulations.
- Every GEI employee will wear a Type III Personal Flotation Device (PFDs) at all times when aboard any boat except when that boat is equipped with a fully enclosed cabin and the employee is inside. Boats must also, at a minimum, have Coast Guard approved PFDs on board for each person and at least one throwable flotation device, such as a seat cushion.
- For every boating activity, a trip plan must be communicated to someone in a position to take appropriate action when the GEI employee is overdue.
- For every trip requiring more than one day, daily communications with an appropriate base must be maintained.
- The consumption of alcoholic beverages and the use of illegal drugs will not be permitted at any time aboard boats on which GEI employees are present.
- All employees working on a boat will monitor the weather, incorporating, as appropriate, National Oceanic and Atmospheric Administration (NOAA) marine weather broadcasts and other local commercial weather forecasting services as may be available.
- For retrieving a person overboard, the boat operator will throw a life ring and line, and use a ladder attached to the boat or the boat step transom to allow the person to climb out of the water. The boat will be equipped with an ABC rated fire extinguisher(s) and a life ring attached to approximately 90 feet of rope.
- Emergency procedures for fire, person overboard, and capsizing will be reviewed on the first day of operations and any time a change of personnel occurs.

1.3 Working Near Water

OSHA Construction Industry Standards (1926) state: "employees working over or near water, **where the danger of drowning exists**, will be provided a Coast Guard-approved PFD." OSHA General Industry Standards (1910) do not address working over or near water. Therefore, GEI uses the OSHA Construction Standard for all employees and all tasks to ensure protection in all operations. A site-specific health and safety plan (HASP) is required to be completed and signed by all GEI employees that may be working over or near water before the work may begin.

The following procedures and safety devices will be provided for and used by employees at locations where the danger of drowning exists and when employees are not protected by passive fall protection systems such as railings, nets, safety belts, or other applicable provisions:

- **Personal Flotation Devices (PFD).** Employees will be required to wear U. S. Coast Guard approved personal flotation devices that are marked or labeled Type I PFD, Type II PFD, or Type III PFD, or a U.S. Coast Guard approved Type V PFD that is marked or labeled for use as a work vest for commercial use or for use on vessels. GEI employees will inspect buoyant work vests or life preservers for defects that could alter their strength or buoyancy prior to, and after, each use. Defective units will not be used and will be marked as defective and properly disposed.

- **Ring Buoys.** U. S. Coast Guard approved 30-inch ring buoys with at least 150 feet of 600 pound capacity line will be readily available for emergency rescue operations. Distance between ring buoys will not exceed 150 feet.

These requirements can be superseded by the use of 100 percent fall protection. If an employee cannot fall into the water as a result of use of active or passive fall protection, there is no danger of drowning and a PFD is not required. For example, where an employee is working on a steep slope and could fall into water, a PFD is required.

1.4 Procedures

Safety lines that prevent employees from reaching the water eliminate the danger of drowning, and negate the need for a PFD. The same is true when working on a barge or floating platform with an approved railing system.

Employees working over or near water where the distance to the water is greater than the length of the lanyard (and by virtue of safety devices no danger of drowning exists), are not required to comply with requirements for working in proximity to water. If the distance between the water surface and the employee is less than the length of the lanyard and thus will allow entry into the water, the OSHA standard is relevant. Employees who exit the basket of the aerial lift to a location that is over or near water, (and the danger of drowning as a result of a fall exists), and do not maintain 100 percent fall protection,

must wear a PFD. When GEI employees are working over or adjacent to water, the client will provide at least one lifesaving skiff to be immediately available for potential rescue purposes.

Employees will not work alone, where practical, in situations where a drowning hazard exists.

1.5 Training

Training will be conducted for employees unfamiliar with the use of safety equipment and PPE required by this SOP. Employees working over or near water will be trained in their responsibilities and the safe work practices associated with working on or near water.

1.6 Limitations

None

1.7 References

United States Army Corps of Engineers, Safety and Health Requirements Manual (EM), 385-1-1.November 3, 2003 – Section 19 Floating Plant and Marine Activities

1.8 Attachments

None

1.9 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Western Regional Region Health and Safety Officer

1.10 Revision Dates

November 2010
May 2011

STANDARD OPERATING PROCEDURES
SOP No. HS-010 Inclement Weather

1.1 Objective

Inclement weather can affect work activities and pose safety hazards to employees working in these conditions. The following guidelines will be followed when weather conditions become a safety concern.

1.2 Execution

All employees will be aware of local weather conditions and monitor any advisories issued by the National Weather Service and other local reporting services. Depending on location and season, storms are capable of producing heavy rain, floods, extreme temperatures, high wind conditions, lighting, tornados, and/or snowfall.

1.2.1 Heavy Rain

If working or driving in a storm use extreme caution and turn your lights on when the rainfall becomes heavy. Employees should be aware of the following:

- Heavy rain causes visibility issues, especially when driving.
- Surfaces and tools become slippery.
- If you are working in the rain and your clothes become wet there is a risk of hypothermia when exposed to winds, even in warm temperatures.
- If the storms are going to produce thunder and/or lightning, leave the work area immediately and move to a safe area.
- Use your best judgment to determine if the rainfall becomes too heavy to continue working safely.

1.2.2 Lightning

Lightning can strike as far as 10 miles from the area where it is raining. That's about the distance you can hear thunder. **If you can hear thunder, you are within striking distance. Seek safe shelter immediately.** This can be within a building or vehicle. Wait 30 minutes after the last clap of thunder or flash of lightning before going outside again.

1.2.3 Flooding

Flooding may occur as a result of heavy rain in a short period of time. Flooding can be particularly acute in canyon areas where dry creek beds can turn into raging rivers from rainfall in distant or higher elevation areas. Be aware of this and your surroundings and move to a safe place if you begin to see any signs that flooding may occur. Do not

attempt to drive through areas or streets that are flooded. Seek alternate routes. Be particularly cautious at night when flooded areas are difficult to see. Urban flooding can stop traffic and increase the potential for traffic accidents and being trapped in vehicles.

1.2.4 Extreme Temperatures

Work activities may take place in extreme heat or cold. Be prepared if these conditions are anticipated. Have the correct personal protective equipment (PPE) available, exercise proper fluid intake, and take breaks to complete work and prevent heat and cold stress. For more information about these conditions see the heat stress and cold stress programs found in GEI's Health and Safety Manual.

1.2.5 High Wind and Tornados

Tropical storms are described as storms with sustained winds ranging from 39 to 73 miles per hour (mph) and hurricanes produce sustained winds that exceed 74 mph. When winds approach 40 mph (gale force winds) twigs begin to break off of trees and vehicles will veer off of the road. When winds approach **40 mph** or the GEI employee feels unsafe based on the activities being performed, work is to be stopped and you should seek shelter as soon as possible. Blowing or falling debris and overhanging limbs/signs can be a significant hazard. Avoid driving in these conditions; 70 percent of injuries during hurricanes are a result of vehicle accidents. Note that tall or elevated equipment will have manufacturer's safe operating wind speeds defined that could be less than 40 mph, the operator's manual should be consulted prior to operation of the equipment.

A tornado is a violent, dangerous, rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. Based on the Fujita Scale or F-Scale Numbers begin at F0: 40-72 mph and go to F6: 319-379 mph (F6 is generally theoretical). Nearly three-fourths of all tornados are on the weak F0-F1 scale with just over two-thirds of deaths resulting from the violent F4-F5 tornados. All tornado wind speeds exceed the 40 mph stop work speed, shelter should be taken immediately if a tornado is seen. If a tornado siren is sounded move immediately to safety indoors and then move to a windowless interior space, basement, stair well etc., or designated fall-out shelter if available. Windows should not be opened before an oncoming tornado, keep the building envelope closed to the extent possible. If there is no shelter available seat belt yourself into your stationary vehicle or seek a depression or low spot on the land surface.

1.2.6 Snowfall and Ice Conditions

Working in the winter months will result in activities taking place during periods of snowfall or icy conditions. If you are working during or after snow has fallen, dress appropriately for the conditions. Snow and ice can cause working surfaces to become

slippery; clear snow and ice from all work areas to prevent slip hazards. Use caution when performing any snow or ice removal activities to prevent injuries. Driving in snowy and icy conditions is also hazardous. Reduce speed and use caution if you must drive in these conditions.

If the weather conditions deteriorate and you do not feel safe working in these conditions, stop work, move to a safe indoor location, and contact your Project Manager to let them know the weather and work status and your location.

1.3 Limitations

- Follow safety procedures as defined in the site-specific health and safety plan (HASP) at all times.
- Protection from working in extreme weather conditions can best be accomplished if the conditions are anticipated. Monitor local weather conditions prior to starting work.

1.4 References

Center for Disease Control and Prevention – Natural Disasters and Severe Weather
http://www.bt.cdc.gov/disasters/
National Lightning Safety Institute
NOAA, National Weather Service
Office of Climate, Water, and Weather Services

1.5 Attachment

None

1.6 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Western Regional Region Health and Safety Officer

STANDARD OPERATING PROCEDURES

SOP NO. HS-009 Hazard Identification and Management

1.1 Objective

The purpose of this SOP is to outline the steps GEI personnel will take to identify potential hazards on site, the risks associated with these hazards, and the proper engineering controls, work practices, and personal protective equipment (PPE) to use to minimize the associated risks.

1.2 Hazard Identification

An initial identification of hazards should be done based on a review of available documents, including lists of chemicals used on site, analytical data from soil, surface water, groundwater, air, spill history, site history, equipment on site, maps, photos, and a preliminary survey.

1.3 Risk Identification

Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances will be identified. GEI employees and GEI subcontractors who will be working on the site will be informed of any risks that have been identified.

Risks to consider include, but are not limited to:

- Potential exposures exceeding the permissible exposure limits and published exposure levels.
- Potential Immediately to Life and Health (IDLH) Concentrations.
- Potential Skin Absorption and Irritation Sources.
- Potential Eye Irritation Sources.
- Potential hazardous atmospheres, including oxygen deficiency and fire and explosion hazards.

1.4 Engineering Controls, Work Practices, and Personal Protective Equipment for Employee Protection

Engineering controls, work practices, and PPE for substances regulated in OSHA Subpart Z (Toxic and Hazardous Substances) will be implemented in accordance with this section to protect employees from exposure to hazardous substances and safety and health hazards.

1.4.1 Engineering Controls, Work Practices, and Personal Protective Equipment for Substances Regulated in Subparts G (Occupational Health and Environment Control) and Subpart Z (Toxic and Hazardous Substances)

Engineering controls and work practices will be instituted to reduce and maintain employee exposure at or below the permissible exposure limits for substances regulated by 29 CFR Part 1910, to the extent required by Subpart Z, except to the extent that such controls and practices are not feasible.

Engineering controls that may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices that may be feasible include removing all non-essential employees from potential exposure during opening of drums, wetting down dusty operations, and locating employees upwind of possible hazards.

If engineering controls and work practices are not feasible, or not required, any reasonable combination of engineering controls, work practices, and PPE will be used to reduce and maintain at or below the permissible exposure limits or dose limits for substances regulated by 29 CFR Part 1910, Subpart Z.

GEI will not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

The provisions of 29 CFR, subpart G, Occupational Health and Environment control, will be followed.

1.4.2 Engineering Controls, Work Practices, and Personal Protective Equipment for Substances Not Regulated in Subparts G and Subparts Z

An appropriate combination of engineering controls, work practices, and personal protective equipment will be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Subparts Z. GEI will use published literature and MSDS' as a guide in making the determination of what level of protection is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

1.4.3 Decontamination Procedure

Decontamination procedure(s) will be developed, communicated to employees, and implemented before any employees or equipment enter areas on site where potential for exposure to hazardous substances exists. Procedures will be developed to minimize

employee contact with hazardous substances or with equipment that has contacted hazardous substances.

All GEI employees leaving a contaminated area will be properly decontaminated; all contaminated clothing and equipment leaving a contaminated area will be properly disposed of or decontaminated.

Decontamination procedures will be monitored by the site safety officer to determine their effectiveness. When such procedures are found to be ineffective, the site safety officer will contact the CHSO and appropriate steps will be taken to correct any deficiencies.

1.4.3.1 Location

Decontamination will be performed in geographical areas that will minimize the exposure to employees, equipment, and the environment.

1.4.3.2 Equipment and Solvents

All equipment and solvents used for decontamination will be decontaminated or disposed of properly.

1.4.3.3 Personal Protective Clothing and Equipment

Protective clothing and equipment will be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

Employees whose clothing becomes wetted with hazardous substances will immediately remove that clothing and proceed to shower. The clothing will be disposed of or decontaminated before it is removed from the work zone.

1.4.3.4 Commercial Laundries or Cleaning Establishments

Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment will be informed of the potentially harmful effects of exposures to hazardous substances.

1.4.3.5 Showers and Changing Rooms

Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they will be provided and meet the requirements of 29 CFR 1910.141 (Sanitation). If temperature conditions prevent the effective use of water, then other effective means for cleansing will be provided and used.

1.5 Limitations

None

1.6 References

OSHA 1910.120 Hazardous Waste Operations and Emergency Response
OSHA 1910 Subpart G Occupational Health and Environment Control
OSHA 1910 Subpart Z Toxic and Hazardous Substances
OSHA 1910.141 General Environmental Controls - Sanitation

1.7 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Western Regional Region Health and Safety Officer

STANDARD OPERATING PROCEDURES

SOP No. HS-008 Hand and Power Tools

1.1 Objective

The purpose of this SOP is to minimize the potential for injuries to GEI employees when using hand and power tools.

1.2 General Requirements

1.2.1 Condition of Tools

All hand and power tools and similar equipment, whether furnished by GEI or the employee, will be maintained in a safe condition.

1.2.2 Guarding

When power tools are designed to accommodate guards, they will be equipped with such guards prior to, and at all times during, use. All guards will be in good condition and be adequate to provide protection to the employee.

1.2.3 Personal Protective Equipment

Employees using hand or power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects will be provided with the personal protective equipment (PPE) necessary to protect them from the hazard. All employees will wear work gloves and safety glasses at a minimum. In addition, face shields and hearing protection may be required.

1.3 Hand Tools

GEI does not issue or permit the use of unsafe hand tools.

1.3.1 Power-operated Hand Tools

1.3.1.1 Electric power-operated

Electric power operated tools will either be double-insulated type or grounded according to Occupational Safety and Health Administration (OSHA) regulations.

1.3.1.2 Pneumatic Power Tools

Pneumatic power tools will be properly maintained and operated according to the manufacturer's safe operating procedures.

1.3.1.3 Fuel Powered Tools

Fuel powered tools will be stopped while being refueled, serviced, or maintained, and fuel will be transported, handled, and stored in accordance with federal regulations.

1.3.1.4 Hydraulic Power Tools

The fluid used in hydraulic powered tools will be fire-resistant and approved under Schedule 30 of the U.S. Bureau of Mines, Department of the Interior, and will retain its operating characteristics at the most extreme temperatures to which it will be exposed.

1.3.1.5 Powder-actuated Tools

Only employees who have been trained in the operation of the particular tool in use will be allowed to operate a power-actuated tool.

1.3.2 Abrasive Wheels and Tools

1.3.2.1 Power

Grinding machines will be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operations.

1.3.2.2 Guarding

Grinding machines will be equipped with safety guards in conformance with the requirements of the American National Standards Institute (ANSI) B7.1-1970.

1.3.3 Woodworking Tools

1.3.3.1 Disconnect Switches

Fixed power driven woodworking tools will be provided with a disconnect switch that can either be locked or tagged in the off position.

1.3.3.2 Speeds

The operating speed will be etched or otherwise permanently marked on all circular saws over 20 inches in diameter or operating at over 10,000 peripheral feet per minute. Saws will not be operated at a speed other than that marked on the blade.

1.3.3.3 Self-feed

Automatic feeding devices will be installed on machines whenever the nature of the work will permit. Feeder attachments will have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points.

1.3.3.4 Guarding

Portable, power-driven circular saws will be equipped with guards above and below the base plate or shoe.

1.3.3.5 Personal Protective Equipment

Personal protective equipment will conform to OSHA and ANSI standards.

1.3.3.6 Other Requirements

Woodworking tools and machinery will meet other applicable requirements of ANSI 01.1-1961, Safety Code for Woodworking Machinery.

1.3.4 Jacks – Lever and Ratchet, Screw, and Hydraulic

1.3.4.1 General Requirements

The manufacturer's rated capacity will be legibly marked on all jacks and will not be exceeded. All jacks will have a positive stop to prevent over-travel.

1.3.4.2 Blocking

When the working area does not have a solid working surface and it is necessary to provide a firm foundation, the base of the jack will be blocked or cribbed.

1.3.4.3 Operation and Maintenance

Hydraulic jacks exposed to freezing temperatures will be supplied with adequate antifreeze liquid. Jacks will be properly lubricated at regular intervals. Jacks will be thoroughly inspected, if necessary, based upon the service conditions. Repair or replacement parts will be examined for possible defects. Jacks that are out of order will be tagged accordingly, and will not be used until repairs are made. Parts subjected to wear will be inspected on a regular basis and repaired or replaced as needed.

1.4 References

OSHA Standards for the Construction Industry, Subpart I

1.5 Contact

GEI Corporate Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Western Regional Health and Safety Officer

STANDARD OPERATING PROCEDURES

HS-007 General Safety Requirements

1.1 General Health and Safety Training

GEI requires all employees to complete Health and Safety Training on an annual basis. Project employees must have completed, at a minimum, GEI's General 4-Hour Health and Safety Training or when required, HAZWOPER training before beginning any on-site work. In addition, all field staff must be current in First Aid and CPR Training. Further Health and Safety training requirements can be found in Section 2 of the GEI Health and Safety Manual. In addition, all site-specific safety training will be completed before beginning work on each project site.

1.2 Tailgate Meetings

Health and Safety tailgate meetings will be conducted by the GEI Project Manager or site safety officer (SSO), and be recorded in the GEI field book or in the GEI briefing log. All GEI staff on site will sign the meeting log to indicate attendance.

1.3 Health and Safety Plans (HASP)

GEI projects must have a HASP before beginning any work. GEI HASP templates are located on the Health and Safety page on the GEI intranet. Specific requirements for HASPs are located in Section 7 of GEI's Health and Safety Manual. After the HASP has been completed, it must be sent to the Corporate Health and Safety Officer (CHSO) and the Regional Health and Safety Officer (RHSO) for review. All project employees must read the HASP and sign the signature page to document that they have read, understood, and will comply with the requirements of the HASP. The site-specific HASP must be kept on-site at all times.

1.4 Personal Protective Equipment (PPE)

Project-specific PPE will be identified in the HASP based on the hazards present during work tasks. All required PPE must be worn on the project site. More information regarding PPE is located in Section 6 of GEI's Health and Safety Manual.

1.5 Fire Protection and Prevention

The work site should be kept clear of flammable materials and debris. GEI field personnel should know where all fire extinguishers are located, and be familiar in the use of the extinguisher. Information on the correct use of a fire extinguisher is included in

GEI's general health and safety training. Call 911(or other number identified in the project HASP) in the event of a fire.

1.6 Accident/Incident Reporting

The following accident reporting procedures must be followed:

- Seek medical attention.
- Notify your supervisor.
- Notify CHSO and Human Resources (HR) within two hours of the accident/incident.
- Complete Accident Reporting Form (found on the Health and Safety page of the GEI Intranet) within **24 hours** and send to CHSO and HR. Refer to Section 8 of the GEI Health and Safety Manual for more information.

1.7 Near Miss Reporting

GEI employees will complete a near-miss reporting form if a hazardous or unsafe condition or near miss is observed. The near-miss reporting form is located on the Health and Safety page of the GEI Intranet. Refer to Section 8 of the GEI Health and Safety Manual for more information.

1.8 Housekeeping

Work areas, passages, and stairs will be kept clear of debris. All debris will be removed from the project site at regular intervals.

1.9 Illumination

Project sites will be illuminated either with natural or artificial illumination, in compliance with OSHA regulations.

1.10 Sanitation

Hand-washing is an essential form of protection from chemical and biological exposures and illness. GEI employees should wash their hands after performing work tasks and regularly throughout the day. If soap and water are not available, hand sanitizers and/or wipes should be used.

1.11 Machinery, Tools, Material, and Equipment

Machinery, tools, material, and equipment will be kept in good repair and will be inspected by a competent person. Any unsafe equipment will be identified as unsafe by

tagging or locking the controls to render them inoperable or will be physically removed from the site.

1.12 Vehicles

GEI's motor vehicles will be in good working order. Brakes, tires, head lights, and tail lights will be inspected prior to initial use and regularly during extended use by the vehicle operator. If a need for repair is discovered, the operator should contact the branch manager or their designee responsible for the scheduling of such repair to make arrangements for the repair. Each GEI-owned vehicle will have a fire extinguisher and first aid kit. Additional fire extinguishers and first aid kits are kept in each GEI office for use in personal or rental vehicles.

1.13 Heavy Equipment

GEI employees will keep a line of sight between them and heavy equipment operators. If a GEI employee needs to communicate with heavy equipment operators, they will use hand signals or direct communication with the operator. GEI employees should never operate or climb on heavy equipment. GEI employees should not approach heavy equipment while it is in operation. GEI personnel should not use cellular telephones when working near operating equipment. For more information regarding heavy equipment, refer to GEI's Heavy Equipment SOP.

1.14 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Western Regional Region Health and Safety Officer

STANDARD OPERATING PROCEDURE
HS-004 Driver Safety

1.1 Objective

GEI values the safety of its employees, both on and while traveling to and from worksites. Accordingly, GEI has implemented a Save Driving Program to encourage safe driving habits and promote the ongoing safety of our staff and the communities where we work. For more information, refer to the Operation of Vehicles section of GEI's Employee Handbook.

More than 41,000 people lose their lives in motor vehicle crashes each year and over two million more suffer disabling injuries. This standard operating procedure provides requirements and recommendations to minimize the potential risks while operating or riding in a motor vehicle.

1.2 General Requirements

GEI employees will adhere to the following requirements when operating a vehicle while conducting business on behalf of GEI. These requirements apply to GEI owned, rental, and personal vehicles used to conduct GEI business:

- Employees must maintain a valid and current driver's license.
- All employees using a personal vehicle for work-related travel must have proper insurance coverage that meets the requirements in the state in which they reside.
- Employees must wear their safety belt at all times while in a moving vehicle.
- Vehicle accidents will be reported within two hours of their occurrence to their supervisor and a written Accident Report form will be submitted within 24 hours.
- Vehicles will be properly maintained and safely operated.
- Employees will follow safe driving behaviors, which include limiting distractions such as manipulating radios or other equipment that may cause a distraction. Employees are not to exceed the posted speed limit and should always maintain a safe distance between other vehicles.
- When parking a vehicle at a job site, the employee should position the vehicle in a manner to reduce or eliminate the need to operate the vehicle in reverse. A safety cone will be placed at the rear of the vehicle after parking the vehicle and be removed prior to moving the vehicle. This procedure makes the employee aware of other vehicles, equipment, and structures within the backup radius of the vehicle.

When driving a rental vehicle or GEI vehicle that you are unfamiliar with orient yourself to the vehicle by:

- Walking around the vehicle.
- Becoming familiar with the size of the vehicle.
- Adjusting all mirrors (rear and side).
- Becoming familiar with dashboard and steering controls.
- Locating the turn signals, windshield wipers, lights, emergency flashers, and the heating, air conditioning, and defrost controls.

1.3 Driving Defensively

Driving defensively means not only taking responsibility for yourself and your actions but also keeping an eye on "the other guy." Good defensive drivers may be able to anticipate what the other driver will do next. GEI recommends the following guidelines to help reduce your risks on the road.

Do not start the engine without securing each passenger in the vehicle. Safety belts save thousands of lives each year!

- Remember that driving too fast or too slow can increase the likelihood of a collision.
- Be alert! If you notice that a car is straddling the center line, weaving, making wide turns, stopping abruptly or responding slowly to traffic signals, the driver may be impaired or using a cellular telephone.
- Avoid an impaired driver by turning right at the nearest corner or exiting at the nearest exit. If it appears that an oncoming car is crossing into your lane, pull over to the roadside, sound the horn and flash your lights.
- Notify the police immediately after seeing a motorist who is driving suspiciously.
- Follow the rules of the road. Do not contest the "right of way" or try to race another car during a merge. Be respectful of other motorists.
- Do not follow too closely. GEI employees should use a "three-second following distance" or a "three-second plus following distance."
- While driving be cautious, aware, and responsible.

1.4 Cellular Phone Use and Other Distractions

Refer to the HR policy on use of cellular telephones while operating a vehicle on company business.

1.5 Drugs and Alcohol

The use of drugs or alcohol is prohibited when driving any vehicle on GEI business. Alcohol is a factor in almost half of all fatal motor vehicle crashes.

1.6 Adverse Driving Conditions

1.6.1 Driving at Night

Traffic death rates are three times greater at night than during the day. Driving at night is more of a challenge than many people think and is also more dangerous. Why is night driving so dangerous? One obvious answer is the darkness. Ninety percent of a driver's reaction depends on vision, and vision is severely limited at night. Depth perception, color recognition, and peripheral vision are all compromised after sundown.

Another factor adding danger to night or early morning driving is fatigue. Drowsiness makes driving more difficult by dulling concentration and slowing reaction time.

Fortunately, there are effective measures to minimize these after-dark dangers by preparing your car and following special guidelines while you drive. They include:

- Have your headlights properly aimed. Misaimed headlights blind other drivers and reduce your ability to see the road.
- Do not drink and drive. Alcohol severely impairs your driving ability and acts as a depressant. Just one drink can induce fatigue.
- Avoid smoking when you drive. Smoke's nicotine and carbon monoxide hamper night vision.
- If there is any doubt, turn your headlights on. Lights will not help you see better in early twilight, but they will make it easier for other drivers to see you. Being seen is as important as seeing.
- Do not overdrive your headlights. You should be able to stop inside the illuminated area. If you do not, you create a blind crash area in front of your vehicle.
- If an oncoming vehicle does not lower beams from high to low, avoid glare by watching the right edge of the road and using it as a steering guide.
- Make frequent stops for light snacks and exercise. If you are too tired to drive, stop and get some rest.

Observe night driving safety as soon as the sun goes down. ***Twilight is one of the most difficult times to drive, because your eyes are constantly changing to adapt to the growing darkness!***

1.6.2 Snow/Freezing Conditions

Sometimes, it is impossible to avoid driving in wintry weather conditions. When snow and ice are present, be prepared by following these winter driving safety tips.

1.6.2.1 Prepare the Vehicle Before a Snowstorm

- Check under the hood and take a look at the vehicles cooling system. Make sure the vehicle contains adequate antifreeze and the hoses are in good condition.

- Test heaters and defrosters ahead of time to make sure they are in good working condition.
- Test your windshield wipers and check the condition of your wiper blades. If wipers leave streaks on your windshields, replace the blades.
- It is recommended that a washer/antifreeze solution is used during winter conditions.
- Check all your lights and periodically clear them of snow and dirt.
- Car batteries need extra power in cold conditions. Make sure the battery's terminals are clean and cables are secure.
- Fill up. Keep your gas tank at least half full in the winter to help avoid gas line freeze up.

1.6.2.2 Driving During and After a Snowstorm

- Wear sunglasses. You might want to keep a pair in the car just in case the sun is reflecting off the snow.
- Be aware of blind spots created by snow banks.
- Be extra cautious of pedestrians and other vehicles in intersections.
- Allow extra time for braking and increase the distance between you and the car ahead of you.
- Reduce your speed and do not exceed the posted limit.
- If you start to lose traction, do not panic. Take your foot off the gas and gradually reduce your speed. Accelerate slowly once you feel traction is regained.
- If you start to skid, steer in the direction of the skid. Remember, steering can be more important than braking on slippery roads.

1.6.3 Driving In the Rain

Losing control of your car on wet pavement is a frightening experience. Unfortunately, it can happen unless you take preventive measures.

- You can prevent skids by driving slowly and carefully, especially on curves.
- Steer and brake with a light touch.
- When you need to stop or slow, do not brake hard or lock the wheels and risk a skid.
- Maintain mild pressure on the brake pedal.

If you do find yourself in a skid, remain calm, ease your foot off the gas, and carefully steer in the direction you want the front of the car to go. For cars without anti-lock brakes, avoid using your brakes. This procedure, known as "steering into the skid," will bring the back end of your car in line with the front. If your car has ABS, brake firmly as you "steer into the skid."

While skids on wet pavement may be frightening, hydroplaning can be even worse. Hydroplaning happens when the water in front of your tires builds up faster than your car's weight can push it out of the way. The water pressure causes your car to rise up and slide on a thin layer of water between your tires and the road. At this point, your car can be completely out of contact with the road, and you are in danger of skidding or drifting out of your lane, or even off the road.

To avoid hydroplaning, keep the tires properly inflated and maintain good tread on the tires. If tires need to be replaced, notify the branch manager or their designee. Slow down when roads are wet, and stay away from puddles. Try to drive in the tire tracks left by the cars in front of you. If you find yourself hydroplaning, do not brake or turn suddenly. This could throw your car into a skid. Ease your foot off the gas until the car slows and you can feel the road again. If you need to brake, do it gently with light pumping actions. If your car has anti-lock brakes, then brake normally; the car's computer will mimic a pumping action, when necessary.

A defensive driver adjusts his or her speed to the wet road conditions in time to avoid having to use any of these measures.

1.6.4 Off Road

If operation of a vehicle is required off publicly or privately maintained roads or in situations where four-wheel-drive vehicles are required, the appropriate vehicle for the situation will be used. Operators of vehicles being used in these situations will be trained on the use and limitations of the vehicle while operating in off-road situations.

1.7 Driver Training

All GEI employees are required to complete the on-line Driver Training modules. Employees will complete the quiz at the end of each module and forward the training certificate to the Regional Health and Safety Officer.

1.8 Sources

National Safety Council
Oklahoma Safety Council
GEI Consultants, Inc. Employee Handbook

1.9 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Western Regional Region Health and Safety Officer

STANDARD OPERATING PROCEDURES
SOP NO. HS-003 Container Management

1.1 Objective

This SOP has been developed to minimize the potential for injuries to GEI employees performing container and drum handling and sampling, through proper use of engineering and administrative controls and education.

1.2 General

Hazardous substances and contaminated liquids and other residues will be handled, transported, labeled, and disposed of in accordance with this paragraph. Drums and containers will meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.

Site operations will be organized to minimize the amount of drum or container movement. Prior to movement of drums or containers, all employees exposed to the transfer operation will be notified of the potential hazards associated with the contents of the drums or containers. Unlabeled drums and containers will be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent will be kept available and used in areas where spills, leaks, or ruptures may occur. Where spills may occur, a spill containment program, which may be part of the health and safety plan, will be implemented to contain and isolate the entire volume of the hazardous substance being transferred. Fire extinguishing equipment meeting the requirements of 29 CFR Part 1910, Subpart L, will be on hand and ready for use to control incipient fires.

1.3 Opening Drums and Containers

The following procedures will be followed in areas where drums or containers are being opened:

- Employees not actually involved in opening drums or containers will be kept a safe distance from the drums or containers being opened.

- If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation will be placed between the employee and the drums or containers being opened to protect the employee in case of accidental release.

- GEI employees will not handle or attempt to open bulging containers. Employees will not stand upon or work from drums or containers. GEI will contract with a hazardous waste company to handle, manage, and dispose of a bulging drum.

1.4 Material Handling Equipment

Material handling equipment used to transfer drums and containers will be selected, positioned, and operated to minimize sources of ignition.

1.5 Radioactive Wastes

GEI does not routinely handle or manage radioactive waste. If required to do so for a project, procedures will be approved by the Corporate Health and Safety Officer (CHSO) and Regional Health and Safety Officer (RHSO).

1.6 Shock-sensitive Wastes

GEI employees will not handle shock-sensitive waste. Shock-sensitive waste or chemicals may explode with friction, movement or heat. Some chemicals are shock-sensitive by nature, others become shock-sensitive through drying, decomposition, or slow reactions with oxygen, nitrogen, or the container. Some chemicals that are, or can, become shock-sensitive will have that hazard noted in the MSDS.

- Drums and containers containing packaged laboratory wastes will be considered to contain shock-sensitive or explosive materials until they have been characterized. *Caution: Shipping of shock-sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Shippers will refer to 49 CFR 173.21 and 173.50.*

1.7 Laboratory Waste Packs

GEI employees will not handle or open laboratory waste packs.

1.8 Sampling of Drum and Container Contents

Sampling of containers and drums will be done in accordance with a site-specific sampling plan that will be developed in conjunction with a site-specific health and safety plan.

1.9 Shipping and Transport

Drums and containers will be identified and classified prior to packaging for shipment. Drum or container staging areas will be kept to a minimum number as approved by the client to safely identify and classify materials and prepare them for transport. Staging areas will be provided with adequate access and egress routes. Bulking of hazardous

wastes will be permitted only after a thorough characterization of the materials has been completed and approved by the Client.

1.10 Tank and Vault Procedures

GEI employees do not routinely sample vaults and tanks. Entry procedures will be coordinated and approved by the CHSO and RHSO.

1.11 Limitations

None

1.12 References

OSHA 1910.120 Hazardous Waste Operations and Emergency Response (j) Handling of Drums and Containers.

1.13 Attachments

GEI – Weekly Facility/Hazardous Waste Inspection Checklist.

1.14 Contact

GEI Corporate Health and Safety Officer
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STANDARD OPERATING PROCEDURE
HS-004 Driver Safety

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- Adjusting all mirrors (rear and side).
- Becoming familiar with dashboard and steering controls.
- Locating the turn signals, windshield wipers, lights, emergency flashers, and the heating, air conditioning, and defrost controls.

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Do not start the engine without securing each passenger in the vehicle. Safety belts save thousands of lives each year!

- Remember that driving too fast or too slow can increase the likelihood of a collision.
- Be alert! If you notice that a car is straddling the center line, weaving, making wide turns, stopping abruptly or responding slowly to traffic signals, the driver may be impaired or using a cellular telephone.
- Avoid an impaired driver by turning right at the nearest corner or exiting at the nearest exit. If it appears that an oncoming car is crossing into your lane, pull over to the roadside, sound the horn and flash your lights.
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- Follow the rules of the road. Do not contest the "right of way" or try to race another car during a merge. Be respectful of other motorists.
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1.4 Cellular Phone Use and Other Distractions

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1.5 Drugs and Alcohol

The use of drugs or alcohol is prohibited when driving any vehicle on GEI business. Alcohol is a factor in almost half of all fatal motor vehicle crashes.

1.6 Adverse Driving Conditions

1.6.1 Driving at Night

Traffic death rates are three times greater at night than during the day. Driving at night is more of a challenge than many people think and is also more dangerous. Why is night driving so dangerous? One obvious answer is the darkness. Ninety percent of a driver's reaction depends on vision, and vision is severely limited at night. Depth perception, color recognition, and peripheral vision are all compromised after sundown.

Another factor adding danger to night or early morning driving is fatigue. Drowsiness makes driving more difficult by dulling concentration and slowing reaction time.

Fortunately, there are effective measures to minimize these after-dark dangers by preparing your car and following special guidelines while you drive. They include:

- Have your headlights properly aimed. Misaimed headlights blind other drivers and reduce your ability to see the road.
- Do not drink and drive. Alcohol severely impairs your driving ability and acts as a depressant. Just one drink can induce fatigue.
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1.6.2 Snow/Freezing Conditions

Sometimes, it is impossible to avoid driving in wintry weather conditions. When snow and ice are present, be prepared by following these winter driving safety tips.

1.6.2.1 Prepare the Vehicle Before a Snowstorm

- Check under the hood and take a look at the vehicles cooling system. Make sure the vehicle contains adequate antifreeze and the hoses are in good condition.

- Test heaters and defrosters ahead of time to make sure they are in good working condition.
- Test your windshield wipers and check the condition of your wiper blades. If wipers leave streaks on your windshields, replace the blades.
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- Fill up. Keep your gas tank at least half full in the winter to help avoid gas line freeze up.

1.6.2.2 Driving During and After a Snowstorm

- Wear sunglasses. You might want to keep a pair in the car just in case the sun is reflecting off the snow.
- Be aware of blind spots created by snow banks.
- Be extra cautious of pedestrians and other vehicles in intersections.
- Allow extra time for braking and increase the distance between you and the car ahead of you.
- Reduce your speed and do not exceed the posted limit.
- If you start to lose traction, do not panic. Take your foot off the gas and gradually reduce your speed. Accelerate slowly once you feel traction is regained.
- If you start to skid, steer in the direction of the skid. Remember, steering can be more important than braking on slippery roads.

1.6.3 Driving In the Rain

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- Maintain mild pressure on the brake pedal.

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1.7 Driver Training

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1.8 Sources

National Safety Council
Oklahoma Safety Council
GEI Consultants, Inc. Employee Handbook

1.9 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Western Regional Region Health and Safety Officer

STANDARD OPERATING PROCEDURES

HS-007 General Safety Requirements

1.1 General Health and Safety Training

GEI requires all employees to complete Health and Safety Training on an annual basis. Project employees must have completed, at a minimum, GEI's General 4-Hour Health and Safety Training or when required, HAZWOPER training before beginning any on-site work. In addition, all field staff must be current in First Aid and CPR Training. Further Health and Safety training requirements can be found in Section 2 of the GEI Health and Safety Manual. In addition, all site-specific safety training will be completed before beginning work on each project site.

1.2 Tailgate Meetings

Health and Safety tailgate meetings will be conducted by the GEI Project Manager or site safety officer (SSO), and be recorded in the GEI field book or in the GEI briefing log. All GEI staff on site will sign the meeting log to indicate attendance.

1.3 Health and Safety Plans (HASP)

GEI projects must have a HASP before beginning any work. GEI HASP templates are located on the Health and Safety page on the GEI intranet. Specific requirements for HASPs are located in Section 7 of GEI's Health and Safety Manual. After the HASP has been completed, it must be sent to the Corporate Health and Safety Officer (CHSO) and the Regional Health and Safety Officer (RHSO) for review. All project employees must read the HASP and sign the signature page to document that they have read, understood, and will comply with the requirements of the HASP. The site-specific HASP must be kept on-site at all times.

1.4 Personal Protective Equipment (PPE)

Project-specific PPE will be identified in the HASP based on the hazards present during work tasks. All required PPE must be worn on the project site. More information regarding PPE is located in Section 6 of GEI's Health and Safety Manual.

1.5 Fire Protection and Prevention

The work site should be kept clear of flammable materials and debris. GEI field personnel should know where all fire extinguishers are located, and be familiar in the use of the extinguisher. Information on the correct use of a fire extinguisher is included in

GEI's general health and safety training. Call 911(or other number identified in the project HASP) in the event of a fire.

1.6 Accident/Incident Reporting

The following accident reporting procedures must be followed:

- Seek medical attention.
- Notify your supervisor.
- Notify CHSO and Human Resources (HR) within two hours of the accident/incident.
- Complete Accident Reporting Form (found on the Health and Safety page of the GEI Intranet) within **24 hours** and send to CHSO and HR. Refer to Section 8 of the GEI Health and Safety Manual for more information.

1.7 Near Miss Reporting

GEI employees will complete a near-miss reporting form if a hazardous or unsafe condition or near miss is observed. The near-miss reporting form is located on the Health and Safety page of the GEI Intranet. Refer to Section 8 of the GEI Health and Safety Manual for more information.

1.8 Housekeeping

Work areas, passages, and stairs will be kept clear of debris. All debris will be removed from the project site at regular intervals.

1.9 Illumination

Project sites will be illuminated either with natural or artificial illumination, in compliance with OSHA regulations.

1.10 Sanitation

Hand-washing is an essential form of protection from chemical and biological exposures and illness. GEI employees should wash their hands after performing work tasks and regularly throughout the day. If soap and water are not available, hand sanitizers and/or wipes should be used.

1.11 Machinery, Tools, Material, and Equipment

Machinery, tools, material, and equipment will be kept in good repair and will be inspected by a competent person. Any unsafe equipment will be identified as unsafe by

tagging or locking the controls to render them inoperable or will be physically removed from the site.

1.12 Vehicles

GEI's motor vehicles will be in good working order. Brakes, tires, head lights, and tail lights will be inspected prior to initial use and regularly during extended use by the vehicle operator. If a need for repair is discovered, the operator should contact the branch manager or their designee responsible for the scheduling of such repair to make arrangements for the repair. Each GEI-owned vehicle will have a fire extinguisher and first aid kit. Additional fire extinguishers and first aid kits are kept in each GEI office for use in personal or rental vehicles.

1.13 Heavy Equipment

GEI employees will keep a line of sight between them and heavy equipment operators. If a GEI employee needs to communicate with heavy equipment operators, they will use hand signals or direct communication with the operator. GEI employees should never operate or climb on heavy equipment. GEI employees should not approach heavy equipment while it is in operation. GEI personnel should not use cellular telephones when working near operating equipment. For more information regarding heavy equipment, refer to GEI's Heavy Equipment SOP.

1.14 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Western Regional Region Health and Safety Officer

STANDARD OPERATING PROCEDURES

SOP No. HS-008 Hand and Power Tools

1.1 Objective

The purpose of this SOP is to minimize the potential for injuries to GEI employees when using hand and power tools.

1.2 General Requirements

1.2.1 Condition of Tools

All hand and power tools and similar equipment, whether furnished by GEI or the employee, will be maintained in a safe condition.

1.2.2 Guarding

When power tools are designed to accommodate guards, they will be equipped with such guards prior to, and at all times during, use. All guards will be in good condition and be adequate to provide protection to the employee.

1.2.3 Personal Protective Equipment

Employees using hand or power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects will be provided with the personal protective equipment (PPE) necessary to protect them from the hazard. All employees will wear work gloves and safety glasses at a minimum. In addition, face shields and hearing protection may be required.

1.3 Hand Tools

GEI does not issue or permit the use of unsafe hand tools.

1.3.1 Power-operated Hand Tools

1.3.1.1 Electric power-operated

Electric power operated tools will either be double-insulated type or grounded according to Occupational Safety and Health Administration (OSHA) regulations.

1.3.1.2 Pneumatic Power Tools

Pneumatic power tools will be properly maintained and operated according to the manufacturer's safe operating procedures.

1.3.1.3 Fuel Powered Tools

Fuel powered tools will be stopped while being refueled, serviced, or maintained, and fuel will be transported, handled, and stored in accordance with federal regulations.

1.3.1.4 Hydraulic Power Tools

The fluid used in hydraulic powered tools will be fire-resistant and approved under Schedule 30 of the U.S. Bureau of Mines, Department of the Interior, and will retain its operating characteristics at the most extreme temperatures to which it will be exposed.

1.3.1.5 Powder-actuated Tools

Only employees who have been trained in the operation of the particular tool in use will be allowed to operate a power-actuated tool.

1.3.2 Abrasive Wheels and Tools

1.3.2.1 Power

Grinding machines will be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operations.

1.3.2.2 Guarding

Grinding machines will be equipped with safety guards in conformance with the requirements of the American National Standards Institute (ANSI) B7.1-1970.

1.3.3 Woodworking Tools

1.3.3.1 Disconnect Switches

Fixed power driven woodworking tools will be provided with a disconnect switch that can either be locked or tagged in the off position.

1.3.3.2 Speeds

The operating speed will be etched or otherwise permanently marked on all circular saws over 20 inches in diameter or operating at over 10,000 peripheral feet per minute. Saws will not be operated at a speed other than that marked on the blade.

1.3.3.3 Self-feed

Automatic feeding devices will be installed on machines whenever the nature of the work will permit. Feeder attachments will have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points.

1.3.3.4 Guarding

Portable, power-driven circular saws will be equipped with guards above and below the base plate or shoe.

1.3.3.5 Personal Protective Equipment

Personal protective equipment will conform to OSHA and ANSI standards.

1.3.3.6 Other Requirements

Woodworking tools and machinery will meet other applicable requirements of ANSI 01.1-1961, Safety Code for Woodworking Machinery.

1.3.4 Jacks – Lever and Ratchet, Screw, and Hydraulic

1.3.4.1 General Requirements

The manufacturer's rated capacity will be legibly marked on all jacks and will not be exceeded. All jacks will have a positive stop to prevent over-travel.

1.3.4.2 Blocking

When the working area does not have a solid working surface and it is necessary to provide a firm foundation, the base of the jack will be blocked or cribbed.

1.3.4.3 Operation and Maintenance

Hydraulic jacks exposed to freezing temperatures will be supplied with adequate antifreeze liquid. Jacks will be properly lubricated at regular intervals. Jacks will be thoroughly inspected, if necessary, based upon the service conditions. Repair or replacement parts will be examined for possible defects. Jacks that are out of order will be tagged accordingly, and will not be used until repairs are made. Parts subjected to wear will be inspected on a regular basis and repaired or replaced as needed.

1.4 References

OSHA Standards for the Construction Industry, Subpart I

1.5 Contact

GEI Corporate Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Western Regional Health and Safety Officer

STANDARD OPERATING PROCEDURES

SOP NO. HS-009 Hazard Identification and Management

1.1 Objective

The purpose of this SOP is to outline the steps GEI personnel will take to identify potential hazards on site, the risks associated with these hazards, and the proper engineering controls, work practices, and personal protective equipment (PPE) to use to minimize the associated risks.

1.2 Hazard Identification

An initial identification of hazards should be done based on a review of available documents, including lists of chemicals used on site, analytical data from soil, surface water, groundwater, air, spill history, site history, equipment on site, maps, photos, and a preliminary survey.

1.3 Risk Identification

Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances will be identified. GEI employees and GEI subcontractors who will be working on the site will be informed of any risks that have been identified.

Risks to consider include, but are not limited to:

- Potential exposures exceeding the permissible exposure limits and published exposure levels.
- Potential Immediately to Life and Health (IDLH) Concentrations.
- Potential Skin Absorption and Irritation Sources.
- Potential Eye Irritation Sources.
- Potential hazardous atmospheres, including oxygen deficiency and fire and explosion hazards.

1.4 Engineering Controls, Work Practices, and Personal Protective Equipment for Employee Protection

Engineering controls, work practices, and PPE for substances regulated in OSHA Subpart Z (Toxic and Hazardous Substances) will be implemented in accordance with this section to protect employees from exposure to hazardous substances and safety and health hazards.

1.4.1 Engineering Controls, Work Practices, and Personal Protective Equipment for Substances Regulated in Subparts G (Occupational Health and Environment Control) and Subpart Z (Toxic and Hazardous Substances)

Engineering controls and work practices will be instituted to reduce and maintain employee exposure at or below the permissible exposure limits for substances regulated by 29 CFR Part 1910, to the extent required by Subpart Z, except to the extent that such controls and practices are not feasible.

Engineering controls that may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices that may be feasible include removing all non-essential employees from potential exposure during opening of drums, wetting down dusty operations, and locating employees upwind of possible hazards.

If engineering controls and work practices are not feasible, or not required, any reasonable combination of engineering controls, work practices, and PPE will be used to reduce and maintain at or below the permissible exposure limits or dose limits for substances regulated by 29 CFR Part 1910, Subpart Z.

GEI will not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

The provisions of 29 CFR, subpart G, Occupational Health and Environment control, will be followed.

1.4.2 Engineering Controls, Work Practices, and Personal Protective Equipment for Substances Not Regulated in Subparts G and Subparts Z

An appropriate combination of engineering controls, work practices, and personal protective equipment will be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Subparts Z. GEI will use published literature and MSDS' as a guide in making the determination of what level of protection is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

1.4.3 Decontamination Procedure

Decontamination procedure(s) will be developed, communicated to employees, and implemented before any employees or equipment enter areas on site where potential for exposure to hazardous substances exists. Procedures will be developed to minimize

employee contact with hazardous substances or with equipment that has contacted hazardous substances.

All GEI employees leaving a contaminated area will be properly decontaminated; all contaminated clothing and equipment leaving a contaminated area will be properly disposed of or decontaminated.

Decontamination procedures will be monitored by the site safety officer to determine their effectiveness. When such procedures are found to be ineffective, the site safety officer will contact the CHSO and appropriate steps will be taken to correct any deficiencies.

1.4.3.1 Location

Decontamination will be performed in geographical areas that will minimize the exposure to employees, equipment, and the environment.

1.4.3.2 Equipment and Solvents

All equipment and solvents used for decontamination will be decontaminated or disposed of properly.

1.4.3.3 Personal Protective Clothing and Equipment

Protective clothing and equipment will be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

Employees whose clothing becomes wetted with hazardous substances will immediately remove that clothing and proceed to shower. The clothing will be disposed of or decontaminated before it is removed from the work zone.

1.4.3.4 Commercial Laundries or Cleaning Establishments

Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment will be informed of the potentially harmful effects of exposures to hazardous substances.

1.4.3.5 Showers and Changing Rooms

Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they will be provided and meet the requirements of 29 CFR 1910.141 (Sanitation). If temperature conditions prevent the effective use of water, then other effective means for cleansing will be provided and used.

1.5 Limitations

None

1.6 References

OSHA 1910.120 Hazardous Waste Operations and Emergency Response
OSHA 1910 Subpart G Occupational Health and Environment Control
OSHA 1910 Subpart Z Toxic and Hazardous Substances
OSHA 1910.141 General Environmental Controls - Sanitation

1.7 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Western Regional Region Health and Safety Officer

STANDARD OPERATING PROCEDURES
SOP No. HS-010 Inclement Weather

1.1 Objective

Inclement weather can affect work activities and pose safety hazards to employees working in these conditions. The following guidelines will be followed when weather conditions become a safety concern.

1.2 Execution

All employees will be aware of local weather conditions and monitor any advisories issued by the National Weather Service and other local reporting services. Depending on location and season, storms are capable of producing heavy rain, floods, extreme temperatures, high wind conditions, lighting, tornados, and/or snowfall.

1.2.1 Heavy Rain

If working or driving in a storm use extreme caution and turn your lights on when the rainfall becomes heavy. Employees should be aware of the following:

- Heavy rain causes visibility issues, especially when driving.
- Surfaces and tools become slippery.
- If you are working in the rain and your clothes become wet there is a risk of hypothermia when exposed to winds, even in warm temperatures.
- If the storms are going to produce thunder and/or lightning, leave the work area immediately and move to a safe area.
- Use your best judgment to determine if the rainfall becomes too heavy to continue working safely.

1.2.2 Lightning

Lightning can strike as far as 10 miles from the area where it is raining. That's about the distance you can hear thunder. **If you can hear thunder, you are within striking distance. Seek safe shelter immediately.** This can be within a building or vehicle. Wait 30 minutes after the last clap of thunder or flash of lightning before going outside again.

1.2.3 Flooding

Flooding may occur as a result of heavy rain in a short period of time. Flooding can be particularly acute in canyon areas where dry creek beds can turn into raging rivers from rainfall in distant or higher elevation areas. Be aware of this and your surroundings and move to a safe place if you begin to see any signs that flooding may occur. Do not

attempt to drive through areas or streets that are flooded. Seek alternate routes. Be particularly cautious at night when flooded areas are difficult to see. Urban flooding can stop traffic and increase the potential for traffic accidents and being trapped in vehicles.

1.2.4 Extreme Temperatures

Work activities may take place in extreme heat or cold. Be prepared if these conditions are anticipated. Have the correct personal protective equipment (PPE) available, exercise proper fluid intake, and take breaks to complete work and prevent heat and cold stress. For more information about these conditions see the heat stress and cold stress programs found in GEI's Health and Safety Manual.

1.2.5 High Wind and Tornados

Tropical storms are described as storms with sustained winds ranging from 39 to 73 miles per hour (mph) and hurricanes produce sustained winds that exceed 74 mph. When winds approach 40 mph (gale force winds) twigs begin to break off of trees and vehicles will veer off of the road. When winds approach **40 mph** or the GEI employee feels unsafe based on the activities being performed, work is to be stopped and you should seek shelter as soon as possible. Blowing or falling debris and overhanging limbs/signs can be a significant hazard. Avoid driving in these conditions; 70 percent of injuries during hurricanes are a result of vehicle accidents. Note that tall or elevated equipment will have manufacturer's safe operating wind speeds defined that could be less than 40 mph, the operator's manual should be consulted prior to operation of the equipment.

A tornado is a violent, dangerous, rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. Based on the Fujita Scale or F-Scale Numbers begin at F0: 40-72 mph and go to F6: 319-379 mph (F6 is generally theoretical). Nearly three-fourths of all tornados are on the weak F0-F1 scale with just over two-thirds of deaths resulting from the violent F4-F5 tornados. All tornado wind speeds exceed the 40 mph stop work speed, shelter should be taken immediately if a tornado is seen. If a tornado siren is sounded move immediately to safety indoors and then move to a windowless interior space, basement, stair well etc., or designated fall-out shelter if available. Windows should not be opened before an oncoming tornado, keep the building envelope closed to the extent possible. If there is no shelter available seat belt yourself into your stationary vehicle or seek a depression or low spot on the land surface.

1.2.6 Snowfall and Ice Conditions

Working in the winter months will result in activities taking place during periods of snowfall or icy conditions. If you are working during or after snow has fallen, dress appropriately for the conditions. Snow and ice can cause working surfaces to become

slippery; clear snow and ice from all work areas to prevent slip hazards. Use caution when performing any snow or ice removal activities to prevent injuries. Driving in snowy and icy conditions is also hazardous. Reduce speed and use caution if you must drive in these conditions.

If the weather conditions deteriorate and you do not feel safe working in these conditions, stop work, move to a safe indoor location, and contact your Project Manager to let them know the weather and work status and your location.

1.3 Limitations

- Follow safety procedures as defined in the site-specific health and safety plan (HASP) at all times.
- Protection from working in extreme weather conditions can best be accomplished if the conditions are anticipated. Monitor local weather conditions prior to starting work.

1.4 References

Center for Disease Control and Prevention – Natural Disasters and Severe Weather
http://www.bt.cdc.gov/disasters/
National Lightning Safety Institute
NOAA, National Weather Service
Office of Climate, Water, and Weather Services

1.5 Attachment

None

1.6 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
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GEI Western Regional Region Health and Safety Officer

STANDARD OPERATING PROCEDURES
HS-017 Water Safety

1.1 Objective

The purpose of this SOP is to ensure the safe deployment and return of GEI personnel during field activities while aboard a boat or when working near water.

1.2 Execution

Boat safety practices will be conducted in general accordance with guidance provided in the United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM) 385-1-1. Personnel will board the boat at specified locations to be determined and agreed upon prior to field deployment. The following safety practices will be adhered to:

- Boats operated by GEI will comply with Coast Guard regulations.
- Every GEI employee will wear a Type III Personal Flotation Device (PFDs) at all times when aboard any boat except when that boat is equipped with a fully enclosed cabin and the employee is inside. Boats must also, at a minimum, have Coast Guard approved PFDs on board for each person and at least one throwable flotation device, such as a seat cushion.
- For every boating activity, a trip plan must be communicated to someone in a position to take appropriate action when the GEI employee is overdue.
- For every trip requiring more than one day, daily communications with an appropriate base must be maintained.
- The consumption of alcoholic beverages and the use of illegal drugs will not be permitted at any time aboard boats on which GEI employees are present.
- All employees working on a boat will monitor the weather, incorporating, as appropriate, National Oceanic and Atmospheric Administration (NOAA) marine weather broadcasts and other local commercial weather forecasting services as may be available.
- For retrieving a person overboard, the boat operator will throw a life ring and line, and use a ladder attached to the boat or the boat step transom to allow the person to climb out of the water. The boat will be equipped with an ABC rated fire extinguisher(s) and a life ring attached to approximately 90 feet of rope.
- Emergency procedures for fire, person overboard, and capsizing will be reviewed on the first day of operations and any time a change of personnel occurs.

1.3 Working Near Water

OSHA Construction Industry Standards (1926) state: "employees working over or near water, **where the danger of drowning exists**, will be provided a Coast Guard-approved PFD." OSHA General Industry Standards (1910) do not address working over or near water. Therefore, GEI uses the OSHA Construction Standard for all employees and all tasks to ensure protection in all operations. A site-specific health and safety plan (HASP) is required to be completed and signed by all GEI employees that may be working over or near water before the work may begin.

The following procedures and safety devices will be provided for and used by employees at locations where the danger of drowning exists and when employees are not protected by passive fall protection systems such as railings, nets, safety belts, or other applicable provisions:

- **Personal Flotation Devices (PFD).** Employees will be required to wear U. S. Coast Guard approved personal flotation devices that are marked or labeled Type I PFD, Type II PFD, or Type III PFD, or a U.S. Coast Guard approved Type V PFD that is marked or labeled for use as a work vest for commercial use or for use on vessels. GEI employees will inspect buoyant work vests or life preservers for defects that could alter their strength or buoyancy prior to, and after, each use. Defective units will not be used and will be marked as defective and properly disposed.

- **Ring Buoys.** U. S. Coast Guard approved 30-inch ring buoys with at least 150 feet of 600 pound capacity line will be readily available for emergency rescue operations. Distance between ring buoys will not exceed 150 feet.

These requirements can be superseded by the use of 100 percent fall protection. If an employee cannot fall into the water as a result of use of active or passive fall protection, there is no danger of drowning and a PFD is not required. For example, where an employee is working on a steep slope and could fall into water, a PFD is required.

1.4 Procedures

Safety lines that prevent employees from reaching the water eliminate the danger of drowning, and negate the need for a PFD. The same is true when working on a barge or floating platform with an approved railing system.

Employees working over or near water where the distance to the water is greater than the length of the lanyard (and by virtue of safety devices no danger of drowning exists), are not required to comply with requirements for working in proximity to water. If the distance between the water surface and the employee is less than the length of the lanyard and thus will allow entry into the water, the OSHA standard is relevant. Employees who exit the basket of the aerial lift to a location that is over or near water, (and the danger of drowning as a result of a fall exists), and do not maintain 100 percent fall protection,

must wear a PFD. When GEI employees are working over or adjacent to water, the client will provide at least one lifesaving skiff to be immediately available for potential rescue purposes.

Employees will not work alone, where practical, in situations where a drowning hazard exists.

1.5 Training

Training will be conducted for employees unfamiliar with the use of safety equipment and PPE required by this SOP. Employees working over or near water will be trained in their responsibilities and the safe work practices associated with working on or near water.

1.6 Limitations

None

1.7 References

United States Army Corps of Engineers, Safety and Health Requirements Manual (EM), 385-1-1.November 3, 2003 – Section 19 Floating Plant and Marine Activities

1.8 Attachments

None

1.9 Contact

GEI Corporate Health and Safety Officer
GEI Mid-West Regional Health and Safety Officer
GEI Atlantic Regional Health and Safety Officer
GEI New England Regional Health and Safety Officer
GEI Western Regional Region Health and Safety Officer

1.10 Revision Dates

November 2010
May 2011

Appendix F

GEI Confined Space Entry Program

Appendix B. Confined Space Entry Program

POLICY

The purpose of the GEI Consultants, Inc. program is to protect employees from potentially hazardous confined spaces at various locations. Entrance into an area identified as a confined space shall be in strict compliance with the following confined space entry program. The primary goal is to ensure employee health and safety during confined space work-related activities through use of the permit system.

The following procedures comply with the OSHA standard, 29 CFR 1910.146, Permit-required Confined Spaces.

PROGRAM ADMINISTRATION RESPONSIBILITIES

The GEI Corporate Health & Safety Officer (CHSO) will be responsible for all facets of this program and has support to make decisions to ensure the program's success. The CHSO will make recommendations based on changes in the field to update the confined space entry (CSE) policies/procedures and remain in compliance with the CSE program. This program will be reviewed annually by the Health and Safety Committee and be updated as needed. It is the Regional Managers' responsibility to ensure local compliance and implementation of this program.

The entry supervisor is responsible for enforcing proper entry. He/she will ensure proper entry procedures are followed at all times. Subcontractors assisting GEI personnel will comply with the Confined Space Entry Program and are responsible for completing their own training requirements per the standard. GEI Consultants, Inc. employees have the authority to halt any confined space operation when danger of personal injury exists or external danger exists.

If employees encounter a confined space where the GEI entry program potentially does not provide enough protection they will not enter the space. Project employees will contact the CHSO and Project Manager to discuss alternatives to entry. The Health and Safety Committee will review this program and update it as necessary. No GEI employee will enter a confined space. In addition, this program will be reviewed and updated, as necessary on an annual basis. Cancelled permits from the previous year will be used in the review process.

DEFINITIONS

> ***Attendant*** – means an individual stationed outside one or more the permit-required confined spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the confined space entry program.

Authorized entrant – means an employee who is authorized by the employer to enter a permit space.

Confined space – (As defined by the General Industry standard, 29 CFR 1910.146)

A space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit.
- Is not designed for continuous employee occupancy.

Engulfment - The surrounding and effective capture of a person by a liquid or solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

Entry – The action by which a person passes through an opening in a permit required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

Entry permit - A written document that contains specific information about the conditions of the space and how the work will be conducted.

Entry supervisor - The person responsible for determining if acceptable entry conditions are present, authorizing entry, overseeing entry operations, and terminating the permit.

Hazardous atmosphere – GEI has a more stringent definition of a hazardous atmosphere to include an atmosphere that may expose employees to the risk of death or incapacitation, impair the employee to self-rescue, or cause injury or acute illness from one or more of the following causes:

- Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).
- Airborne combustible dust at a concentration that meets or exceeds its LEL. *Note: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet or less.*
- Oxygen concentrations of less than 20.7% or greater than 21.1%.
- Hazardous substance concentrations greater than the published permissible exposure limit (PEL).

- Hazardous substance concentrations recognized as immediately dangerous to life and health (IDLH).

Line breaking – The intentional opening of a pipe, line or duct that is or has been carrying flammable, corrosive, toxic, inert gas or any fluid at a volume, pressure or temperature capable of causing injury.

Lockout/Tagout - The placement of lockout and tagout devices, on an energy isolating device.

Non-permit confined space - A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

Permit-required confined space - A **defined confined space** (see 3.3) that has **one or more** of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant (i.e. water).
- Has a configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or a floor which slopes and tapers to a small cross-section.
- Contains any other recognized serious safety or health hazard (i.e. fall potential).

HAZARD RECOGNITION

The Project Manager is responsible for conducting a hazard analysis at each work site to determine the presence and type of confined spaces.

ELEMENTS

Elements of the Confined Space Entry Program include permit required entry procedures, the permit, training and duties of authorized entrants, attendants, entry supervisors, and rescue/emergency procedures.

NON-PERMIT REQUIRED CONFINED SPACE ENTRY PROCEDURES

Activities in non-permit required confined spaces, such as welding, drilling, and the use of solvents or paints, can create hazardous atmospheres. GEI employees must recognize the inherent hazards created by work being conducted in these spaces and determine if the status of the space has the potential to be a permit-required confined space.

PERMIT-REQUIRED CONFINED SPACE ENTRY PROCEDURES

The following procedures are mandatory for entry into a "permit-required confined space" as defined in Section 3.11. The steps specifically outline acceptable and safe entry conditions. The steps include completing the applicable information in the permit found in Appendix A.

Physical Hazard Identification Checks

Assessment

Physical hazards may be mechanical equipment such as grinders, agitators, pumps, or loose debris such as wood, loose concrete, slag, or rusted manhole ladders; or may be slip, trip or fall hazards.

The Entry Supervisor will assess the space for physical hazards and assure that proper protective procedures have been completed and documented prior to entry.

Isolation

Isolation must be completed prior to entry. Isolation means the process by which a confined space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

Atmospheric Hazard Checks

Assessment

Atmospheric hazards such as oxygen deficiencies, explosive (flammable) gases or toxic vapors may exist in the confined space.

Four questions need to be asked to determine potential atmospheric hazards in the identified confined spaces:

- What was in the space?
- What is stored nearby?
- What could have formed in the space?
- What work is going to be done in the space?

The atmosphere of the space **must** be tested (without entering the space) with a direct reading instrument prior to confined space entry. The entry supervisor will do this testing. Even if continuous ventilation of the space is conducted air quality will be periodically tested. In addition GEI employees acting as the entrants will be given the opportunity to re-evaluate the space if there is reason to believe changes have occurred, or if they request additional monitoring. If the entrants request further monitoring of the space the entry supervisor will complete the requested testing. The entrants can also contact the CHSO to discuss any concerns about the entry.

It is mandatory to test the confined space by monitoring the atmosphere in the following order:

Test Oxygen Deficiencies

Oxygen in a confined space may be consumed by chemical reactions such as rusting. Certain gases also displace oxygen. For example, carbon dioxide, a by-product of fermentation, is commonly found in wastewater plants. Methane, a simple asphyxiant, is commonly found on landfill sites or where organic matter is decomposing either by process or in a trench. Both gases cause oxygen displacement.

No confined space will be entered if the oxygen level is below 20.7% or above 21.1%. See Section 7.2.2.

Check Explosive/Flammable Gases

Due to the potential for decomposing organic materials, explosive atmospheres may result from methane or hydrogen sulfide. In order for an explosion to occur, these vapors must be present within well-defined limits. The lowest concentration where there is sufficient vapor to cause an explosion is called the Lower Explosive Limit (LEL). The concentration above where there is too much vapor for an explosion to occur is called the Upper Explosive Limit (UEL). **Never enter a space containing more than 10% of the LEL.** This can be determined through use of a calibrated combustible gas indicator (CGI).

Keep in mind that if a substance like gasoline is the explosive hazard, the combustible gas indicator needs to be re-calibrated using a substance with a similar flammable range (LEL to UEL) or apply a correction factor or calibration curve supplied by the manufacturer of the instrument.

The LEL of many combustible gases is usually well above the concentration which may pose a health hazard. This means that although the meter may indicate less than 10% of the explosive level, a "toxic" atmosphere from the chemical may still exist.

If a combustible dust is present in the space a particulate meter must be used. If one is not available then the OSHA guideline of less than 5 feet visibility will be considered a flammable/explosive atmosphere.

Check Toxic Air Contaminants

Toxic vapors, gases or particulates may result from a substance in the space, or the breakdown of materials in the space. Testing for toxic materials in a confined

space must be done using direct reading instruments to verify the atmospheric contaminant **before entry**.

Levels of dust, fume, and vapor or gas must be below the Permissible Exposure Limits (PELs) established by OSHA for each toxic substance in the space if it is to be entered without respiratory protection. (In the absence of PELs, other published data, such as Threshold Limit Values [TLVs] may be used.)

Use the following instrumentation and procedures to compile accurate data prior to safe entry.

(a) Air Monitoring Equipment

-Multi-gas meter: Oxygen/CGI/Toxic sensors (using a hydrogen sulfide and carbon monoxide sensors)

-Detector tubes (designed for specific substances)

(Note: The Combustible Gas Indicator (CGI) is often referred to as a LEL meter)

(b) Air Monitoring Procedure

Prior to using the listed instruments, refer to the manufacturer's instructions and the company procedure manual. The multi-gas meter must be calibrated prior to each use and according to manufacturer's instructions. Document all calibration and test results to verify the actions taken during the confined space entry. Any equipment problems will be brought to the attention of the Entry Supervisor, and other appropriate personnel. Entrants and their representatives will be given to opportunity to 1) participate in monitoring of the confined space; and 2) review the results the calibrated air monitoring data. Any discrepancies will be discussed with the CSHO. GEI employees will not work in atmospheres that meet Immediately Dangerous to Life (IDLH) concentrations.

Remember that the space must first be tested for oxygen deficiency, then explosives or flammables, then toxic substances, if applicable. (As oxygen levels decrease so does the accuracy of the CGI meter.)

Air monitoring of the confined space will be done remotely, in the bottom third, middle third, and top third of the space. If descending into a stratified space, each atmospheric envelope should be from top to bottom and side to side. Dependent upon the meter's capabilities adequate time must be given at each level for proper characterization of the atmosphere. Additional tests will be completed depending on the size and shape of the space, the location of the work to be done, and the tasks to be performed. Record all testing results (including the time of testing) on the permit.

Protection Using Engineering Controls

Ventilation

Ventilation is the first step in making the confined space atmosphere safe. The two goals to reach when determining how to successfully ventilate a space are:

- To maintain an oxygen level of at least 20.7%.
- Keep the toxic gases and vapors below the PELs.
- To keep flammable gases and vapors below 10% of the LEL.

See Section 12 for use of forced air ventilation and only follow the alternate procedures in Section 12 if the space can be reclassified from permit required to non-permit required by following the guidelines for reclassification in Section 11.

Personal Protective Equipment

The environment and the planned activities in the confined space will dictate the necessary personal protective equipment (PPE). Required equipment will be listed on the permit.

Protective Equipment

- Protective hearing devices for noise levels exceeding 85dB.
- Communications equipment.
- Adequate lighting devices for working safely and to exit quickly if an emergency arises.
- Barriers and shields to keep external hazards away from confined space entry workers and unauthorized personnel away from the work site.
- Ladders for safe ingress and egress for authorized entrants.
- Miscellaneous equipment necessary for safe entry and rescue from permit spaces.

THE PERMIT

Entry into any area classified as a permit-required confined space must comply with procedures set forth for permit-required confined space entry in this document including completing the permit found in Appendix A. The permit itself is effective as long as the assigned task on the document is in progress. A new permit is required at the beginning of each assigned work shift. The entry permit is specific to the space being entered and must document the following information:

- Space to be entered.
- Permit number.
- Location of space.
- Purpose of entry.
- Date and duration of entry.
- Authorized entrants.
- Entry attendants.
- Entry supervisor.
- Hazards of the space.
- Measures to isolate the space (i.e. lockout/tagout).
- Acceptable entry conditions (adequate oxygen levels and air quality).
- Testing results - both initial and periodic.
- Rescue and emergency procedures and means to summon the rescue teams.
- Communication procedures.
- Equipment list.
- Additional permits.
- Additional information.

A permit number will be obtained and assigned in numeric order from the Corporate Health and Safety Officer. The number will be recorded on the permit. When the entry is complete or canceled, a copy of the permit will be forwarded to the CHSO, Copies of confined space permits will be maintained for two years.

If GEI is working at a project site where multiple contractors are working under their own permit systems, the GEI Entry Supervisor and CHSO will attempt to coordinate confined space entry operations.

TRAINING AND DUTIES

Confined space entry training will be provided prior to the assignment of confined space duties. Training will also be provided if there is a change in work conditions, hazards or duties. Documentation of the training will be kept by GEI and located at the branch and/or corporate offices of GEI. Each record contains the employee's name, dates of training, a training outline, and the signature(s) of the trainer(s).

Duties of Authorized Entrants and Attendants

1. Know the hazards that may be faced during entry including the signs, symptoms, and consequences of exposure.
2. Communication.

All entrants and attendants must maintain contact while working in the confined space.

a) The entrant **must** notify the attendant if immediate exit of the space is necessary. Notification can be either by voice or radio communication device.

b) The attendant **must** order evacuation of the confined space when:

1) A condition develops that is not allowed in the entry permit.
2) Behavioral changes appear that may be due to symptoms of exposure.
3) An endangering situation develops outside of the confined space such as pedestrians, operating vehicles, weather conditions, or any other condition that may put the entrants or attendant at risk.
4) An uncontrolled hazard is detected.
5) The attendant must leave.

c) The attendant must position himself to be able to summon emergency/rescue and may not leave the observation point until relieved by another attendant or all entrants are out of the space safely and the job is complete.

d) The attendant must perform the following actions when unauthorized persons approach or enter a confined space.

1) Warn them.
2) Request exit of the unauthorized person(s).
3) Inform entrants and others if unauthorized entry has occurred.

e) The attendant must be currently certified in CPR and first aid.

3. Rescue

a) The attendant must first summon help.

b) Entrants must leave the space immediately when the attendant orders withdrawal from the space, danger is perceived or an automatic alarm is activated.

Duties of Entry Supervisor

1. Know the hazards that may be faced during entry including the signs, symptoms and consequences of exposure.
2. Determine if the entry permit contains the necessary information including alerting rescue.
3. Determine if the equipment, procedures and practices are in place prior to entry.
4. Determine, at intervals during the entry, if operations and conditions are consistent with the permit.
5. Take necessary measures to prevent entry of unauthorized personnel while work is performed. Physical barriers such as barricade tape or cones will be use to establish a work zone and provide protection to the entrants from pedestrians and vehicle traffic.

6. If training is complete for entrant and/or attendant duties, a supervisor may perform either role during an entry.
7. Cancel authorization and terminate entry if conditions are not acceptable.
8. Terminate permit when the work is completed and forward a copy to the CHSO.

RESCUE

GEI employees will perform only non-entry rescue and will predetermine and utilize the rescue services of local fire rescue services or rescue services supplied by the client, as approved by the CHSO. Rescue procedures will be established **before entry into the identified permit-required confined spaces** and will be specific for each confined space. If rescue services are provided by an outside service they will be given the opportunity to examine the space and practice rescues if needed. The Entry Supervisor will contact the selected rescue service to alert them to the confined space entry. The entry will not take place until rescue services have been alerted. The attendant may supervise and monitor only one entry.

When visual monitoring of the worker is not possible, an explosion-proof voice or alarming communication device will be attached to the entrant, ensuring his/her safety. The attendant will contact the rescue team either by dialing 911 or through the client-specific communication procedure. The attendant will be familiar with the project-specific notification process. The attendant will NOT allow any untrained or unauthorized workers to attempt rescue.

In addition to communication systems, there will be a person readily available in the area who is currently certified in cardiopulmonary resuscitation (CPR) and basic first aid procedures whenever a permit-required confined is entered. In most cases, this person will be the attendant. Information regarding local emergency medical facilities is located on the permit. Please note that if an injured entrant is exposed to a substance for which a Safety Data Sheet exists in the field, the SDS must be made available to the local medical facility outlined on the permit.

RECLASSIFICATION

There are two exemptions to the permit-required confined space regulation.

- If actual or potential atmospheric hazards can be eliminated through ventilation and remain eliminated, and all the physical hazards can be abated or controlled without entering the space (i.e. lockout/tagout), the space may be reclassified to non-permit required. **Control of atmospheric hazards through continuous forced-air ventilation does not constitute "no actual or potential atmospheric hazards."**
- GEI Consultants, Inc. will document that all hazards in a permit space have been eliminated. Additionally, GEI Consultants, Inc. will complete the reclassification permit and forward to the CHSO when work is complete or the permit has been cancelled. Copies of reclassification permits will be maintained for 2 years.

ALTERNATE PROCEDURES

Alternate procedures may **only** be used when approved by the CHSO.

GEI CONSULTANTS, INC.
CONFINED SPACE ENTRY PERMIT

Permit Number: _____
Confined Space (Name and Location):_____
Purpose of Entry:
_____
Entry Date:_____ Entry Start Time: _____
Duration of Entry Permit (Not Valid for longer than regular shift): _____Hours
Entry Supervisor: _____
_____
Name & Title
Authorized Entrants: _____
_____
Entrant One (1) Entrant Two (2)
Attendants: _____
_____
Attendant One (1) Attendant Two (2)

PRECAUTIONS	YES	NO	PRECAUTIONARY MEASURES USED
Lockout/De-energize	☐	☐	
Secure Area	☐	☐	
Atmosphere Safe for Entry	☐	☐	
Lines Blanked or Disconnected	☐	☐	
Traffic Controlled	☐	☐	
Fall Protection	☐	☐	
Rescue Team Onsite	☐	☐	
Other:	☐	☐	

EMERGENCY TELEPHONE NUMBERS	
Local Fire	( ) -
Local Police	( ) -
Local Rescue (EMS)	( ) -
Local Hospital	( ) -
	( ) -

CONTACT _____ TO SUMMONS RESCUE SERVICES.

LIST THE POTENTIAL HAZARDS OF THIS ENTRY:
_____
_____
___

SAFETY EQUIPMENT	YES	NO	SAFETY EQUIPMENT	YES	NO
Body Harness	☐	☐	Ventilation (Type:_____)	☐	☐

Rope & Rope Grab	☐	☐	Protective Clothing	☐	☐
Lanyard	☐	☐	Air-purifying respirator	☐	☐
Shock Absorber	☐	☐	First Aid Kit	☐	☐
Tripod & Winch	☐	☐	Two Way Radios	☐	☐
Other: _____	☐	☐	Other: _____	☐	☐

GAS MONITOR			
MAKE	MODEL	SERIAL NUMBER	CALIBRATION DATE

GAS MONITORING DATA				
GAS & P.E.L.	**TIME**	**UPPER**	**MIDDLE**	**LOWER**
% Oxygen: > 20.7% and < 21.1%				
% Explosive: < 10% L.E.L.				
Toxic PPM: < 10 PPM H_2S				
CO PPM: < 35 PPM				
GAS & P.E.L.	**TIME**	**UPPER**	**MIDDLE**	**LOWER**
% Oxygen: > 20.7% and < 21.1%				
% Explosive: < 10% L.E.L.				
Toxic PPM: < 10 PPM H_2S				
CO PPM: < 35 PPM				
GAS & P.E.L.	**TIME**	**UPPER**	**MIDDLE**	**LOWER**
% Oxygen: > 20.7% and < 21.1%				
% Explosive: < 10% L.E.L.				
Toxic PPM: < 10 PPM H_2S				
CO PPM: < 35 PPM				

P.E.L.: Permissible Entry Level, L.E.L.: Lower Explosive Limit

***ENTRY SUPERVISOR* AUTHORIZING THAT ALL THE ABOVE CONDITIONS HAVE BEEN SATISFIED AND AUTHORIZING ENTRY**		
_____ ***Entry Supervisor* Signature**	_____ **Date**	_____ **& Time**
ENTRANT'S TIME IN AND OUT OF THE CONFINED SPACE		
Time In: _____	Time In: _____	Time In: _____
Time Out: _____	Time Out: _____	Time Out: _____

Comments:

_____

_____

____

CONFINED SPACE AREA CLEARED/SECURED AND PERMIT CANCELED BY:		
_____	_____	_____
Signature	Date	& Time

This permit must be retained for two years.

Appendix G

NYCDEP EAP, Evacuation Drawings & Emergency Contact List

ATTACHMENT 1

NYCDEP EMERGENCY CONTACTS

Environmental Protection

Paerdegat CQ/CSO

NYCDEP EMERGENCY CONTACTS

Title	Name	Telephone Number			
		Work	In-House	Cell	Home
Operations Superintendent	Chris Laudando	718-564-2705	-	347-924-1456	
Deputy Superintendent	Frank Soviero	718-564-2704	-	347-924-1474	646-642-9832
Deputy Superintendent	Anthony Fisher	718-351-8884	-	347-585-4290	718-229-4952
Section Chief Collection EHS (Acting)	Nesive Bell	718-595-4531	-	347-585-4239	
Facility EHS Specialist	Frederick Okeke	718-564-2711		646-957-6918	
Facility EHS Specialist	MD Kabir	718-564-2756		347-585-4258	
Other In-House Extensions					
		-		-	-
		-		-	-
		-		-	-
		-		-	-

Environmental Protection

Paerdegat CQ/CSO

NYCDEP EMERGENCY CONTACTS

BWTCC	**-**	**718-349-2812 718-349-2797**	**Fax 718-349-1345**	**Cell 646-413-3302**	**-**
DEP Emergency Communication Center (ECC)	**-**	**212-689-1520 212-689-1620 212-490-4140 212-460-4161**	**Fax: 212-775-3542**	**-**	**-**
DEP Police	**-**	**888-426-7433**	**-**	**-**	**-**
Bureau EH&S	**Main #: M – F, 7:30 AM – 4:00 PM**	**212-860-9315**	-	-	-
Bureau EH&S	**Off Hours**	**-**	**-**	**347-386-6609**	**-**
Chief – Safety	Joe Reddington	212-860-9315	-	347-386-6609	718-335-4258
EHS - Safety	Eddie Wright	212-860-9371	-	646-584-1844	-
Deputy Commissioner	Vincent Sapienza	718-595-4906	-	646-879-0943	718-835-9063
Assistant Commissioner - Ops	John Petito	718-595-5046	-	646-879-1055	-
Assistant Commissioner – P & C	Jim Mueller	718-595-5973	-	646-784-0392	-
Director – Plant Operations	Arty Spangel	718 595-5013	-	646 879-1464	718 847-0215
Director – Collection & Residuals	Robert LaGrotta	718-595-4730	-	646-879-1487	-
Director – Regulatory Compliance	Diane Hammerman	718-595-4965	-	347-203-0663	-
Director – Engineering & Budget	Michael Quinn	718-595-5043	-	347-924-1454	718-459-4911
Director – EH&S	William Yulinsky	718-595-5272	-	917-495-8376	212-249-7511
Director – CP & AM	Anthony Maracic	718-595-5045	-	347-672-6029	-
Facility Manager (JA, 26W)	Ravi Basant	718-529-3549	-	347-924-1476	718-827-2094
Facility Manager (WI, TI)	Jerry Fragias	212-860-	-	347-672-6073	-
Facility Manager (NC, RO)	Frank Loncar	718-389-2002	-	646-879-1750	-
Facility Manager (CI, OH)	Luis Carrio	718-743-0990	-	347-203-0265	516-593-9856

Environmental Protection

Paerdegat CQ/CSO

NYCDEP EMERGENCY CONTACTS

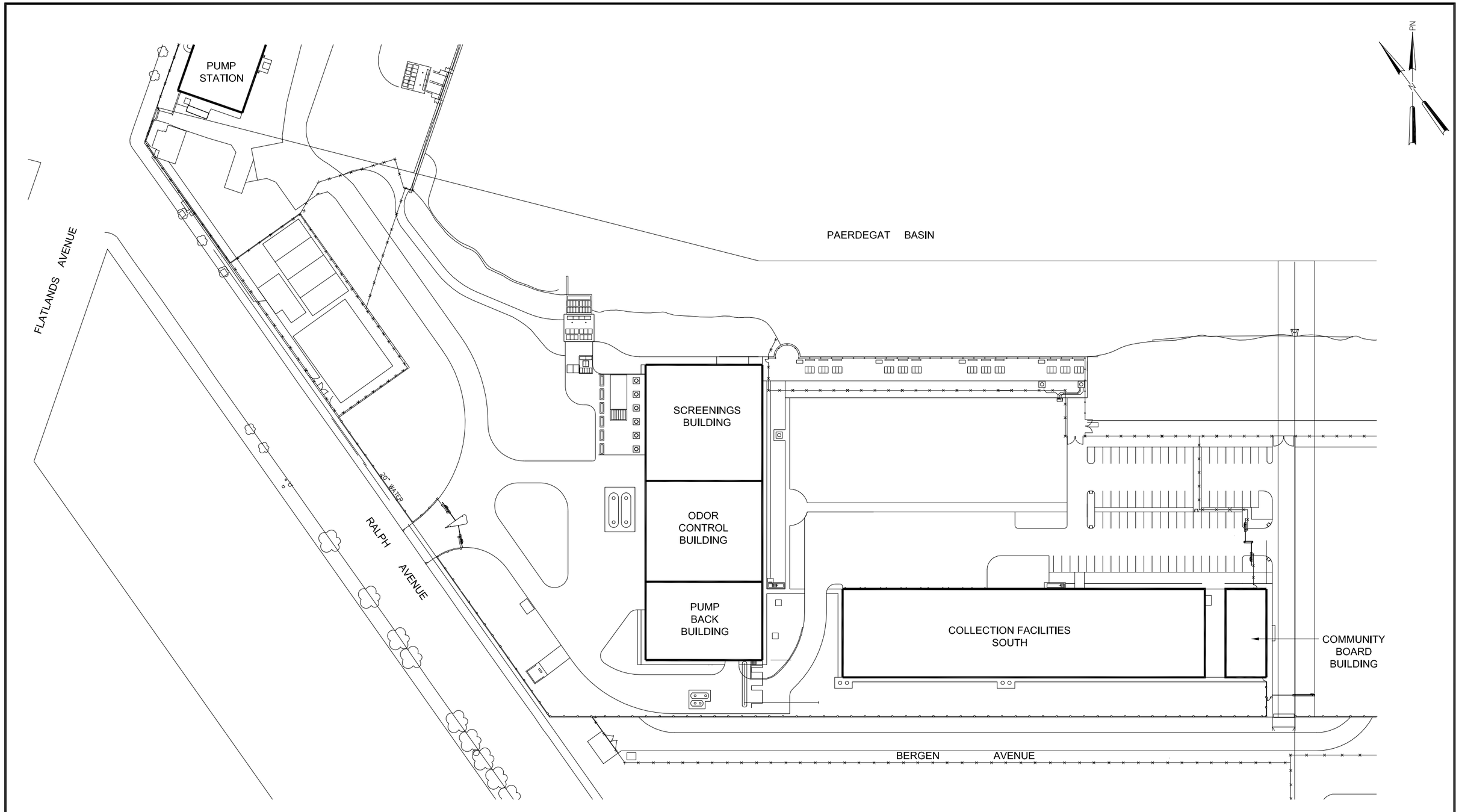
Facility Manager (HP, OB)	Peter Pianelli	718-589-1120	-	646-584-1840	718-351-8331
Facility Manager (NR, PR)	Keith Cataldo	718-595-5553		646-413-1711	
Facility Manager (RH, BB)	Elio Paradis	212-491-5050	-	347-834-5297	
Division Chief – Collections Ops	Jerry Volgende	718-595-4973	-	646 879-1906	917 273-5746
Chief – BWT Pollution Prevention	Pravin Patel	718-595-4731	-	347-672-6065	732-603-9177
Chief – BWT Emergency Response	Cosmo Zingaropoli	718-595-4718	-	347-672-6068	718-980-1999
Chief – Residuals Transportation	Samuel Young	212-860-9329	-	347-672-6052	-
Chief – Marine Services	Kevin Byrnes	212-860-9553	-	347-672-6039	-
Chief – Marine Sciences	Beau Ranheim	212-860-9378	-	646-478-6012	718-855-6642
Marine Sciences – **On-Call ***	Bernadette Boniecki	917-723-3150	*** See this years Beach Season Notification Bureau Directive for monthly "On-Call" schedule.**		
Marine Sciences – **On-Call ***	Markus Koelbl	646-530-4494			
Marine Sciences – **On-Call ***	Naji Yao	917-442-8061			
SPDES Compliance Section	-	718-595-5021 718-595-5020 718-595-5015	**Fax:** 718-595-5145	**Voicemail:** 718-595-5021 718-595-5020	
Air Compliance Section	Wayne Kuang	718-595-4899	-	-	-
Transportation	Dispatch Office	212-860-9329	-	-	-
Transportation	Mobile	-	-	347-672-6052	-
Transportation	Dispatch Office	-	**Fax:** 212-860-9318		-
Newtown Creek Micro Lab		718-389-2002 ext. 4430			
Newtown Creek – Shift SEE Desk		718-389-2002			
DEP Hazardous Materials	Dispatcher	212-860-9349	-	-	-
Director - Hazardous Materials	Greg Hoag	718-595-4652	-	347-263-1459	845-639-7621
DEP Office of Public Affairs		718-595-6600			

NYCDEP EMERGENCY CONTACTS

Public Employee Safety & Health (PESH)	-	212-775-3548	Fax: 212-775-3542	-	-
NYSDEC	-	718-482-4007	**Hotline: 800-457-7362**		-
NYSDEC – Region 2 (Bypasses)		**718-482-4007**			
NYC Department of Health & Mental Hygiene (DOHMH)	Main Number	212-676-1520	-	-	-
DOHMH	**Poison Control**	212-340-4494	-	-	-
DOHMH	Chris Boyd	212-676-1520	-	347-613-6537	-
DOHMH	Angela Ward	212-676-1536	-	347-672-4978 347-813-9478	-
DOHMH	Lily Huang	212-676-1537	-	917-647-3287	-
For BEDC, Consultant, Contractor and Subcontractor Contact Information, See Volume 2 of the EAP (Operational Emergency Manual), Contractor Emergency Requirements section.					

Figure 2
Paerdegat
Site Layout

Figure 1: Paerdegat Facility Overview



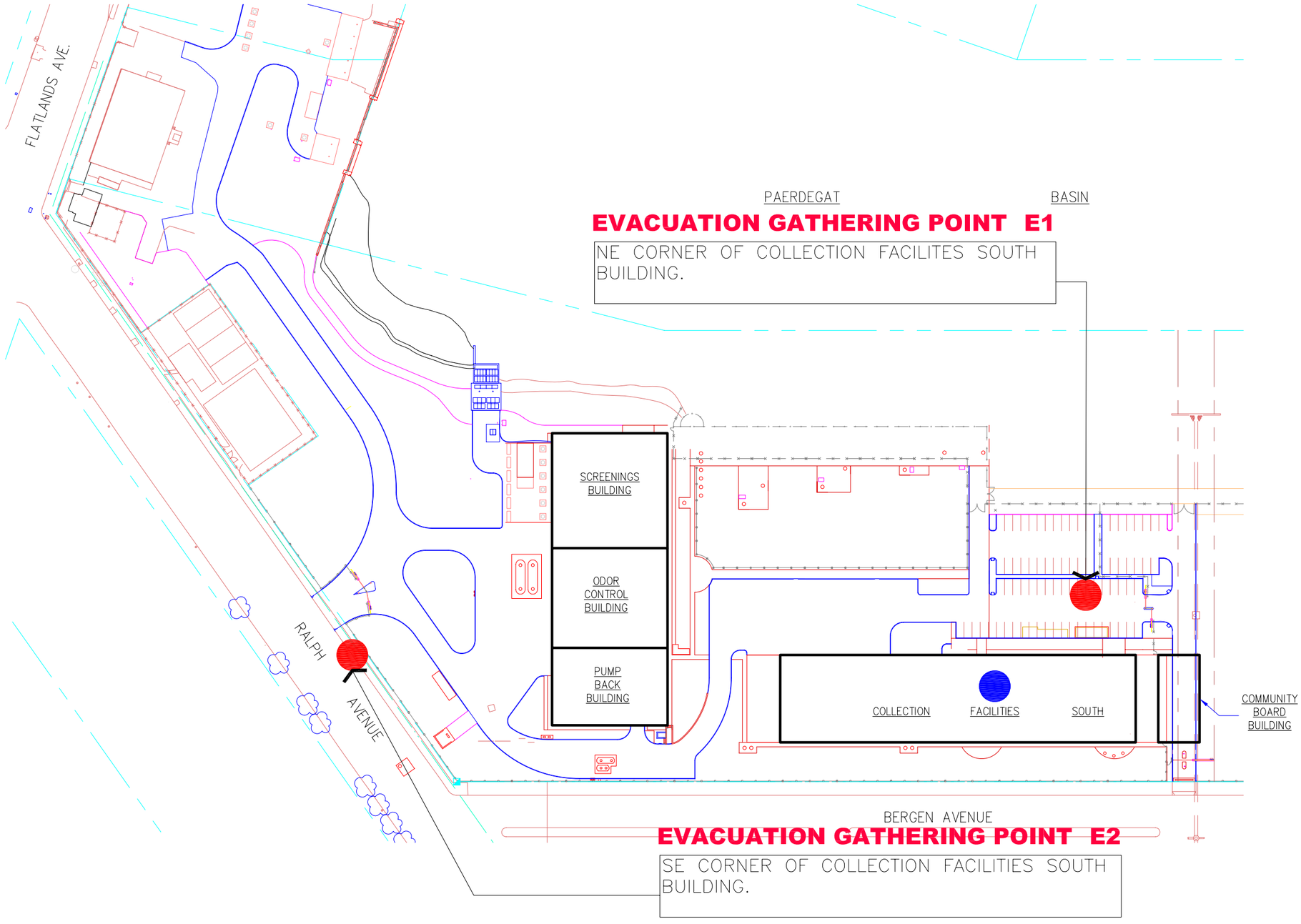
City of New York
Department of Environmental Protection
Bureau of Wastewater Treatment

PAERDEGAT FACILITY

03/04/08

Figure 3
Paerdegat
Evacuation Points and Routes

FIGURE 2: PAERDEGAT FACILITY EVACUATION GATHERING POINTS



City of New York
Department of Environmental Protection
Bureau of Wastewater Treatment

PAERDEGAT FACILITY
12/2012

LEGEND:

- EVACUATION GATHERING POINTS
- SHELTER IN PLACE GATHERING POINT

6. Evacuation Procedure

Evacuation procedures may be necessary during one or more of the following emergencies:

- Uncontrollable fire
- Hazardous chemical release
- Acts of violence including bomb threats
- Severe Flooding

Contractors, Vendors, and Consultants working at the Paerdegat CQ/CSO Facility must understand and be familiar with Facility evacuation requirements. Contractor supervisors must provide an orientation to the contractor representative as a minimum, and that person is responsible for communicating the information to their employees or sub-contractors.

Specific Facility-wide and shelter-in-place guidelines are provided at the end of this section.

6.1 Personnel Responsibilities during an Evacuation

6.1.1 All Facility Personnel

IT IS THE RESPONSIBILITY OF FACILITY PERSONNEL TO FAMILIARIZE HIMSELF/HERSELF WITH THE LOCATION OF THE PREDETERMINED EVACUATION GATHERING POINT.

- Do not take short cuts when going to an evacuation gathering point.
- **Do not run and do not drive. Walk quickly.**
- Report your presence to a supervisor immediately upon arrival to an evacuation gathering point.
- Stand away from evacuation gathering point gates.
- Do not block access for emergency vehicles.
- Avoid areas affected by the emergency even if it takes longer to reach the evacuation gathering point.
- Stay out of tunnels, elevators and other enclosed areas.

- If selected, assist in identifying any equipment which must be secured after all personnel have been notified to evacuate. **IF IT IS SAFE TO DO SO**, qualified personnel will be directed to secure the equipment.
- Notify the **EC** or designated gathering point lead person if someone is unaccounted for.
- Stay at the gathering point until the "All Clear" is sounded.

6.1.2 Emergency Coordinator

- Determine the need for a Facility evacuation.
- Determine if a full, partial shelter-in-place evacuation is required.
- Determine and announce if there are any changes to the predetermined evacuation gathering points.
- Call 911 if outside assistance is needed.
- Notify responding agencies if any Facility personnel, visitors, or contractors are unaccounted for.
- Determine and announce the "All Clear".

6.1.3 Facility Supervisors

Head counts for Facility personnel will be conducted by comparing the personnel present at the evacuation point to the daily work sheets. Contractors are responsible for accounting for their personnel.

DURING AN EVACUATION THE HEAD COUNT ASSISTANT (SSEE, SSTW OR SEE) WILL BE RESPONSIBLE FOR CONDUCTING A HEAD COUNT AT THE EVACUATION GATHERING POINT OF ALL PERSONS.

The facility log book will be maintained at the control desk. All personnel reporting for work, routine or otherwise will be required to sign in on the facility log. During an evacuation, the **responsible individual** will bring this log book to the evacuation gathering point where personnel present will be compared to it. Once a head count is completed, the Supervisor or his/her designee must complete a Missing Person Form **(Attachment 6)** for each missing person under his/her supervision.

Contractors shall maintain their own sign in sheet and will report an accurate muster and all missing personnel to the EC, day contractors will sign in on the facility log book.

Additional responsibilities of Facility Supervisors/EC assistants during an evacuation include:

- Assist in conducting tasks, such as attendance taking or "running" messages to other evacuation points in the event radio or phone communication is not possible.
- Maintain continuous communication with the **EC** or other Supervisors using either portable radios or phones to monitor the situation and account for missing persons.
- Notify **EC** that all personnel are accounted for, or names of missing personnel and location last seen.
- Keep those under his supervision informed about the emergency situation.

6.2 Evacuation Guidelines

Possible types of evacuations covered in the Paerdegat CQ/CSO include:

- Full Evacuation
- Partial Evacuation
- Shelter-in-Place

As Determined by the EC

Table 3 provides a matrix of the potential evacuation types which may be required for each emergency.

Table No. 3 Emergency Evacuation Matrix

Emergency	Full Evacuation	Partial Evacuation	Shelter-in-Place
Incipient Fires		✔	
Uncontrollable & Structural Fires	✔	✔	
Incidental Chemical Spills		✔	
Major Chemical Releases	✔	✔	✔
Bomb Threats	✔	✔	✔
Civil Disobedience	✔		✔
Workplace Violence		✔	✔
Tornadoes		✔	✔
Hurricanes		✔	✔
Tidal Surge		✔	✔
Snow Storms-Blizzards		✔	✔
Earthquakes	✔		✔
Power Outages		✔	✔
Confined Space Emergency[1]			
Medical Emergency[1]			

[1]Confined space and medical emergencies typically do not require evacuations.

6.3 Full Evacuation

At the Paerdegat CQ/CSO, a full evacuation is considered when the entire Facility is affected and the safety of Facility personnel is at risk.

Specific full evacuation guidelines are provided at the end of this section and are summarized below:

- The announcement for a full evacuation will be broadcast over the PA system via verbal announcement and alarm.
- There are **two** primary (**E1 and E2**) evacuation gathering points established for the Facility (Figure 2).
  - ❖ **E1 is located at the northeast corner of the CFS building**
  - ❖ **E2 is located at the southeast corner of the Ralph Ave entrance gate.**

Alternate locations will be determined by the **EC** if necessary

Full evacuation may also be announced using the facility portable radios.

6.4 Partial Evacuation

At the Paerdegat CQ/CSO, a Partial Evacuation is considered when a certain part of the facility or certain part of the site is evacuated based on the extent and severity of the emergency or after a full evacuation following a headcount has been completed.

Specific partial evacuation Guidelines are provided at the end of this section and are summarized below:

- The announcement for a partial evacuation will be broadcast over the PA system via verbal announcement and alarm
- Partial evacuation may also be announced using the facility's portable radios.
- The **EC** will determine what portions of the facility are to be evacuated and what parts are considered "safe areas".
- Both primary and alternative gathering points may be utilized during a partial evacuation.

6.5 Shelter-In-Place

At the Paerdegat CQ/CSO, Shelter-in-Place is a precaution aimed to keep personnel safe while remaining indoors. Shelter-in-place means selecting a small interior room, with few or no windows and taking refuge there until the hazardous event has passed. **The Paerdegat CQ/CSO meeting point for emergencies which do not require evacuations is to be determined by the EC.** Personnel will muster here and await further instructions from the EC.

The general guidelines, personnel roles and responsibilities for shelter-in-place are similar to those discussed above for a full evacuation. Specific shelter-in-place guidelines are provided at the end of this section and summarized below:

- The announcement for shelter-in-place will be broadcast over the PA system via verbal announcement and alarm.
- All personnel will report to the EC at the control room if safe to do so, where specific shelter-in-place instructions will be given at the EC's discretion.
- Shelter-in-place may also be announced using the Facility portable radios.

6.6 Determination of "All Clear"

The responding agency in-charge (e.g. fire department) will determine and notify the **EC** that it is safe to announce an "All Clear."

The "All Clear" from the agency means that the "emergency is no longer a threat to health and life". This DOES NOT signify permission to proceed back into the Facility and that all immediate danger has passed or been removed.

The **EC** will discuss and collect information with the responding agency in-charge to determine whether re-entry is acceptable. Based on a walk-through with the Agency (if possible), the EC can make a determination at this time whether a full or partial "re-entry" is acceptable.

Based on this assessment, the **EC** or designee will then do the following via portable radio or cell phone:

- Notify the Facility Supervisors that the "All Clear" has been given.
- Notify the Facility Supervisors of any areas of the Facility which are considered unsafe and not ready for occupation.

The facility Supervisors are responsible for notifying those under his/her supervision that the "All Clear" has been given and provide guidance to the employees on re-entry protocol.

The preferred method to announce the "All Clear" will be via portable radios or PA system. If these methods of communication are not working, then the "All Clear" may be announced over the PA system or by using messengers between the gathering points.

After the "All Clear" is announced and re-entry is allowed, facility personnel will be allowed to leave the evacuation areas and return to areas designated as safe by the **EC**. At this time, personnel are allowed to begin post-emergency activities per the DEP EHS guidance document "Major Incident Emergency Management and Recovery", Revision 0, dated 2/24/08, which is included in the Operational Emergency Manual (Volume 2 of the EAP)

6.7 Special Aid Assistance

The supervisor or designee of any area where DEP employees with special needs may work will be responsible for the safe evacuation of these personnel. Upon evacuation notification, via alarm or radios, the supervisor or their designee will locate and assist in the safe evacuation of all DEP employees with special needs under their supervision. Once at the evacuation gathering point, the supervisor will immediately notify the headcount assistant of the status of persons with special needs.

Guests and visitors with special needs will be assigned a facility representative upon checking in at the Shift Engineer's desk. The facility representative will remain with the visitor at all times. The facility representative will be responsible for the safe evacuation of their visitor to the evacuation gathering point and will immediately notify the headcount assistant of the presence and status of the visitor.

NOTIFICATION REQUIREMENTS

The Paerdegat CQ/CSO is equipped with a PA system, portable radios, and a land-line phone system. The primary method of notification of an evacuation will be the PA system. The primary method of communication during an evacuation will be via portable radios followed by the outside phone system (land-line).

The **EC** will use the PA system and the following alarm signals to alert all personnel of an evacuation regardless of type:

Step 1: DEP Facility: A verbal announcement will be broadcast over the PA system AND on all facility radios.

Upon hearing the announcement **ALL** facility personnel will go to the primary evacuation gathering point **E1** or alternative/secondary gathering point **E2** if directed by their supervisor, and wait for instructions.

IF the PA system is not functioning, the Portable Radio System will be used by the **EC** to initiate evacuation guidelines.

The **EC** will use **CHANNEL "2"** to notify **ALL** Facility personnel of an evacuation.

Step 1: Personnel with portable radios have the responsibility of verbally notifying others when an emergency occurs.

Step 2: Follow evacuation guidelines described below.

Emergency contact numbers are provided in **Attachment 1**.

EVACUATION REQUIREMENTS

Full Evacuation Guidelines

Step 1: For Full Evacuations there is one primary **E1** and one secondary **E2** evacuation gathering point (Figure 3)

- **E1 is located at the northeast corner of the CFS building**
- **E2 is located at the southeast corner of the Ralph Ave entrance gate.**

Alternate evacuation gathering points will be determined by the **EC** if necessary

For partial evacuations, the **EC** will broadcast the appropriate place or building to gather (e.g. control room)

The Head Count Assistant will conduct a head count at the evacuation gathering point of all persons under his/her supervision.

IT IS MANDATORY THAT YOU REPORT YOUR PRESENCE TO A HEAD COUNT ASSISTANT IMMEDIATELY UPON ARRIVAL TO AN EVACUATION GATHERING POINT

Step 2: Head Count Assistants will notify the **EC** via portable radio or cell phone the status of personnel assigned to them, including the following information:

- All personnel accounted for at each location.
- Name(s) of missing personnel, if any and location last seen and at what approximate time.
- Complete Missing Persons Form (**Attachment 6**) if persons are not accounted for.

Shelter-In-Place Guidelines

During certain types of emergencies, (e.g. tornado warning, chemical releases), it may be safer to take shelter within the facility rather than evacuating to a gathering point. The general guidelines and personnel roles and responsibilities for shelter-in-place are similar to those discussed above for a Facility-wide evacuation. The Paerdegat CQ/CSO meeting point for emergencies which do not require evacuations is the file room in the crew quarters building. Personnel will muster here and await further instructions from the EC.

The general shelter-in-place guidelines are listed below:

- The **EC** will determine if shelter-in-place is appropriate.
- Notification and communication guidelines are the same as the guidelines used for a Facility-wide evacuation.

- Facility supervisors will conduct a head count of all persons under his/her supervision.
- All doors and windows to the outside should be closed and locked and as many internal doors as possible should be closed.
- Any window coverings should be closed.
- Stay away from windows or doors that contain glass.

Appendix H

NYCDEP Confined Space Entry Program

Confined Space Entry Program

Environmental Health & Safety Policies, Procedures and Guidelines

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Applies to:	All DEP Bureaus and Offices
EHS Policy Volume:	☐I ☐II ☑**III** ☐IV
Revision Number:	3
Document Type:	☑**Policy** ☐Procedure ☐Guideline ☐SOP
Effective Date:	**January 2, 2012**
Reviewed By:	**Confined Space Policy Working Group**
Approved By:	**OEHS**

Objective

To protect DEP employees from the hazards of entering and working in confined spaces and to maintain compliance with the OSHA Permit-Required Confined Spaces Standard (29 CFR 1910.146).

Purpose

The purpose of this Confined Space Entry program is to:

- Inform DEP employees about hazards, requirements and responsibilities of DEP personnel
- Provide details for confined space entries
- Describe the training requirements, metrics and auditing protocol, and reporting and recordkeeping requirements.

DEP Office of Environmental, Health and Safety Compliance Authorization

I, a duly authorized representative of the DEP Agency Compliance Office, have reviewed this document, have found it to be acceptable and authorize its use for all DEP operations.

Revision / Action	Signature		
Revision 0, Authorization	On File	Date:	02/14/03
Revision 1, Authorization	On File	Date:	10/11/05
Revision 2, Authorization	On File	Date:	09/29/11
Revision 3 Authorization		Date:	12/20/11
		Date:	
		Date:	
		Date:	
		Date:	

Table of Contents

1 PURPOSE 1
2 SCOPE 1
3 REFERENCES 1
4 DEFINITIONS 1
5 RESPONSIBILITIES 3
5.1 RESPONSIBLE INDIVIDUAL (RI) 3
5.2 BUREAU ENVIRONMENTAL HEALTH &SAFETY PERSONNEL (BEHS) 3
5.3 ENTRY SUPERVISOR 4
5.4 ATTENDANT 4
5.5 ENTRANT 5
5.6 DEP CONTRACT SUPERVISOR 6
6 PROCEDURES AND PROTOCOLS 6
6.1 IDENTIFICATION, EVALUATION, LABELING AND RECLASSIFICATION 6
6.2 ENTRY PROCEDURES 10
6.3 HAZARD CONTROL AND PROTECTIVE EQUIPMENT 15
6.4 EMERGENCY PROCEDURES 18
7 TRAINING 22
8 METRICS AND AUDITING 23
9 RECORDKEEPING 23
10 ATTACHMENTS 23
ATTACHMENT A CONFINED SPACE INVENTORY 23
ATTACHMENT B CONFINED SPACE HAZARD IDENTIFICATION/EVALUATION FORM 23
ATTACHMENT C CONFINED SPACE ENTRY PERMIT 23
ATTACHMENT D CONFINED SPACE RECLASSIFICATION FORM 23
ATTACHMENT E NON-PERMIT ENTRY DOCUMENTATION FORM 23
ATTACHMENT F ANNUAL REVIEW DOCUMENTATION 23

Volume III	**Confined Space Entry Program**	Revision: 3 Issuance Date: 12/20/11 Effective Date: 01/02/12

1 PURPOSE

The purpose of this Confined Space Entry Program is to protect DEP employees from the hazards of entering and working in confined spaces, and maintain compliance with the OSHA Permit-Required Confined Spaces Standard (29 CFR 1910.146).

2 SCOPE

DEP's Confined Space Entry Program applies to all DEP employees who enter DEP confined spaces and to contractors as described in Section 6.2.3. If a confined space entry cannot be made safely and according to procedures, no entry shall be permitted.

The DEP Confined Space Entry Program applies to all Bureaus and Offices within DEP; however, depending on individual needs, it may be necessary for certain Bureaus/Offices to develop supplemental procedures or to modify the program attachments. Any supplemental procedures developed or modification of program attachments shall be consistent with the approach used in this program. Throughout this document, references to the use of Attachments A – F is specially meant to allow the use of an equivalent form as approved by the Bureau EHS Director.

3 REFERENCES

NYCDEP Contractor Selection and Management Policy

NYCDEP Control of Hazardous Energy Lock-Out / Tag-Out Policy

NYCDEP Hazard Markings and Color-Coding Policy

NYCDEP Hot Work Policy

NYCDEP Personal Protective Equipment Policy

NYCDEP Respiratory Protection Policy

29 CFR 1910.146 Permit Required Confined Spaces

4 DEFINITIONS

Acceptable Entry Conditions - Conditions that must exist in a permit-required confined space to allow entry and to ensure that employees involved in a permit-required confined space entry can safely enter into and work within the space.

Attendant – An individual stationed outside a permit-required confined space who monitors the activities of the authorized entrants and who performs all attendant's duties assigned in this program.

Authorized Entrant – An individual who is authorized, in accordance with this program, to enter a permit-required confined space.

Confined Space - Any space that meets all three of the following conditions:

1. Is large enough and so configured that an employee can bodily enter and perform assigned work, and

2. Has limited or restricted means for entry or exit (for example, tanks, vaults, aqueducts, and sewer lines), and

3. Is not designed for continuous employee occupancy.

Entry - The action by which an authorized entrant passes any part of his/her body through an opening into a confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

Entry Supervisor - The person responsible, in accordance with this procedure, for determining whether acceptable entry conditions are present at a permit-required confined space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating the entry operation as required by the regulations.

Hazardous Atmosphere - An atmosphere that may expose employees to the risk of death, incapacitation, injury, acute illness, or impairment of ability to self-rescue (that is, escape unaided from a permit-required confined space).

Immediately dangerous to life or health (IDLH) - Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit-required confined space.

Lockout/Tagout – Established procedure to control hazardous energy by placement of a lockout or tagout device to prevent equipment or process from becoming energized.

Lower Explosive Limit (LEL) – Also known as Lower Flammable Limit (LFL), is the lowest concentration of flammable gases or vapors in air, below which ignition will not occur.

Permissible Exposure Limits (PEL) – Established to protect workers against the health effects of exposure to hazardous substances, PELs are regulatory limits on the amount or concentration of a substance in the air. OSHA PELs are based on an 8-hour time weighted average (TWA) exposure.

Permit-Required Confined Space (PRCS) - A confined space which has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere, or
- Contains a material that has the potential for engulfing an entrant, or
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross section, or
- Contains any other recognized or potentially serious safety or health hazard.

5 RESPONSIBILITIES

5.1 Responsible Individual (RI)

The ***Responsible Individual,*** the highest ranking manager or supervisor, for each Bureau/Office at locations where confined space entries are made, is responsible for:

- Ensuring that required equipment is available;
- Ensuring that employees are trained;
- Coordinating with any DEP staff managing contractor activities involving PRCS entry at the ***RI***'s facilities.
- Maintaining the written program including the confined space inventory and associated evaluations;
- Coordinating identification, evaluation and classification of confined spaces with ***Bureau EHS***;
- Ensuring the regular calibration, inspection and maintenance of gas monitoring/detection devices used for confined space entry;
- Reviewing entry operations whenever there is reason to believe that hazard control measures may not protect entrants and revising measures for subsequent entries; and
- Annually reviewing the Confined Space Program cancelled entry permits with ***Bureau EHS*** Personnel and correcting any deficiencies in hazard control measures; and,
- Ensuring that all other requirements of this program are met.

The ***RI*** may delegate tasks, as appropriate.

5.2 Bureau Environmental Health &Safety Personnel (BEHS)

It is the responsibility of ***BEHS*** to facilitate and foster adherence to this program. Responsibilities include:

- Working with the ***RI*** to ensure consistent and accurate identification, evaluation, and classification of confined spaces;
- Annually reviewing the effectiveness of the Confined Space Entry Program with the ***RI*** and making recommendations to the Office of Environmental, Health and Safety (OEHS) of programmatic changes; and
- Ensuring that identified issues and deficiencies noted during annual reviews are communicated to all affected staff (i.e., via training, toolbox talks or other suitable forums); and
- Coordinating training for affected employees.

5.3 Entry Supervisor

Responsibilities of the ***Entry Supervisor*** include:

- Verifying that acceptable entry conditions exist prior to a PRCS entry;
- Knowing the hazards that may be faced during entry, including information on the modes, signs, symptoms, and consequences of exposure;
- Verifying that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before signing the permit and allowing entry to begin;
- Terminating the entry and canceling the permit when required;
- Verifying that rescue services are available and that the means for summoning them are operable;
- Being familiar with emergency procedures and non-entry rescue equipment;
- Removing unauthorized individuals who enter or who attempt to enter the PRCS during entry operations;
- Ensuring that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained; and
- Ensuring that the entry permit is properly completed and filed after entry is complete.

Note*: An Entry Supervisor may serve as an Attendant or as an Authorized Entrant, as long as he or she is trained and equipped as required by this procedure for each role that the person fills. Also, the duties of Entry Supervisor may be passed from one Entry Supervisor to another during the course of an entry operation.*

5.4 Attendant

Responsibilities of the ***Attendant*** include:

- Knowing the hazards that may be faced during entry, including information on the modes, signs, symptoms, and consequences of the exposure;
- Being aware of and observing entrants for possible behavioral effects of hazard exposure in authorized entrants;
- Being in continuous communication and maintaining an accurate count of authorized entrants in the PRCS and ensuring accurate identification of who is in the PRCS;
- Ensuring that air monitoring results are recorded on the entry permit;
- Remaining outside the PRCS during entry operations until relieved by another ***Attendant*** and performing no additional duties that might interfere with monitoring and protecting the authorized entrants;
- Monitoring activities inside and outside the space to determine whether it is safe for entrants to remain in the PRCS and ordering ***Entrants*** to evacuate the space immediately under any of the following conditions:

- ♦ A prohibited condition is detected,
- ♦ Behavioral effects of hazard exposure are detected in an ***Entrant***,
- ♦ Communication is compromised,
- ♦ There is a situation outside the space that could endanger the ***Entrant***, or
- ♦ The ***Attendant*** cannot effectively and safely perform all of his duties;

➢ Taking the following actions when unauthorized persons approach or enter a PRCS while entry is underway:

- ♦ Warning the unauthorized persons that they must stay away from the PRCS;
- ♦ Advising the unauthorized persons that they must exit immediately if they have entered the PRCS; and
- ♦ Informing the ***Entrants*** and the ***Entry Supervisor*** if unauthorized persons do not cooperate or have entered the PRCS;

➢ Summoning rescue and other emergency services as soon as it is determined that ***Entrants*** may need assistance to escape from PRCS hazards;

➢ Performing non-entry rescues, if needed, using available equipment such as a tripod retrieval system (Note: ***Attendant*** entry is prohibited).

5.5 Entrant

Responsibilities of the ***Entrants*** include:

➢ Knowing the hazards that may be faced during entry, including information on the modes, signs, symptoms, and consequences of the exposure;

➢ Properly using equipment per manufacturer's specifications and training;

➢ Being in continuous communication with the ***Attendant*** to enable the ***Attendant*** to monitor ***Entrant*** status and, when necessary, to alert entrants of the need to evacuate the space;

➢ Alerting the ***Attendant*** whenever:

- ♦ Any warning sign or symptom of exposure to a dangerous situation is recognized, or
- ♦ A prohibited condition is detected; and

➢ Exiting from the PRCS as quickly as possible whenever:

- ♦ An evacuation alarm is activated or an order to evacuate is given by another ***Entrant***, the ***Attendant*** or the ***Entry Supervisor***,
- ♦ Any warning sign or symptom of exposure to a dangerous situation is recognized, or
- ♦ A prohibited condition is detected.

5.6 DEP Contract Supervisor

The ***Contract Supervisor*** is the person responsible for managing and overseeing the Contract. Responsibilities of the ***Contract Supervisor*** include:

- Coordinating with facility ***RI*** on all contractor activities involving confined space entry to ensure that the contractor is made aware of:
  - Existence of PRCSs that must be entered in accordance with applicable regulations;
  - Hazards within the PRCSs based on DEP experience; and
  - Precautions and procedures in place that DEP uses to protect its employees when they are in or near a PRCS; and
- Coordinating confined space entries with ***RI*** when both DEP and contractor employees are to work near or in a PRCS to ensure that both the contractor and DEP employees are safe.

6 PROCEDURES AND PROTOCOLS

6.1 Identification, Evaluation, Labeling and Reclassification

6.1.1 Identification

The ***RI*** will work with facility staff and ***BEHS*** to identify and inventory (***Attachment A***) all spaces that potentially meet the definition of a confined space (see Section 4 and Figure 1). Where there are numerous spaces with similar characteristics (e.g., sewers), they may be listed by category.

The ***RI*** must be cognizant of any equipment, process or facility modification or installation that may change the classification of a space or create a new confined space and coordinate the evaluation and revision of the inventory and facilitate any other actions required by a new classification (e.g., posting of signs, training, etc.).

6.1.2 Evaluation and Classification

A Confined Space Evaluation Form (***Attachment B***) must be completed for each potential confined space identified on the inventory (see Section 6.1.1) by ***BEHS*** or other authorized employee who is qualified and trained in the DEP Confined Space Entry Program. All spaces evaluated must be included on the inventory.

The confined space identification and classification flowchart (Figure 1) can be used as a guide during the evaluation, which is a two-step process:

1. A determination must be made as to whether the identified space meets the criteria for a confined space.
2. If the identified space meets the criteria for a confined space then the space must be evaluated to determine whether it meets the criteria for a PRCS.

When determining whether a confined space meets the criteria of a PRCS, it is necessary to identify and evaluate all potential hazards inside and outside the space under normal operations expected during entry including, but not limited to, the following:

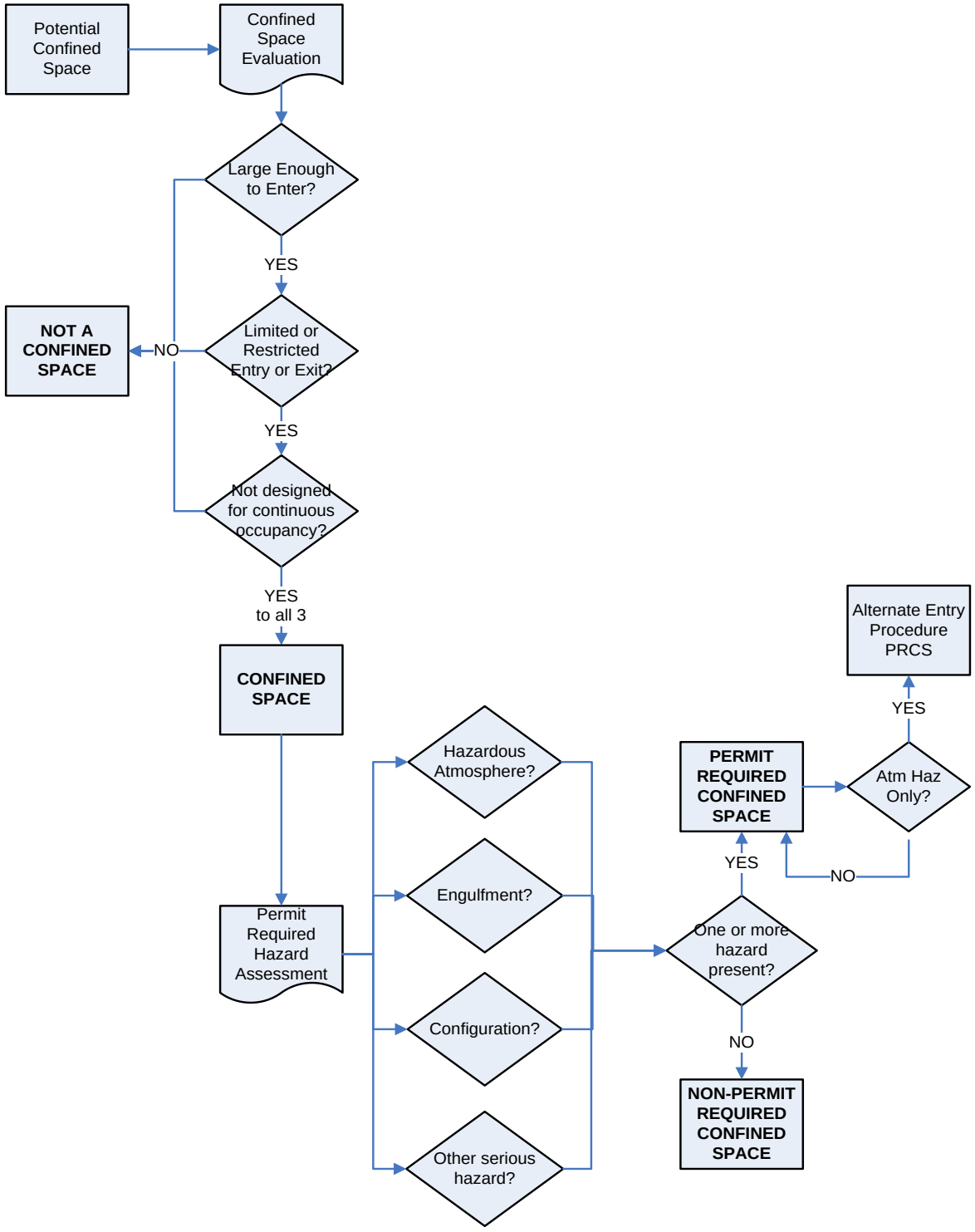
- Atmospheric
- Engulfment
- Electrical
- Chemical
- Mechanical
- Pneumatic
- Steam
- Heat
- Noise
- Potential Energy (Gravity)
- Stored Energy (e.g., spring tension)

The evaluation should be of the identified space and not of work that may be performed in the space during future entries (e.g., welding or cutting). Any additional hazards or changes in existing hazards will be identified and evaluated by the ***Entry Supervisor*** when the entry permit is completed prior to entry.

Based on the results of the evaluation, spaces will be classified into one of the following four categories:

1. Not a confined space. The space does not meet the definition of a confined space. Entry into the space is not regulated by this program; however, any entry must be made safely per applicable regulations and/or applicable DEP policy.
2. Non-Permit-Required Confined Space. The space meets the definition of a confined space but does not meet the definition of a PRCS. Entry into the space must meet the minimum requirements set forth in this program for non-permit confined spaces.
3. Permit-Required Confined Space. The space meets the definition of a PRCS; the space contains or, with respect to atmospheric hazards, has the potential to contain, hazards capable of causing death or serious physical harm. Entry into the space must be performed in accordance with this program.
4. Permit-Required Confined Space – Atmospheric Hazard Only. These are PRCS spaces where the only hazard posed is an actual or potential hazardous atmosphere and these are the only spaces that may potentially be entered utilizing the "alternate procedures" detailed in this program.

Figure 1 - Confined Space Identification & Classification



6.1.3 Labeling Confined Spaces

Permit-Required Confined Spaces

The ***RI*** must ensure that all identified PRCSs are posted with a sign alerting employees to the hazard. The sign must conform to the DEP Hazard Marking and Color Coding Procedure. The following or similar language may be used for the posted sign:

DANGER

PERMIT-REQUIRED CONFINED SPACE

DO NOT ENTER

Alternatively, the ***RI*** may inform exposed employees by any other equally effective means such as postings or memorandum identifying the PRCSs (ex., all reservoir building fore bays are to be considered PRCSs), if appropriate. When utilizing an alternate means to notify employees of a PRCS, the information should also be included in new employee training and/or posted at the facility.

6.1.4 Reclassification of Confined Spaces

Confined spaces may be permanently or temporarily reclassified based on the introduction or elimination of hazards in or around the space. If all hazards in a PRCS are permanently eliminated, the space must be reclassified by completion of a new ***Attachment B***. Details regarding how all hazards were permanently eliminated must be documented either in the space provided on ***Attachment B*** or by completing ***Attachment D***.

If a hazard is permanently introduced into a non-permit-required confined space or an additional hazard is permanently introduced into a PRCS, the ***RI*** must coordinate a re-evaluation of the space and update the confined space evaluation, inventory and labeling for that space to reflect the new hazard(s) and classification, as needed. The re-evaluation should be documented using ***Attachment B***.

If all hazards in a PRCS can be temporarily eliminated and the PRCS will be routinely reclassified to a non-permit-required confined space, then ***Attachment D*** should be completed to document the hazard elimination procedure for use during future entries. ***Attachment D*** should be reviewed and approved by ***BEHS*** (or other authorized personnel). Once ***Attachment D*** is approved, the ***RI*** must coordinate updating the confined space inventory for that space to reflect that a written standard procedure has been developed for temporarily reclassifying the PRCS to a temporary non-permit-required confined space for routine entries.

If the only hazard posed in a PRCS is actual or potential hazardous atmospheres, ***BEHS*** working with the ***RI*** and facility staff can make a determination that routine entry utilizing alternate procedures is appropriate (use of alternate procedures is NOT required). If routine use of alternate procedures is deemed appropriate, ***Attachment D*** must be completed to document the procedure to control the hazardous atmosphere and the attachment must be reviewed and certified by ***BEHS***. Reclassifications should be clearly communicated to all potentially affected staff. The ***RI*** must coordinate updating the confined space inventory for that space to reflect that a written alternate procedure has been

established and must keep ALL original PRCS entry permits and/or data forms used to demonstrate that the atmospheric hazards are adequately controlled (i.e., oxygen and LEL within limits and air contaminants below PELs) by forced air ventilation.

6.2 Entry Procedures

This section provides the minimum entry procedures that must be complied with for all spaces determined to be confined spaces as set forth in the section above. Bureaus may establish procedures equivalent to or more stringent than these minimum requirements.

6.2.1 Non-Permit-Required Confined Space Entry

This procedure applies to spaces that have been classified as non-permit-required confined spaces. Entries into non-permit-required confined spaces do not require a permit.

1. Prior to entering a non-permit-required confined space, entrants should verify that planned work activities in or around the space will not create any hazards necessitating the reclassification of the non-permit-required confined space to a PRCS (e.g., welding may generate fumes that might change the atmosphere).
2. To determine the number of personnel needed to ensure a safe entry, consideration should be given to the location of the space (i.e., remoteness, high vehicle traffic, etc.).
3. The entrance to the space should be appropriately barricaded and/or attended to prevent creation of a fall hazard for others.
4. During entry into a non-permit-required confined space, **air monitoring is required for all unventilated spaces** to confirm acceptable entry conditions**.** ***Attachment E*** may be used to document air monitoring results.
5. In the event that a hazardous situation is encountered during the entry, ***Entrants*** shall immediately exit the space, secure the space to prevent others from entering, notify their supervisor and request that the space be re-evaluated.

6.2.2 Permit-Required Confined Space Entry

The following procedures apply to spaces that have been classified as PRCSs. All necessary steps must be taken before entry to minimize hazards, including, whenever possible, reclassifying the space to a temporary non-permit-required confined space or requiring an alternate entry procedure.

6.2.2.1 Temporary Reclassification to Non-Permit Confined Space

If the PRCS poses NO actual or potential atmospheric hazards and if ALL other hazards within the space can be eliminated for the length of the entry, the ***Entry Supervisor*** may temporarily reclassify the PRCS as a non-permit required confined space by following the procedure detailed in section 6.2.2.3 to reclassify and authorize entry as a temporary non-permit required confined space. Once the PRCS has been reclassified the space may be entered in accordance with section 6.2.1.

All determinations for reclassifying a space to non-permit status shall be documented and certified using ***Attachment C***, the Confined Space Entry Permit. If a PRCS will be routinely reclassified to a non-permit-required confined space, ***Attachment D*** should be completed to document the hazard elimination procedure for use during future entries. The attachments shall be made available to the employees entering the space upon request.

6.2.2.2 Entry by Alternate Procedure – Hazardous Atmosphere Only

When the ONLY hazard within the space is atmospheric and it can be controlled by continuous forced air ventilation, a PRCS may be entered by following alternate entry procedures. Alternate entry procedures can only be used when:

1. The confined space has been classified as a PRCS Alternate Entry Procedure space and/or the ***Entry Supervisor*** has determined that the only hazard in the space is an actually or potentially hazardous atmosphere; AND
2. The atmospheric hazard can be controlled through the use of continuous forced air ventilation; AND
3. The effectiveness of the continuous forced air ventilation is sufficient to maintain the space safe for entry as demonstrated by air monitoring results.

In order to initially re-identify a PRCS to an alternate procedure space, data must be collected, which may require an entry as a PRCS, to demonstrate that all atmospheric hazards (including those indicated in Table 1 in section 6.3.2) are adequately controlled by forced air ventilation.

At a minimum, alternate entries require following section 6.2.2.3 to reclassify the space, an entry permit (***Attachment C***), ***Entry Supervisor, Attendant, Entrant***, atmospheric monitoring, and forced air ventilation. The controlling of atmospheric hazards with forced air ventilation is a control measure and does not eliminate the hazard; therefore, continuous air monitoring must be conducted within the space to verify that conditions are acceptable for and during entry. If a hazardous atmosphere is detected during entry, the space shall be evacuated immediately and the space shall be evaluated to determine how the hazardous atmosphere developed; corrective measures must then be implemented prior to any re-entry.

If a PRCS will be routinely entered by an alternate entry procedure, ***Attachment D*** should be completed to document the specific procedure for the control of the hazardous atmosphere in that PRCS for use during future entries.

6.2.2.3 Permit-Required Confined Space Entry Procedures

At a minimum, entry requires an entry permit***, Entry Supervisor***, ***Attendant***, ***Entrant***, atmospheric monitoring, forced ventilation as needed to eliminate or control atmospheric hazards, and provision in advance for rescue (see Section 6.4).

ENTRY PLANNING:

The ***Entry Supervisor*** will:

1. Assess the need and/or purpose for entering the space.
2. Review the Confined Space Hazard Identification/Evaluation Form to determine whether current conditions within the space are consistent with those identified.
3. Review and evaluate all aspects of the work to be performed to determine whether a new hazard could be created or an existing hazard magnified and to identify appropriate hazard control measures.
4. Review previous entry records (completed permits). Carefully assess any comments or difficulties noted and proceed accordingly.
5. Confirm that the entry team (***Entry Supervisor***, ***Attendant*** and ***Entrants***) has received requisite training in its assigned duties.
6. Make all necessary pre-notifications of rescue services whether within the Bureau or to an outside agency (see Emergency Procedures Section 6.4).
7. Prepare for and be equipped to follow the appropriate Emergency Procedure identified in Section 6.4.
8. Notify other workers and supervisors in the area that an entry will take place.

PRE-ENTRY PROCEDURE:

The entry team will:

1. Review/complete entry permit, including all pre-entry checks, requirements and controls.
2. Implement controls that are capable of being accomplished prior to opening of the space.
3. Prepare to open the space by eliminating any condition that could make it unsafe to remove manholes, doors, hatches or covers.
4. Open the space. When the entrance covers are removed, ensure that the entrance is appropriately barricaded (traffic cones and/or barricades) to create safe working conditions and prevent unauthorized entry into the space or inadvertent fall hazards.
5. Implement any additional controls as identified on the permit that required opening of space.
6. Perform and document initial air monitoring in accordance with air monitoring requirements (Section 6.3.2) before entry and, if required, before initiating forced air ventilation. If acceptable readings are not achieved, **NO ENTRY WILL BE MADE**.
7. If required, establish forced air ventilation in accordance with Section 6.3.3 to meet the entry permit requirements. Perform and document air monitoring to

verify conditions are acceptable. If acceptable readings are not achieved, **NO ENTRY WILL BE MADE**.

8. After evaluating pre-entry readings and instituted hazard controls, the ***Entry Supervisor*** may authorize entry under the appropriate classification: alternate entry procedure, temporarily reclassified non-permit-required spaces, or PRCS.
9. Ensure that the entry permit properly reflects the information identified during the pre-entry process. Post the signed entry permit near the confined space entrance.
10. Station the ***Attendant*** outside of the space and ensure that a system is in place for communication with ***Entrants***.

ENTRY PROCEDURE:

1. If non-entry rescue equipment is utilized, the ***Entrant*** will connect to the non-entry rescue retrieval system in accordance with Section 6.4 and carefully enter.
2. Commence continuous air monitoring in accordance with Section 6.3.2 for the duration of the entry and record periodically (e.g., every 15 minutes) on the permit.
3. Implement any additional controls identified on the permit that required entry into the space.
4. Immediately evacuate the space if hazards arise inside or outside the space that may endanger entrants such as unusual odors or unexpected hazardous conditions, alarming of air monitoring devices, signs or symptoms of exposure or any other condition that may impact the health or safety of entrant(s).
5. If a space is evacuated, no re-entry will be made until air monitoring readings are determined to be within acceptable range and/or any other unanticipated hazardous condition, as confirmed by the entry supervisor, is corrected. If permit conditions change for re-entry, a new permit must be completed.
6. The entry permit will be cancelled on-site by the ***Entry Supervisor*** when work is complete or any previously unidentified hazardous conditions develop. Any safety and health issues encountered during the entry must be noted on the permit.
7. After the PRCS work is complete, the completed permit must be returned to the ***RI***.

SEQUENTIAL SEWER ENTRIES UNDER ONE PERMIT:

When entries are made at multiple points in a sewer system over the course of the same day, entry may be made under a single permit, using the same precautions and procedures described above at each location. Each entry must be documented on the permit (***Attachment C***) including air monitoring and entrant accounting at each location.

6.2.3 Contractor Entry Procedures

The DEP ***Contract Supervisor*** shall ensure that the Operating Bureau communicates and coordinates with the Contractor in regards to identified hazards within and around confined spaces that may be entered as well as any precautions and procedures that have been implemented for the protection of employees. A plan detailing how hazard communication and coordination will occur shall be incorporated into the work plan or other written document and approved/accepted by both Contractor and Operating Bureau.

At the conclusion of any entry operations, the DEP ***Contract Supervisor*** will debrief contractors regarding the PRCS program followed and regarding any hazards confronted or created in PRCSs during the entry operations. The DEP ***Contract Supervisor*** will provide any pertinent information from the debriefing to the facility ***RI*** for inclusion in the confined space program as necessary.

6.2.3.1 Shared Spaces

Where contractors share a space with an operating (or other) bureau, the contractors shall fully comply with all aspects of this policy (training shall be in compliance with OSHA requirements). The Contracting Bureau EHS shall be responsible for reviewing and accepting the Contractor's Confined Space Program for compliance with this Policy.

Space classifications shall be as classified by the Operating Bureau or may be reclassified as agreed upon by both Contractor and Operating Bureau.

When a joint entry is to be made into a PRCS, the Contractor shall use the DEP permit or Operating Bureau approved equivalent. Contractor's rescue service/system shall be adequate for all personnel (Contractor and DEP) entering the confined space, and DEP personnel will enter under the Contractor's approved rescue plan.

6.2.3.2 Contractor Spaces

When contractors are working in an area with no active DEP operations which has been cleared by the DEP facility ***RI*** and released to the Contractor, the contractor may enter PRCSs utilizing its own confined space program which must comply with all OSHA requirements. At a minimum, the contractor shall utilize the DEP confined space classifications, unless or until a re-evaluation and re-classification by the Contractor is completed and the ***Contract Supervisor*** consents to the re-classification.

When DEP personnel are required, for inspection and/or observation purposes, to enter a contractor PRCS in a work area wholly relinquished to a contractor, such entry may be done under the Contractor's permit and work procedures.

6.2.3.3 Tunnels

When the work to be performed consists of solely construction-type activities located in an underground tunnel, shaft, chamber, or passageway, the contractor may utilize a confined space entry program or develop a program in compliance with the OSHA Underground Construction standard (29 CFR 1926.800), as appropriate.

6.3 Hazard Control and Protective Equipment

6.3.1 Hazard Elimination and Control

The elimination of all hazards in a PRCS is required prior to entry, whenever feasible. When hazards cannot be eliminated, controls must be implemented for the protection of entrants. In evaluating the entry hazards and specifying controls, the ***Entry Supervisor*** must also consider any hazards that may be created by the work to be conducted in the space. Welding, application of coatings, opening of piping, and other work may introduce into the space additional hazards that must be controlled. The introduction of hazards may also necessitate the re-evaluation of air monitoring, ventilation, personal protective equipment, and any other established precautions. The ***Entry Supervisor*** must verify that hazard elimination and/or control is conducted and documented on the entry permit or other required forms.

Isolation

Whenever possible, prior to entry, a confined space must be protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lock-out and/or tag-out of all sources of energy; or blocking or disconnection of all mechanical linkages.

Blanking or lockout of gates and valves is usually sufficient for the control of most liquids if the minor leakage that may occur from a single valve does not create a serious hazard or interfere with escape. Double block and bleed or misaligning/removing sections of lines is used for high hazard liquids and gases where even small leakage may present a hazard to entrants.

The DEP Control of Hazardous Energy Lock-Out/Tag-Out policy, Bureau-specific procedures and equipment-specific energy control procedures for lockout of processes and equipment must be followed when isolating energy and equipment hazards.

Preparation

Confined space preparation involves the removal of conditions that may present a serious hazard or impair self-rescue, including removal of potential sources of hazardous atmospheres. Non-serious hazards may remain after the space has been prepared for entry; however, those hazards must be addressed as required by other DEP policies and procedures and/or regulations.

6.3.2 Air Monitoring

Air monitoring is required to determine whether acceptable entry conditions are present immediately prior to, and during entry, and for use in devising and implementing adequate control measures for the protection of authorized entrants. Monitoring for atmospheric hazards including the parameters specified in Table 1 must be conducted by individuals trained in the use of the monitoring equipment and under the supervision of the ***Entry Supervisor***. Air monitoring results shall be recorded on the entry permit and should be posted outside the space so ***Entrants*** can confirm that the atmosphere is safe before any entry or re-entry. ***Entrants*** may observe air monitoring as it occurs. Continuous monitoring and periodic recording of results is required whenever a space is occupied.

Exposure Limits

Exposure limits for confined space entry are based on atmospheric concentrations of various parameters capable of causing death, incapacitation, injury, acute illness or impairment of ability to self-rescue. These are limits requiring immediate evacuation if exceeded in a confined space. Exposure limits for chronic or other health effects may be different and must be addressed separately. Contact ***BEHS*** for assistance in establishing limits for additional atmospheric hazards (chlorine, mercury, methane, etc.).

Minimum air monitoring requirements and acceptable limits are:

Table 1

Parameter	Confined Space Exposure Limit (Acceptable Range)
Oxygen	19.5% to 23.5%
LEL	less than 10% of the LEL
Hydrogen Sulfide	less than 10 ppm
Carbon Monoxide	less than 35 ppm

Calibration

All air monitoring equipment must be regularly calibrated, inspected and maintained per manufacturers' instructions. Calibration is the adjustment of the instrument's reading to coincide with a known (standard) concentration of test gas. Calibration is required when an instrument fails a bump test (see below); after it has been serviced; and as specified by the manufacturer. Calibration cycles vary and are based on the application and frequency of usage of the instruments. Calibration cycles must be between 30 and 90 days. For instruments that are used infrequently, calibration can take place prior to use. In the absence of manufacturer's recommendations, the instrument's calibration cycle must not exceed 30 days. If an instrument is not calibrated or fails calibration it shall not be used.

Bump Tests

Prior to each day's use, a bump test of the air monitoring equipment must be made. A bump test is conducted by exposing the instrument to a test gas or test condition to verify meter response. A bump test that activates alarms is preferred. If the bump test results are not acceptable, calibration must be performed.

Air Monitoring Locations

Air monitoring locations shall be selected based on the size and configuration of the space, location of potential contaminant sources, and the characteristics of potential contaminants including gas/vapor density. During entry, monitoring locations must include the breathing zone of the entrants. More than one meter may be required depending on the size and configuration of the space, the hazards, and the number and location of ***Entrants***. Meters must be located so that audible and/visible alarms are readily apparent to ***Entrant(s)*** or ***Attendant(s)*** at all times when the space is occupied.

Meter Response Time

Sampling at each location shall be of sufficient duration to allow for meters to respond. If hoses are attached to meters, additional time is required for the atmospheric sample to be pumped through the hose. Consult the operating manual for response times and pump flow rates.

6.3.3 Ventilation

Natural ventilation should be maximized to the extent feasible by opening covers, hatches or other barriers that restrict the natural flow of air through the space. Forced air ventilation may be used to remove a non-recurring hazardous atmosphere that cannot be removed through natural ventilation, for the continuous control of atmospheric hazards, or for human comfort during entry.

When continuous forced air ventilation is used during entry, the ventilation must be directed so as to ventilate the immediate areas where entrants are or will be within the space; it must operate until all entrants have left the space. The air supply utilized for ventilation must be from a clean source and may not increase the hazards in the space. Air exhausted from the confined space must be so directed that it does not impact the ***Attendant*** or support staff.

Forced air ventilation may be used to eliminate a non-recurring atmospheric hazard, allowing for reclassification if the requirements of Section 6.2.2.1 are satisfied. When monitoring confirms that the atmosphere in the space is acceptable and that a hazardous atmosphere will not recur, continued forced air ventilation is not required. To verify that ventilation is not required, air monitoring must be conducted prior to entry with the ventilation off over a set period of time based on the characteristics of the hazard.

For spaces where the ONLY hazard is atmospheric and continuous forced air ventilation can control the atmospheric hazards, alternate entry procedures may be followed if all requirements of Section 6.2.2.2 are satisfied.

6.3.4 Personal Protective Equipment

Personal protective equipment (PPE) shall be selected in accordance with the DEP Personal Protective Equipment policy. The ***Entry Supervisor*** must identify hazards requiring PPE,

specify the PPE and document it on the entry permit. ***BEHS*** may be contacted for assistance in hazard assessment and PPE selection.

Respiratory protection selection and use, including the use of escape packs, shall be in accordance with the DEP Respiratory Protection Policy. The ***Entry Supervisor*** must identify hazards requiring respiratory protection and consult with the Respiratory Protection Program Administrator to select the proper respiratory protection. The respiratory protection requirements must be documented on the entry permit.

For protection of entrants during entry into any IDLH or potentially IDLH atmosphere, selection of PPE, respiratory protection, and other precautions must be in accordance with a ***BEHS*** approved procedure or ***BEHS*** must be consulted prior to entry.

6.3.5 Communication

Two types of communication are required during entry: communication between the ***Attendant*** and ***Entrants***, and communication between the ***Attendant*** and emergency responders. The ***Entry Supervisor*** must verify that communication is adequate and communication equipment is operable, and document same on the entry permit.

Entrant-Attendant Communication

The minimum level of communication required at all times is the ability to provide notification of an emergency. This may be accomplished through verbal communication, hand signals, warning horns or signals, or other methods. The ***Entry Supervisor*** must verify that the ***Entrant(s)*** and ***Attendant(s)*** have coordinated signals so there is no confusion that could cause a delay in egress from the space or other emergency action.

Attendant-Rescue Communication

The ***Entry Supervisor*** shall verify that communication between the ***Attendant*** and rescue services is adequate and timely based on the specific rescue provisions established for the entry. The ***Attendant*** shall not have to leave an occupied space unattended in order to make emergency communications.

6.4 Emergency Procedures

The ***Entry Supervisor*** is responsible for ensuring that location-specific emergency procedures have been established and communicated to all ***Entrants*** and ***Attendants*** prior to anyone's entering a PRCS since conditions, locations, and staffing vary from place to place. **If the emergency procedure for an entry cannot be properly implemented, the entry shall be postponed and permit cancelled until all issues have been addressed.**

In the event of an emergency requiring rescue, non-entry rescues are the preferred method of rescue whenever possible. Non-entry rescues can be performed by the ***Attendant, Entry Supervisor,*** and/or other personnel with documented training in non-entry rescue. The ***Entry Supervisor*** is responsible for ensuring that non-entry rescue equipment is adequate to carry the weight of those authorized to enter the PRCS. Typically, non-entry rescue equipment is rated for

310 lbs., including PPE; however, equipment ratings vary so each unit should be checked.

All PRCS entries require that plans be established for summoning rescue and emergency services in case a rescue requiring entry is needed. Rescues requiring entry into a PRCS shall only be performed by PRCS entry rescue-trained DEP personnel and/or available PRCS entry rescue services.

6.4.1 Evacuation

Confined space ***Entrants*** are required to immediately evacuate a confined space whenever:

- An order to evacuate is given by the ***Attendant, Entry Supervisor*** or other ***Entrants***;
- An air monitor alarm or evacuation alarm sounds;
- An unusual or prohibited condition is detected;
- An ***Entrant*** experiences behavioral effects of hazard exposure;
- Communications are compromised;
- A situation is detected outside the space that could endanger the ***Entrant***;
- The ***Attendant*** cannot effectively and safely perform all of his or her duties; or
- Any other situation arises that may compromise the safety of the ***Entrant***.

Confined space ***Entrants*** will not re-enter a confined space until the source of the problem is identified, the condition is abated, and re-entry is authorized by the ***Entry Supervisor***.

6.4.2 Non-Entry Rescue

Non-Entry rescue is the preferred method of rescue for **all PRCS** entries and can be performed by the ***Attendant, Entry Supervisor,*** and/or other personnel with documented training in non-entry rescue**.** A non-entry rescue allows for the removal of an entrant from a space while minimizing the risk to personnel performing the removal since they do not enter the space. When initiating a non-entry rescue the following should occur:

- Summon rescue, other emergency services and additional on-site assistance.
- Confirm that the ***Entrant's*** body harness is attached to the retrieval system and that the ***Entrant*** is positioned so that he or she will not become entangled with or strike against pipes, machinery or equipment.
- If the ***Entrant*** has sustained an injury that may be aggravated by non-entry removal and conditions are not immediately dangerous to life and health, wait for professional rescue services to arrive and package the ***Entrant*** for removal.
- Perform non-entry rescue.

6.4.3 New York City (In-City) - Entry Rescue

6.4.3.1 Phase I – Pre-Notification of Confined Space Entry

PRCS entries which are considered and documented to be *routine* for in-City Bureaus will be covered under the current DEP-FDNY agreement which does not

require pre-notification to FDNY. Locations and/or types of routine PRCS entries have been reviewed and agreed upon by FDNY and DEP. The estimated response times are less than 5 minutes which is acceptable to DEP.

Examples of BWSO (non-routine PRCS entries requiring pre-notification to FDNY):

- Sewer manhole dives to target a connection
- Visual inspection of a sewer line
- Plugging a sewer main
- Sewer Flushing which requires entry of DEP personnel.

Examples of BWT (non-routine PRCS entries requiring pre-notification to FDNY):

- All Plant Entries
- Chemical Tanks
- Sewer line entry

In situations where use of a body harness might increase the overall risk during entry, would not facilitate an external rescue, or employees need to unhook from the lifeline, emergency service units shall be provided with advance notification of the entry to be performed. In-City designations of non-routine and routine PRCSs may be found on Pipeline under the Confined Space Policy. These designations will be reviewed and updated by Bureaus during their annual program review.

All pre-notifications shall be documented on the permit. Other unanticipated situations may arise that are and may require pre-notification to FDNY to evaluate or plan for more rapid response times. Each affected Bureau should periodically communicate with Fire and Police rescue groups to offer coordination, familiarization, pre-planning and exercise opportunities. Pre-entry notifications should be made to the Fire Department utilizing the contact information below:

Fire Department
Chief of Rescue Operations or Officer
on Duty Special Operations Command
Tel. #: (212) 755 – 8684 or 212-755-8597
Fax #: (212) 755 – 8470

Police Department
Emergency Services Unit
Tel. #: (718)-677-8300
Fax #: (718)-677-8330

6.4.3.2 Phase II – Emergency Numbers on Entry Permit

The Emergency Phone Number space on each Confined Space Entry Permit must include 911 and one of the following telephone numbers for the Fire Communications Center for the borough where entry is made:

Manhattan:	212-999-2222
Bronx:	718-999-3333
Brooklyn:	718-999-4444

Queens: 718-999-5555
Staten Island: 718-999-6666

6.4.3.3 Phase III – Emergency Situations

If an emergency situation arises, the DEP ***Entry Supervisor*** and/or the ***Attendant*** shall ensure the following occurs:

1. 911 is called and the operator is provided with all pertinent information (i.e., address and exact location, number of people involved, type of incident if known, etc.).**The caller to 911 must state that this is a "CONFINED SPACE INCIDENT."**
2. A call (or patch through by 911 operator) is made to the appropriate Fire Communications Center directly. **Note:** a Police Department Emergency Rescue Unit may be dispatched if FDNY commitments so require. Average time to respond is less than five minutes.
3. Bureau specific emergency notification protocols are implemented.

6.4.4 Upstate - Entry Rescue

6.4.4.1 Permit Required Confined Spaces

In general, an on-site rescue team should be assigned and standing by prior to any entries being made into a PRCS. The confined space rescue team may be a DEP rescue team or a vetted and approved external confined space entry rescue team.

The ***Entry Supervisor*** will work with the rescue team to ensure that it is afforded access to the PRCS and provided with information regarding the planned work activities and associated hazards for rescue pre-planning purposes. All PPE and rescue equipment necessary for making the rescue will be assembled and brought to the site prior to entry into the PRCS being allowed.

In the event of an emergency, rescue services will be summoned by the ***Attendant, Entry Supervisor*** or ***Entrants*** when needed. The procedure to summon additional emergency services such as medical services (i.e., ambulance) is to call either 911 or, if other than 911, the emergency phone number entered in the appropriate space on the entry permit.

There is a limited number of locations where it may be possible to utilize an off-site rescue team; however, the use of an off-site rescue team must be approved in advance by ***BEHS*** and ***Bureau Senior Management***.

6.4.4.2 Alternate Procedure Spaces

Prior to allowing any work to be done in an alternate procedure confined space, the ***Entry Supervisor*** must determine how contact will be made with rescue services should the need arise. The applicable phone numbers must be on the entry permit form as well as posted at the communication source that might be used.

7 TRAINING

All employees required to enter a confined space must be trained in DEP entry policies and procedures and the proper use of specified equipment prior to their being assigned confined space entry duties. The training is designed to ensure that employees acquire the skills, understanding and knowledge necessary for the safe performance of duties under this program. Training can be provided as broken out below or may be combined depending on the needs of the employee.

1. **Entrant/Attendant** - Participants will be trained in the duties of the authorized ***Entrant*** and the confined space ***Attendant***. Topics to be covered include: hazards that may be faced during confined space entry; proper use of confined space equipment such as air monitoring equipment, ventilation apparatus, PPE, and non-entry rescue equipment and standard entry procedures and emergency procedures including performance of non-entry rescue. ***Entrant/Attendant*** training will include an entry into an actual or simulated confined space.

2. **Entry Supervisor and Hazard Analysis** - Participants will be trained in the duties of the ***Entry Supervisor*** including how to properly assess hazards, and to plan and supervise entry into confined spaces including completion of entry permit, verification of permit conditions and termination and permit close-out procedures. Participants will also be trained in emergency planning and non-entry rescue procedures. Training will emphasize understanding and application of regulations, hazard recognition and control, DEP Confined Space program and other pertinent DEP policies and programs. Prerequisite to this training is ***Entrant/Attendant*** training.

3. **Confined Space Rescue** - Each rescue team member will be trained and/or current in the following requirements:

   - Trained to perform confined space entry, the assigned rescue duties and in the characteristics of the space;
   - Practiced in making a PRCS rescue at least once every 12 months;
   - Trained in the proper use of PPE and rescue equipment;
   - Trained in basic first-aid and CPR; and
   - Be familiar with the emergency services for providing necessary medical services if other than 911.

   Note: While all members of the recue team must be trained in first-aid and CPR, OSHA requires only that a minimum of one member of the rescue team holds a current certification in first aid and CPR.

4. **Refresher or additional training** - Training is required before a change in assigned duties (e.g., to entry supervisor); whenever there is a change in PRCS operations that presents a hazard about which an employee has not previously been trained; whenever there is reason to believe that there are deviations from the accepted program or inadequacies in the employee's knowledge; or whenever there is a significant change in policy.

5. **Awareness level training** - DEP encourages awareness level training and communications for all employees working in locations where they may come into contact with confined spaces but are not expected to enter them. Such employees must be able to recognize the existence of a confined space and be instructed to avoid this hazard. This training can be integrated into other training (e.g., Right-to-Know).

8 METRICS AND AUDITING

This program must be reviewed annually and entry procedures revised, as needed, by the ***RI*** and ***BEHS***. The annual review will include a review of the following:

- Review of all entry permits generated since the last annual evaluation;
- Review of permits for proper completion and certification of hazard elimination;
- Review of permits for effectiveness in controlling and communicating hazards; and
- Review of permits for proper close-out, documentation and recordkeeping.
- Review of routine and non-routine PRCS designations.

The review must be documented using ***Attachment F***. Regulations also allow a rolling evaluation within 1 year after each entry (although this may be more difficult to administer) and do not require a review if no entry was performed during a prior 12-month period.

The review will identify entry procedures that did not protect from PRCS hazards, employees participating in entry operations. Such procedures must be modified for use in subsequent entries as necessary to protect employees. If the reviewers believe this DEP Confined Space Entry program should be revised to facilitate hazard control, they shall so advise OEHS.

9 RECORDKEEPING

The ***RI*** will retain all canceled entry permits for at least one year to facilitate the annual review of the program. Training records will be kept and maintained by ***BEHS.***

10 ATTACHMENTS

Attachment A Confined Space Inventory
Attachment B Confined Space Hazard Identification/Evaluation Form
Attachment C Confined Space Entry Permit
Attachment D Confined Space Reclassification Form
Attachment E Non-Permit Entry Documentation Form
Attachment F Annual Review Documentation

ATTACHMENT A
CONFINED SPACE INVENTORY

Bureau: _____ Division: _____

Location/Operation/Workgroup: _____

ID No.	Name / Location of Space	Classification (check box after completion of Evaluation)				PRCS Re-Classification Status (insert date procedure developed)	
		PRCS	PRCS - Atmospheric Only	Non-Permit Confined Space	Not a Con-fined Space	Alternate Entry Procedure*	Non-Permit Entry Procedure **

* PRCS with **only** atmospheric hazards with written standard procedure for alternate entry.
** PRCS with written standard procedure for temporary reclassification to a Non-Permit Confined Space.

Person conducting initial inventory: (Print name)_____

Signature of person conducting initial inventory:_____ Date:_____
(Signature

ATTACHMENT B
CONFINED SPACE EVALUATION
AND CLASSIFICATION

Bureau:	
Facility/Location:	
Description of Space:	
Space ID#:	
☐ Check if this is a reevaluation or reclassification and explain in Section 3 or attach documentation.	

SECTION 1 – CONFINED SPACE DETERMINATION

		Yes	No
1A	**Is space large enough to bodily enter and perform work?**	☐	☐
1B	**Does space have limited or restricted means for entry and exit?**	☐	☐
1C	**Is the space "not designed" for continuous occupancy?**	☐	☐
If yes to all three - the space is a confined space. Proceed to hazard assessment in Section 2. *If no to any question – the space is not a confined space. Complete form in Section 3.*			

SECTION 2 – EVALUATION

			Yes	No
2A	**Contains or has the potential to contain a hazardous atmosphere?**		☐	☐
	If Yes, Specify: Oxygen (< 19.5% or > 23.5%)	☐		
	Flammable (>10%LEL)	☐		
	Toxic/Corrosive (Specify)			
	Other (Specify)			
2B	**Contains a material with the potential for engulfment?**		☐	☐
	If yes, Specify:			
2C	**Contains converging walls or other internal configuration hazard which could cause entrapment?**		☐	☐
	If yes, Specify:			
2D	**Contains any other serious safety or health hazard?** (Mechanical, Energy, Heat, Electrical, Chemical, Noise)		☐	☐
	If yes, Specify:			
If the answer to any question above is "yes" – the space is a Permit-Required Confined Space *If all answers are "no" – the space is a Non-Permit Required Confined Space*				

SECTION 3 - CLASSIFICATION

	Not a Confined Space	☐
	Non-Permit Required Confined Space	☐
	Permit-Required Confined Space *With Atmospheric Hazard Only* ☐	☐
Notes or Comments:		
Survey Conducted By (Print Name):		
Signature:		
Date:		

ATTACHMENT C
CONFINED SPACE ENTRY PERMIT

SECTION 1 - PRE-ENTRY

Date:	Space ID#:	Permit #:
Location:		
Space Description:		
Purpose of Entry:		
Entry Date &Time:	Entry Expiration Date & Time:	

Pre-Entry Preparations	Yes	No	n/a		Yes	No	n/a
Draining				Lock-Out/De-Energize/ Isolation			
Cleaning				Purging/Flushing/Venting			
Secure work area				Forced Air Ventilation			
Other (specify):				Other (specify):			

Additional Hazards including those created by work in the space:		Hazard completely controlled/eliminated?	
Hazard:	Control:	Yes	No
Hazard:	Control:	Yes	No
Hazard:	Control:	Yes	No

Entry Equipment	Yes	No	n/a		Yes	No	n/a
Traffic workzone equipment				Ventilation (type):			
Fall barriers/warning signs				Communication (type):			
Fall protection/non-entry rescue				PPE (specify):			
Access ladder				PPE (specify):			
Lighting (explosive proof?)				Other (specify):			
Escape Pack				Other (specify):			

Air Monitoring	Yes	No	n/a	Pre-Entry Readings:	Top	__ft.	__ft.	Bottom
Meter Calibrations Current				Oxygen (19.5 to 23.5%)				
Bump-Test/Fresh Air Checks				LEL (<10%)				
Can acceptable readings be maintained without continuous forced air ventilation?				H2S (<10 ppm)				
				CO (<35 ppm)				
				Other (specify):				
				Other (specify):				

SECTION 2 - ENTRY AUTHORIZATION

Type of Entry	Requirements	Select Type
Temporary Non-permit Space	All hazards confirmed temporarily eliminated.	☐
Alternate Procedure Entry	The only hazard is atmospheric that is controlled by continuous forced air ventilation. Air monitoring results confirm effectiveness of ventilation.	☐
Permit Required Confined Space	Entry to be made under permit conditions. Sections 3 and 4 must be complete before signing authorization.	☐
Entry Supervisor Name:		
Signature:		

SECTION 3 - ADDITIONAL PRCS ENTRY REQUIREMENTS

For PRCS entry specify hazard(s) not completely controlled or eliminated and additional precaution(s) to be followed:

SECTION 4 - RESCUE PLAN

Rescue Pre-notification ?	Yes ☐ No ☐	Non Routine Entry? Yes ☐	No ☐
Emergency Phone Numbers	Rescue Team if not 911:	Other required notification numbers:	

Emergency Communications	Radio	☐	**On-Site Rescue Equipment**	Retrieval System	☐
	Cell Phone	☐		Harness	☐
	Other (specify):	☐		SCBA	☐
Rescue Methods	Non-Entry	☐		Other:	☐
	Entry rescue:			Other:	☐
	Off-Site Team:_____	☐			
	On-Site Team:_____	☐			
Rescue Plan Details:					

SECTION 5 – ENTRY AND AIR MONITORING LOGS

Meter#: Conducted by: ☐ Check if additional pages used.

Time	Area	O2	LEL	H2S	CO	Other:		Time	Area	O2	LEL	H2S	CO	Other:

Authorized Entrants	In	Out	In	Out	In	Out	In	Out	In	Out
Attendant(s):										

*Time in and out must be logged for each entrant.

SECTION 6 –ENTRY CLOSE-OUT FOR PERMIT ENTRIES

Reason: ☐ Entry Completed ☐ Prohibited Condition ☐ Other:	
Comments and/or problems encountered:	
Date:	Time:
Entry Supervisor Name:	Signature:

POST PERMIT AT THE CONFINED SPACE DURING ENTRY

ATTACHMENT D

Confined Space Reclassification

Space Name:	Date:
Space Location:	Space ID No.:

The following actions form the basis for determining that all hazards identified on Confined Space Evaluation survey have been eliminated or controlled. These actions must be verified complete prior to reclassification of this confined space to Non-Permit space or Alternate Entry Procedure space.

Potential Hazard	Description	Elimination Method (List or Attach)
Example: Inundation	Potential for water to fill the from main water supply pipes to fill the clarifier with water.	1. Close and lockout chemical feed pump and chemical feed shutoff valve. 2. Close and lockout inlet Valves 1 and 2 3. Pump out clarifier to Sludge Tank 4. Close and lockout Sludge Outlet valve.

☐ **Alternate Entry Procedure Space:** I certify that the only hazard(s) are atmospheric hazards within this space and the atmospheric hazard(s) can be controlled by forced air ventilation alone as demonstrated by the attached data (if a PRCS entry was necessary attach permit).

☐ **Non-Permit Space – Permanent Reclassification:** Hazard elimination procedures (above or attached) have been implemented, are permanent and all hazards within this space have been **permanently eliminated**. This space is now permanently reclassified as a non-permit space unless new hazards appear or are introduced.

☐ **Non-Permit Space – Temporary Reclassification:** The procedures above (or attached) have been found to reliably eliminate all hazards within this space on a temporary basis, until the work is complete and the controls are removed. This space can be temporarily reclassified as a non-permit space using these procedures unless new hazards appear or are introduced.

***Note**: control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards.*

_____ _____ _____

Printed Name Signature of Reviewer Date

ATTACHMENT E

NON-PERMIT Required Confined Space Entry Air Monitoring Log

Date: / /

Location: _____ Confined Space # _____

Description: _____

Nature of work (i.e., inspection, repair, maintenance): _____

Entrant(s): _____

Required Air Monitoring - O_2, LEL, CO, H_2S

Additional required air monitoring based on location (i.e. Cl_2, Hg, etc.): _____

Acceptable Air Levels

Oxygen 19.5% to 23.5%, LEL <10%, Hydrogen Sulfide < 10 ppm, Carbon Monoxide <35 ppm,
Other: _____ Other: _____

Initial Air monitoring must be performed prior to every entry. Monitor all items listed in order listed & record time of readings. Use "other" column for any additional parameters.

Time	Location	Oxygen	LEL	H2S	CO	Other	Initials
_____	opening	_____	_____	_____	_____	_____	_____
	halfway	_____	_____	_____	_____	_____	_____
	bottom	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
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_____	_____	_____	_____	_____	_____	_____	_____
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_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____

Note problems or issues encountered during entry operations (use back of page if needed):

_____

_____

_____

ATTACHMENT F

ANNUAL CONFINED SPACE PROGRAM REVIEW

Bureau/Division/Facility:	
Individual Responsible for Local Program:	
Annual Review Participants:	
Review Date:	

Yes	No	n/a	Identification, Evaluation and Labeling of Confined Spaces
☐	☐	☐	Have inventories and evaluations been updated to reflect changes to facilities, equipment and/or hazards, or routine/non-routine designations??
☐	☐	☐	Are labels, signs or other methods used to inform employees of permit-required confined spaces?
Permit Review Review permits from last 12 months, including temporary reclassifications & alternate procedure entries.			
☐	☐	☐	Are entry preparations and precautions appropriately noted on the permits?
☐	☐	☐	For a representative sample of permits obtain the confined space evaluations. Are the entry preparations and precautions consistent with the hazards listed in the evaluation?
☐	☐	☐	Are permits consistently correct and complete? If not, note the specific sections below and obtain feedback from the entry supervisor to identify corrective actions to the permit, entry procedures or written program.
☐	☐	☐	Were there any injuries or near misses attributable to failure of the program or failure to follow the program?
☐	☐	☐	Were there any conditions encountered that were not captured on the evaluation or identified on the entry permit?
☐	☐	☐	Were entry procedures adequate to protect employees from PRCS hazards?
Training			
☐	☐	☐	For a representative sample of permits obtain training records for the entry team. Was training current for entrants, attendants, supervisors and rescue personal at the time of the entry?

Corrective Actions and Comments

Based on the information above as well as feedback from review participants, list corrective actions and name of individual responsible for follow-up. Also, provide any comments or concerns to be forwarded to OEHS regarding the Agency program. Use back of form if additional space is needed.

Local Program including permits and entry procedures:	
Program issues to be sent to OEHS:	

Reviewer Name:		Individual Responsible for Local Program:	
Signature/Date:		Signature/Date:	

The Agency's Confined Space Entry Program includes a requirement for a Bump Test (subsection 6.3.2). This Bump Test is to be performed on all air monitoring equipment ("meter") used for confined space entry, at the beginning of each day the meter is used. This document will serve to provide guidance as to the requirements for a Bump Test.

A Bump Test is used to determine whether the meter is actually responding to the environmental conditions around it or is just relying on the internal check of the equipment's electronics, performed upon startup of the meters. It can also be used to demonstrate that the audible alarm is operational.

Bump tests are not required by regulations, but both OSHA and meter manufacturers address them in information bulletins, technical notes and operating instructions. The definition of Bump Tests is not consistent throughout the industry. For DEP, a Bump Test is defined as exposure of the meter to a condition such that at least one of the components being monitored for falls outside the acceptable range (as indicated in subsection 6.3.2) set point(s), activating the meter's alarm. It is intended to "check" the instrument's responsiveness without performing a full calibration test.

Some methods for the Bump Test include (a) breathing into the meter to activate the Oxygen sensor for low level (without making any contact between the mouth and the orifice of the meter or other potentially contaminated surface); (b) placing a magic marker or "Sharpie" briefly in front of the sensor to activate the LEL sensor for high level.

Equipment such as Bump Test Cylinders may also be used to perform this test. Placing the sensor near the exhaust of a vehicle is NOT recommended as it is likely to have deleterious effects on the sensor. The operator's manual for the meter may also provide information on recommended methods for performing Bump Tests.

After the Bump Test is performed, the meter must be taken into fresh air and "zeroed" out so that it is ready for use.

In addition to the Bump Test defined above and any normally scheduled calibration, operators using meters during confined space entries must take the meter out of service and have it calibrated after the following types of events:

1. The meter is dropped.
2. The meter is exposed to another type of impact.
3. The meter is submersed/partially submersed in water.
4. The meter registers a High Alarm condition (excluding Bump Test).
5. The meter indicates failure during startup.

Further, it is recommended that the meter be calibrated immediately prior to its use when workers are performing potentially high hazardous tasks, including: hot work in a confined space; construction work in a Class 1/Div 1 Area; and other tasks, as designated by the Responsible Individual or Bureau EHS. In the event of an emergency situation in which calibration equipment is not immediately available, a suitable Bump Test may be performed.

After calibration, a tag must be affixed to the meter indicating the date of the next required calibration.

Appendix I

NYCDEP Extreme Hot & Cold Weather Guide

(NYCDEP policies, procedures and guidelines are not available at the time of preparation of this HASP. A copy of these policies, procedures and guidelines will be inserted into this appendix prior to mobilization of the field sampling team.)

Appendix J

NYCDEP Hearing Conservation

Hearing Conservation

Environmental Health & Safety Policies, Procedures and Guidelines

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Applies to:	All DEP Bureaus and Offices
EHS Policy Volume:	☐I ☐II ☑**III** ☐IV
Revision Number:	**0**
Document Type:	☑**Policy** ☐Procedure ☐Guideline ☐SOP
Effective Date:	**October 27, 2003**
Approved By:	**OEHS**

Objective

This procedure outlines the responsibilities of personnel, addresses hazard determination, noise monitoring, hearing conservation program, engineering and administrative controls, personal protective equipment, audiometric testing program and standard threshold shifts.

Purpose

The purpose of the DEP Hearing Conservation Program is to prevent any temporary or permanent noise induced hearing loss to DEP employees and to comply with OSHA Standard 29 CFR 1910.95.

H&S Coordination Committee Approval

The New York City Department of Environmental Protection's H&S Coordination Committee has reviewed this document and by the Chair's signing below agree that it adequately defines the program necessary to address regulatory requirements for their Bureau/Office operations and commit to the policies and/or procedures contained within (or substantially equivalent procedures, if Bureau/Office specific amendment is required and it is approved by the H&S Coordination Committee).

Revision / Action	Signature of Committee Chair	
Revision 0, Authorization	[signature]	Date: 10/27/03
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:

DEP Office of EHS Compliance Authorization

I, a duly authorized representative of the DEP Office of EHS Compliance (OEHSC), have reviewed this document, have found it to be acceptable and authorize its use for all DEP operations.

Revision / Action	Signature	
Revision 0, Authorization	[signature]	Date: 10/27/03
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:

Table of Contents

1 PURPOSE 1
2 SCOPE 1
3 DEFINITIONS 1
4 RESPONSIBILITIES 2
4.1 OEHSC Responsibilities 2
4.2 Bureau EHS Personnel 3
4.3 Responsible Manager 3
4.4 Supervisors 4
4.5 Employees 4
5 PROCEDURE 4
5.1 Hazard Determination 5
5.2 Noise Monitoring 5
5.3 Hearing Conservation Program 7
5.4 Engineering and Administrative Controls 7
5.5 Personal Protective Equipment 8
5.6 Audiometric Testing Program 9
5.7 Standard Threshold Shifts 10
6 TRAINING 13
7 RECORD KEEPING 13
8 ATTACHMENTS 13
8.1 Attachment A – Estimated Noise Levels 13
8.2 Attachment B – 29 CFR 1910.95 Occupational Noise Exposure Standard 13
8.3 Attachment C- Audiometric STS Notification Form 13

Volume III	**Hearing Conservation**	Revision: 0 Effective Date: 10/28/03

1 Purpose

The purpose of the DEP Hearing Conservation Program is to prevent any temporary or permanent noise induced hearing loss to DEP employees and to comply with OSHA Standard 29 CFR 1910.95.

2 Scope

All DEP employees who are exposed to noise levels of 85 dBA for an 8-hour TWA or higher are to be included in a hearing conservation program. Employees that are exposed to impulsive or impact noise at or above 140 dBA are to be included in the program.

3 Definitions

Action level - An 8-hour time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently, a dose of fifty percent.

Audiogram - A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

Audiologist - A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners.

A-Weighted Scale – A measurement using a filter within the sound level meter that excludes some low and very high frequency sounds.

Baseline audiogram - The audiogram against which future audiograms are compared.

Criterion sound level - A sound level of 90 decibels.

Decibel (dB and/or dBA) - Unit of measurement of sound level.

Hertz (Hz) - Unit of measurement of frequency, numerically equal to cycles per second.

Impulse noise (impact noise) - Noise of short duration (typically, less than one second) especially of high intensity and abrupt onset.

Medical pathology - A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear, which should be treated by a physician specialist.

Noise dose - The ratio, expressed as a percentage, of (1) the time integral, over a stated time or event, of the 0.6 power of the measured SLOW exponential time-averaged, squared A-weighted sound pressure and (2) the product of the criterion duration (8 hours) and the 0.6 power of the squared sound pressure corresponding to the criterion sound level (90 dB).

Noise dosimeter - An instrument that integrates a function of sound pressure over a period of time in such a manner that it directly indicates a noise dose.

Noise Reduction Rating (NRR) – A unit of measure used to determine hearing protector attenuation established by the Environmental Protection Agency (EPA). It is a number

rating which describes how much overall noise is reduced by a particular hearing protector.

Otolaryngologist - A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.

Permissible Noise Exposure (PNE): – The amount of time one can be exposed to noise whereby the average sound level over an eight hour period does not exceed 85 decibels or a dose of fifty percent (see 29 CFR 1910.95 Table 1-G-16).

Representative exposure - Measurements of an employee's noise dose or 8-hour time-weighted average sound level that the employers deem to be representative of the exposures of other employees in the workplace.

Sound level - Ten times the common logarithm of the ratio of the square of the measured A-weighted sound pressure to the square of the standard reference pressure of 20 micropascals. Unit: decibels (dB). For use with this regulation, SLOW time response, in accordance with ANSI S1.4-1971 (R1976), is required.

Sound level meter - An instrument for the measurement of sound level.

Standard threshold shift (STS)- As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

Time-weighted average (TWA) sound level - That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured.

4 Responsibilities

4.1 OEHSC Responsibilities

The Office of Environmental, Health and Safety Compliance (OEHSC) responsibilities include:

- Acting as a liaison with the Citywide Office of Occupational Safety and Health (COSH). COSH manages the mandatory audiometric testing and employee recordkeeping services for NYC mayoral agencies;
- Schedule necessary audiometric testing through COSH;
- Transmitting audiometry results and STS notifications from COSH to DEP employees
- Maintaining records of STS notifications;
- Communicating requests from current and former employees and/or their representatives for records to COSH.

4.2 Bureau EHS Personnel

- Assist in performing or procure consultants to perform initial noise surveys in areas suspected to exceed the OSHA Action Levels and to develop and implement a noise monitoring program where Action Levels are exceeded;
- Maintain records of all surveys and monitoring conducted;
- Assist in work place noise control by recommending engineering and administrative means to attenuate noise levels and, when appropriate, recommend acceptable hearing protective devices;
- Inform the ***Responsible Manager*** and ***Supervisor*** of all employees whose 8-hour TWA equals or exceeds 85 dBA and must be included in the Audiometric Testing Program.
- Provide, or arrange for audiometric testing when required.
- Provide Hearing Conservation Program training, training materials, and support necessary for ***Responsible Managers*** to provide any necessary site/job specific training;

4.3 Responsible Manager

The highest-ranking manager or supervisor within each DEP Bureau at each facility (or whose employees perform field operations outside of fixed facilities) is the ***Responsible Manager*** for that Bureau's operation. If a Bureau is working in a facility "owned" by another Bureau, all other Bureau ***Responsible Managers*** must coordinate with the owning Bureau's ***Responsible Manager*** and provide them with information regarding hearing conservation. The ***Responsible Manager*** has the following responsibilities:

- With Bureau EHS, perform and document initial noise surveys in areas suspected to exceed the OSHA Action Levels and implement a noise monitoring program where Action Levels are exceeded and maintain records of such surveys and monitoring;
- Implement recommended engineering and administrative means to attenuate noise levels and maintain engineering controls as necessary;
- Select and procure the appropriate hearing protective devices according to the noise level;
- With Bureau EHS, provide any necessary site/job specific training for employees included in the Hearing Conservation Program and ensure that identified employees receive Audiometric Testing
- Identify and communicate with Bureau EHS when new or existing jobs/processes/conditions/hazards that necessitate a new or modified noise level assessment be performed; and
- Communicate hearing protection requirements to employees, visitors and contractors and enforce the use of required hearing protection.

Responsible Manager may delegate implementation tasks (e.g., to a facility Safety Officer, EHS Liaison or other staff), as appropriate.

4.4 Supervisors

It is the responsibility of DEP Supervisors to ensure that all of their employees exposed to noise levels equal to or greater than the 85 dBA TWA have access to appropriate hearing protective devices in the work area. All DEP ***Supervisors*** are responsible to:

- Notify ***Responsible Manager*** when noise levels for new or existing jobs/ processes /conditions/hazards could have the potential for exposing employee to noise levels equal to or greater than the 85 dBA TWA.
- Inform employees when and if they are exposed to an 8-hour time-weighted average noise level of 85 dBA or greater.
- Based on noise survey results, identify employees who must have regular Audiometric Testing.
- Consult with EHS staff about hearing protection equipment prior to its requisition. Only technically suitable equipment may be purchased and used.
- Ensure hearing protection is made available to employees when noise levels equal or exceed the 85 dBA TWA.
- Ensure hearing protection is used by employees when noise levels equal or exceed the 85 dBA TWA.
- Post signs in high-noise areas in accordance with Section 5.4.1.
- Enforce the use of engineering and administrative controls in designated hazardous noise areas.

4.5 Employees

Employees will be given the opportunity to select their own hearing protective devices from a variety of suitable hearing protective devices provided by the DEP. Employees are responsible for wearing and maintaining hearing protective devices as instructed. Employees exposed to noise above the OSHA Action Level must also participate in annual training and the Audiometric Testing Program.

Because the employees who operate or maintain and repair the equipment are often the ones who know most about the processes involved, they need to express their concerns and ideas to management so that the noise-control devices will be as practical and effective as possible.

5 Procedure

DEP shall identify all work areas (e.g. pump station, shop area, facility, work group, etc.) where employee noise exposures meet or exceed the Action Level and thus would be subject to a Hearing Conservation Program. It is not necessary to monitor workplace noise levels at all

locations and the need for monitoring can be made using the guidelines in Section 5.1. Monitoring must be conducted when information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 dBA.

5.1 Hazard Determination

Factors that suggest the noise exposures in the workplace may be at or exceed the Action Level include employee complaints about the loudness of noise, indications that employees are losing their hearing, or noisy conditions that make normal conversation difficult. In all such cases, specific workplace noise level measurements shall determine whether or not the Audiometric Testing Program should be initiated for the exposed employees working in that area.

To estimate if the noise level in a specific area is approaching or exceeding the 85 dBA TWA refer to Attachment A. In accordance with Attachment A, if it is suspected that the approximate noise level is reaching or exceeding 80 dBA inform ***Bureau EHS*** personal regarding the possible need for monitoring noise levels in this area.

High noise areas and activities should be identified during the Personal Protective Equipment (PPE) assessment process (see PPE procedure), but high noise exposure may occur due to equipment/facility modifications or change of work locations or schedule. Responsible Managers, Supervisors, and Bureau EHS should be aware of the above criteria and should identify new areas and activities that may require monitoring as a result of these changes, before complaints or potential hearing loss occurs.

5.2 Noise Monitoring

In order to determine if exposures are at or above the Action Level, it may be necessary to measure or monitor the actual noise levels in the workplace and to estimate the noise exposure or "dose" received by employees during the workday. Monitoring will also enable the proper selection of hearing protection devices. ***Bureau EHS*** shall provide affected employees or their representatives with an opportunity to observe any noise measurements conducted.

Noise monitoring requires specialized equipment followed by complex calculations to determine noise exposure and will be conducted by ***Bureau EHS*** Personnel or contracted consultants who understand the regulatory requirements and this procedure and who use equipment and techniques meeting all regulatory requirements and equipment manufacturer's instructions. Two types of devices used to monitor an employee's exposure to noise are sound level meters and dosimeters. A sound level meter is a device that measures the intensity of sound at a given moment. A dosimeter is similar to a sound level meter except it stores sound level measurements and integrates these measurements over a period of time to yield a time weighted average noise dose.

For the purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with appropriate appendices of the OSHA noise standard, and without regard to any attenuation provided by the use of personal protective equipment.

When the 8-hour TWA is determined to be in excess of the permissible noise exposure limit, feasible engineering or administrative controls will be implemented. If the controls fail to adequately reduce the noise levels, Personal Protective Equipment such as ear muffs or plugs will be provided to reduce the noise dose to an acceptable level.

5.2.1 Area Noise Monitoring

In an area noise survey, measurements of noise levels are recorded using a sound level meter to identify work areas where employees' exposures may be above hazardous levels, and where more thorough exposure monitoring may be needed. Area monitoring is conducted using a calibrated sound level meter set to the A scale, slow response. Within the area of interest, several different locations will be measured. Typical measurement locations will include:

- In the hearing zone at the employee's normal work location.
- Next to the noise source(s).
- At the entrance(s) to the work area.
- At other locations within the area where the employee might spend time working.

A rough sketch of the area will be included with the results showing the locations where the noise readings were obtained.

If the noise levels are below 85 dBA on a time-weighted average basis in the area, no further routine monitoring will be required for that area Should any of the noise measurements equal or exceed the 85 dBA TWA, records shall be maintained as to the noise levels recorded, where they were taken, and the source(s) of the noise. If measurements indicate that an employee's exposure may equal or exceed the Action Level (8-hour time-weighted average of 85 dBA):

- A Hearing Conservation Program, as defined in the balance of this procedure, shall be implemented at the facility.
- Either all employees working in the high noise areas shall be included in the Audiometric Testing Program.

  Or

  Using personal noise dosimeters, further monitoring of employees within this group may be conducted to determine only the specific employees that receive an exposure that equals or exceeds the Action Level.

5.2.2 Personnel Monitoring

Determination of the individual employees' noise exposure may be accomplished using calibrated noise dosimeters. Each employee to be monitored will have a dosimeter placed on him/her at the beginning of his/her normal work shift with the microphone placed in the "hearing zone". The dosimeter will be worn for the full duration of the work shift

while the employee performs his/her normal work routine. At the end of the work shift, the dosimeter will be removed and information printed out as soon as possible. Background information will be collected from each employee detailing job description, unusual job activities, etc., for the time period sampled. Those employees whose noise exposure equal or exceed the Action Level will be included in the Audiometric Testing Program.

The advantage of conducting personnel monitoring is that it may result in fewer employees being included into the Audiometric Testing Program.

5.2.3 Re-monitoring of Hazardous Noise Areas

Whenever an employee exhibits a standard threshold shift (refer to Section 5.7), the employee's work place shall be re-monitored to identify and abate the cause.

5.3 Hearing Conservation Program

A continuing, effective hearing conservation program shall be implemented at every facility that has employees exposed to noise above the Action Level of the 85 dBA TWA. This will include for all affected employees:

- Monitoring as described above, including providing affected employees or their representatives with an opportunity to observe any noise measurements
- Audiometric Testing Program (see section 5.6)
- Provide hearing protection when administrative or engineering controls fail to reduce sound levels to within the levels of the standards (see section 5.5)
- Provide training (see section 6)
- Post a copy of the occupational noise exposure standard Attachment Band make copies available to employees and their representatives upon request.

5.4 Engineering and Administrative Controls

When employees are subjected to sound exceeding the Permissible Noise Exposure limit (90 dBA for an 8 hour TWA), feasible administrative or engineering controls shall be utilized. Bureau EHS will evaluate the feasibility of controls, recommend controls to the facility Responsible Manager and document and retain the evaluation.

The most reliable means of reducing or eliminating personnel exposure to hazardous noise is through the application of engineering controls. Engineering controls are defined as any modification or replacement of equipment, or related physical change at the noise source or along the transmission path that reduces the noise level at the employee's ear. Engineering controls such as mufflers on heavy equipment exhausts or on air release valves are required where possible.

Administrative controls are defined as changes in the work schedule or operations, which reduce noise exposure. If engineering solutions cannot reduce the noise, administrative

controls such as increasing the distance between the noise source and the worker or rotation of jobs between workers in the high noise area should be used if possible.

If the use of engineering and administrative controls reduces noise exposure to the point where it is below the Action Level, hearing protection and audiometric testing is no longer required.

5.4.1 Posting of Noise Hazard Areas

Although warning signs are not a regulatory requirement, in normally occupied or frequently visited facilities where exposures exceed the 85 dBA TWA, DEP will post warning signs at entrances and/or the periphery of areas where there is sustained environmental noise in excess of 85 dBA. Example:

"High Noise Area, Hearing Protection Required"

5.5 Personal Protective Equipment

Hearing protection devices shall be made available to all employees who are exposed to noise levels at or above the 85 dBA TWA. Hearing protection is required to be worn by all personnel and visitors when:

- Exposed to noise levels at or above 85 dBA for an 8 hour TWA.
- If a comparison of annual to baseline audiogram indicates a standard threshold shift has occurred (unless a licensed health care provider determines it is not work related or aggravated by occupational noise exposure or a subsequent audiogram indicates it was not persistent).
- Employees shall be given the opportunity to select their hearing protective device from a variety of suitable hearing protective devices provided by the DEP.

The most convenient of the acceptable methods to evaluate the adequacy of hearing protective device is to relate the Noise Reduction Rating (NRR) for the specific device and manufacturer to the noise environment. See Appendix B of Attachment B (29 CFR 1910.95 Occupational Noise Exposure Standard) for methods for estimating the adequacy of hearing protector attenuation. In all cases the chosen hearing protective devices shall have a NRR high enough to reduce the noise at the eardrum to the 85 dBA TWA or lower.

Any personnel experiencing difficulty in wearing assigned hearing protection (i.e., irritation of the canals, pain) will be directed to immediately report this to their supervisor.

5.5.1 Use of Hearing Protective Devices

- Always use and maintain hearing protective devices as originally intended and in accordance with instructions provided.
- Earmuff performance may be degraded by anything that compromises the cushion-to-head seal. This includes other pieces of personal protective

equipment such as eyewear, masks, face shields, and helmets. Make sure that other PPE is compatible with hearing protective devices.

5.5.2 Maintenance of Hearing Protective Devices

- Reusable earplugs, such as the triple flange or formable devices should be washed in lukewarm water using hand soap, rinsed in clean water, and dried thoroughly before use. Wet or damp earplugs should not be placed in their containers. Cleaning should be done as needed.
- Earmuff cushions should be kept clean. The plastic or foam cushions may be cleaned in the same way as earplugs, but the inside of the muff should not get wet. When not in use, earmuffs should be kept in a clean location exposed to the open air to allow moisture that may have been absorbed into the cups to evaporate.

5.5.3 Hearing Protection Performance Information

The term "double hearing protection" is misleading. The attenuation provided from any combination earplug and earmuff is not equal to the sum of their individual attenuation values. The adequacy of hearing protective device attenuation shall be re-evaluated whenever employee noise measurements increase to the extent that the Hearing Protective Devices provided may no longer provide adequate attenuation. DEP will provide more effective hearing protective device where necessary.

5.6 Audiometric Testing Program

5.6.1 **Notification**

Upon identification of employees whose 8-hour TWA equals or exceeds 85 dBA, ***Bureau EHS*** personnel will inform the affected work area's ***Responsible Manager*** and the employee's ***Supervisor*** of the need to enroll affected employee(s) in the DEP Audiometric Testing Program and of their obligation to inform the affected employee(s) of the results. Although written communication of these results is not a regulatory requirement, employees and their representatives have the right to access these records.

In work locations where noise levels consistently fall below 8-hour TWA 85 dBA, ***Bureau EHS*** personnel shall notify the affected work area's ***Responsible Manager*** and the employee's ***Supervisor*** that the employees working in that area are no longer required to be enrolled in the Audiometric Testing Program.

5.6.2 Audiometric testing

DEP shall establish a valid baseline audiogram against which subsequent audiograms can be compared. Baseline audiograms must be conducted within 6 months of any of the following occasions:

- Prior to initial assignment in a hearing hazardous work area.

- Annually as long as the employee is assigned to a TWA exposure level equal to or greater than 85 dBA
- At the time of reassignment to a location or activity below the 85 dBA TWA.
- At the termination of employment (if previously enrolled in the Audiometric Testing Program).

Before testing, the employee will be notified that they must observe a minimum of 14 hours without occupational noise exposure.

Note: Compliance with the 14 hours without occupational noise exposure can be accomplished with the use of hearing protective devices, as long as the attenuation efficiency of the hearing protective devices can be ensured to lower noise exposure levels to less than the 85 dBA TWA.

The audiometric testing must be repeated annually following the baseline test to compare and determine if a standard threshold shift in hearing has occurred. If it has, the employee must be informed of this fact in writing, within 21 days of the determination. Refer to Section 5.7 for specific actions when a standard threshold shift is suspected.

5.7 Standard Threshold Shifts

Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift has occurred. If the annual audiogram shows that an employee has suffered a standard threshold shift (STS), DEP will obtain a retest within 30 days and consider the results of the retest as the annual audiogram. Figure 1 summarizes the process for reporting an STS.

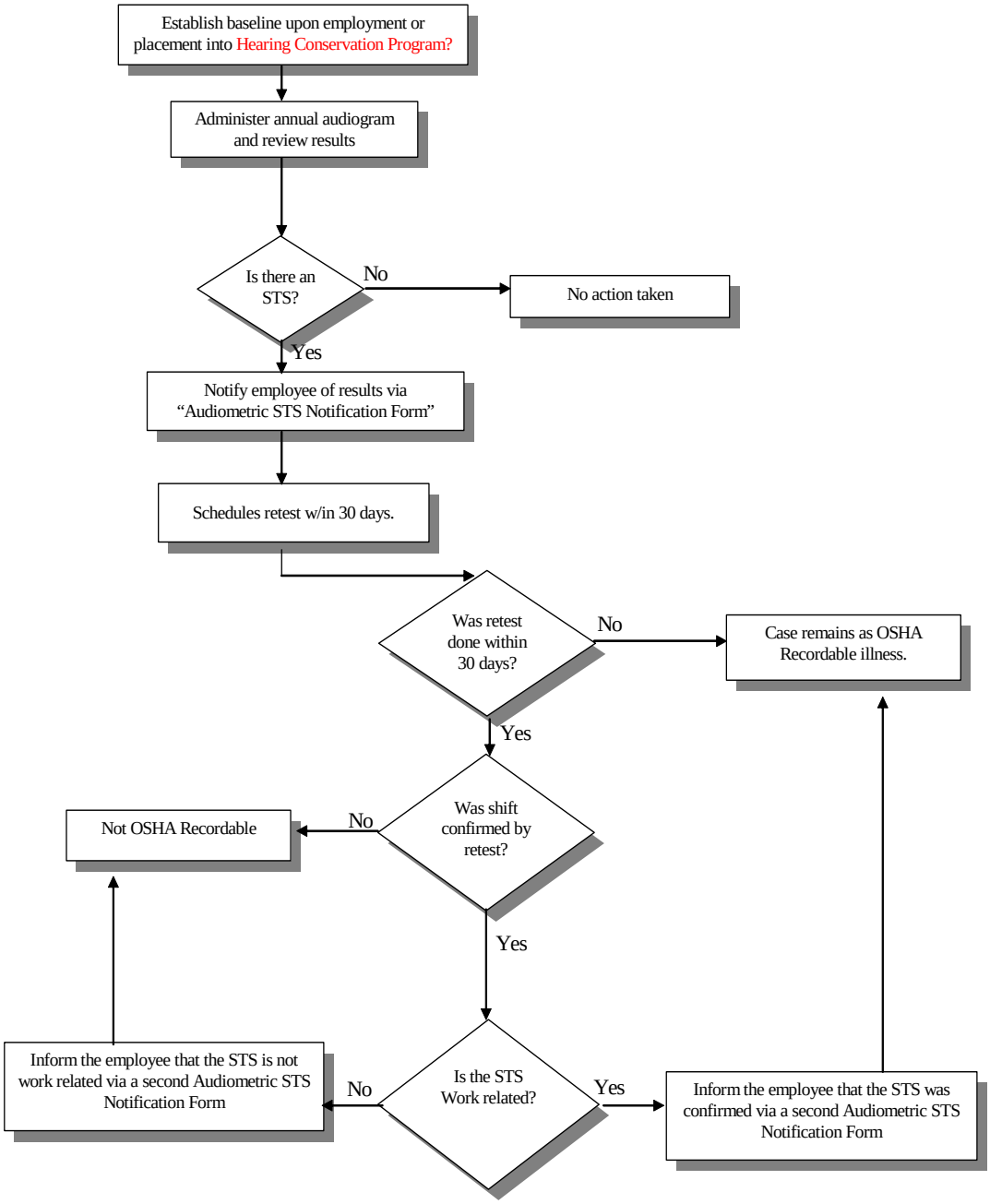
5.7.1 Preliminary Standard Threshold Shifts

DEP must ensure that the following steps are taken when a Preliminary STS occurs:

- Employees not using hearing protective devices must be fitted with Hearing Protective Devices, trained in their use and care, and required to use them.
- Employees already using hearing protective devices must be refitted and retrained in the use of hearing protective devices and provided with hearing protective devices offering greater attenuation in necessary.
- The employee must be referred for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if DEP suspects that a medical pathology of the ear is caused or aggravated by the wearing of hearing protective devices.
- The employee is to be notified within 21 days of receipt of the audiometric report indicating an STS. DEP shall notify the employee of the findings via an STS Notification Form (Attachment C). The employee shall sign the letter and a copy shall be retained by DEP.

FIGURE 1

Reporting Standard Threshold Shifts (STSs)



- The employee is required to wear hearing protection when in noise-exposed work areas, such that noise in the employee's work area is attenuated to the 85 dBA TWA or less.

5.7.2 Confirmed Standard Threshold Shifts

If an employee's hearing test results in a preliminary STS, and a re-test performed within 30 days confirms the findings of the first test (or if a re-test is not performed within 30 days), the employee is said to have a Confirmed STS.

Steps to follow in the event an employee has a confirmed STS:

- A licensed health care provider shall confirm the STS and ensure that it is work-related.
- The employee is to be notified within 21 days of DEP receiving the audiometric report. DEP shall notify the employee of the findings via a STS Notification Form (***Attachment C***). The employee shall sign the letter and a copy shall be retained by DEP.
- The ***Supervisor*** shall ensure that the STS is recorded on the SH-900 Log.
- Employees not using hearing protective devices shall be fitted with hearing protective devices, trained in their use and care, and required to use them
- Employees already using hearing protective devices shall be refitted and retrained in the use of hearing protective devices and provided with hearing protective devices offering greater attenuation if necessary

5.7.3 Non-Confirmed Standard Threshold Shifts

If the retest does not confirm the STS or a licensed health care provider determines that the STS is not work-related, DEP shall notify the employee of the findings via a STS Notification Form (Attachment C). The employee shall sign the letter and a copy shall be retained by DEP. In this event, a STS will not be noted on the SH-900 Log .

If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA of 85 decibels indicates that a standard threshold shift is not persistent, DEP will inform the employee of the new audiometric interpretation.

5.7.4 Revised Baseline

An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or licensed health care provider who is evaluating the audiogram:

- The standard threshold shift revealed by the audiogram is persistent; or
- The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

5.7.5 Medical Referral Only

In the event that a hearing test shows a specific pattern of hearing loss that may persist during subsequent investigations, it may be necessary for the employee to be referred to a hearing specialist for further evaluation. Such a case is referred to as a "Medical Referral" and requires that DEP notify the employee of the findings via a STS Notification Form (***Attachment C***). The employee shall sign the letter and a copy shall be retained by DEP.

6 Training

Ensure employees enrolled in the Audiometric Testing Program receive annual training which complies with all requirements of 29 CFR 1910.95.

7 Record Keeping

DEP must retain all noise exposure measurement records for as long as there is no more recent test for the same area (recommended) and a minimum of two years (required).

Audiometric test records and any STS Notification Forms issued are retained by the Citywide Office of Safety and Health (COSH) for 30 years after the affected employee's employment (regulations require maintaining them for the duration of the affected employee's employment). These records must be made available upon request for examination and copying to each affected employee or former employee, the employee's licensed health care provider or representative, and the New York State Department of Health.

COSH will ensure the audiometric records maintained in the employee's medical folder include:

- Baseline tests
- Annual tests
- Signed STS notification forms
- Follow-up documentation
- Documentation of outside referrals

8 Attachments

8.1 Attachment A – Estimated Noise Levels

8.2 Attachment B – 29 CFR 1910.95 Occupational Noise Exposure Standard

8.3 Attachment C- Audiometric STS Notification Form

HEARING CONSERVATION

ATTACHMENT A

AUDIOMETRIC STANDARD THRESHOLD SHIFT NOTIFICATION

Estimating Noise Levels

The following chart can be used to estimate if the noise level in a specific area based on how well you can hear voices, shouting or telephone conversations at various distances.

Approximate Noise Level	**Voice Levels**			
	Normal Voice	**Raised Voice**	**Shouting**	**Telephone Use**
40 dBA to	Satisfactory to 30-ft separation			Satisfactory
50 dBA to	Satisfactory to 6-ft separation	Satisfactory to 12-ft separation		Satisfactory
60 dBA to	Satisfactory to 3-ft separation	Satisfactory to 6-ft separation		Satisfactory Slightly difficult
70 dBA to	Satisfactory to 1-ft separation	Satisfactory to 3-ft separation		Slightly difficult
80 dBA to		Satisfactory to 1-ft separation Slightly difficult to 6-ft separation	Slightly difficult to 6-ft separation	Difficult
90 dBA to		Slightly difficult to 2-ft separation	Slightly difficult to 3-ft separation	Very difficult
95 dBA		Slightly difficult to 1-ft separation	Unsatisfactory	

HEARING CONSERVATION

ATTACHMENT B

OSHA STANDARD
OCCUPATIONAL NOISE EXPOSURE. - 1910.95

Hearing Conservation – Attachment B

U.S. Department of Labor Occupational Safety & Health Administration Regulations (Standards - 29 CFR)

Occupational noise exposure. - 1910.95

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95
- **Title:** Occupational noise exposure.
- **Appendix:** A, B, C, D, E, F, G, H, I

1910.95(a)

Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table G-16 when measured on the A scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:

FIGURE G-9 - Equivalent A-Weighted Sound Level

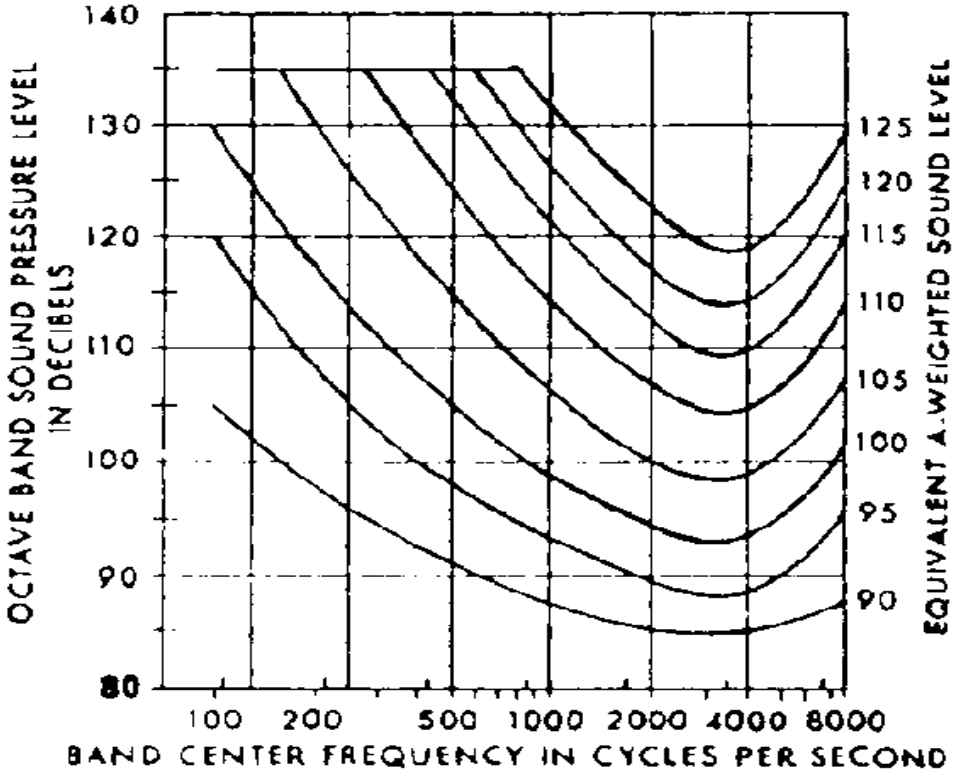


FIGURE G-9

Equivalent sound level contours. Octave band sound pressure levels may be converted to the equivalent A-weighted sound level by plotting them on this graph and noting the A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table 1.G-16.

Hearing Conservation – Attachment B

1910.95(b)

1910.95(b)(1)

When employees are subjected to sound exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

1910.95(b)(2)

If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

TABLE G-16 - PERMISSIBLE NOISE EXPOSURES (1)

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

Footnote(1) When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C(1)/T(1) + C(2)/T(2) C(n)/T(n) exceeds unity, then, the mixed exposure should be considered to exceed the limit value. Cn indicates the total time of exposure at a specified noise level, and Tn indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

1910.95(c)

"Hearing conservation program."

1910.95(c)(1)

The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (o) of this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale (slow response) or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with appendix A and Table G-16a, and without regard to any attenuation provided by the use of personal protective equipment.

1910.95(c)(2)

For purposes of paragraphs (c) through (n) of this section, an 8-hour time-weighted average of 85 decibels or a dose of fifty percent shall also be referred to as the action level.

1910.95(d)

"Monitoring."

1910.95(d)(1)

When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall develop and implement a monitoring program.

1910.95(d)(1)(i)

The sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors.

1910.95(d)(1)(ii)

Where circumstances such as high worker mobility, significant variations in sound level, or a significant component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this paragraph unless the employer can show that area sampling produces equivalent results.

1910.95(d)(2)

1910.95(d)(2)(i)

All continuous, intermittent and impulsive sound levels from 80 decibels to 130 decibels shall be integrated into the noise measurements.

1910.95(d)(2)(ii)

Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy.

1910.95(d)(3)

Monitoring shall be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that:

1910.95(d)(3)(i)

Additional employees may be exposed at or above the action level; or

1910.95(d)(3)(ii)

The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of paragraph (j) of this section.

1910.95(e)

"Employee notification." The employer shall notify each employee exposed at or above an 8-hour time-weighted average of 85 decibels of the results of the monitoring.

1910.95(f)

"Observation of monitoring." The employer shall provide affected employees or their representatives with an opportunity to observe any noise measurements conducted pursuant to this section.

1910.95(g)

"Audiometric testing program."

1910.95(g)(1)

The employer shall establish and maintain an audiometric testing program as provided in this paragraph by making audiometric testing available to all employees whose exposures equal or exceed an 8-hour time-weighted average of 85 decibels.

1910.95(g)(2)

The program shall be provided at no cost to employees.

1910.95(g)(3)

Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintaining and checking calibration and proper functioning of the audiometers being used. A technician who operates microprocessor audiometers does not need to be certified. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.

1910.95(g)(4)

All audiograms obtained pursuant to this section shall meet the requirements of Appendix C: "Audiometric Measuring Instruments."

1910.95(g)(5)

"Baseline audiogram."

1910.95(g)(5)(i)

Within 6 months of an employee's first exposure at or above the action level, the employer shall establish a valid baseline audiogram against which subsequent audiograms can be compared.

1910.95(g)(5)(ii)

"Mobile test van exception." Where mobile test vans are used to meet the audiometric testing obligation, the employer shall obtain a valid baseline audiogram within 1 year of an employee's first exposure at or above the action level. Where baseline audiograms are obtained more than 6 months after the employee's first exposure at or above the action level, employees shall wearing hearing protectors for any period exceeding six months after first exposure until the baseline audiogram is obtained.

1910.95(g)(5)(iii)

Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise. Hearing protectors may be used as a substitute for the requirement that baseline audiograms be preceded by 14 hours without exposure to workplace noise.

1910.95(g)(5)(iv)

The employer shall notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

1910.95(g)(6)

"Annual audiogram." At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above an 8-hour time-weighted average of 85 decibels.

1910.95(g)(7)

"Evaluation of audiogram."

1910.95(g)(7)(i)

Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift as defined in paragraph (g)(10) of this section has occurred. This comparison may be done by a technician.

1910.95(g)(7)(ii)

If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

1910.95(g)(7)(iii)

The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

1910.95(g)(7)(iii)(A)

A copy of the requirements for hearing conservation as set forth in paragraphs (c) through (n) of this section;

1910.95(g)(7)(iii)(B)

The baseline audiogram and most recent audiogram of the employee to be evaluated;

1910.95(g)(7)(iii)(C)

Measurements of background sound pressure levels in the audiometric test room as required in Appendix D: Audiometric Test Rooms.

1910.95(g)(7)(iii)(D)

Records of audiometer calibrations required by paragraph (h)(5) of this section.

1910.95(g)(8)

"Follow-up procedures."

1910.95(g)(8)(i)

If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined in paragraph (g)(10) of this section has occurred, the employee shall be informed of this fact in writing, within 21 days of the determination.

1910.95(g)(8)(ii)

Unless a physician determines that the standard threshold shift is not work related or aggravated by occupational noise exposure, the employer shall ensure that the following steps are taken when a standard threshold shift occurs:

1910.95(g)(8)(ii)(A)

Employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to

use them.

1910.95(g)(8)(ii)(B)

Employees already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

1910.95(g)(8)(ii)(C)

The employee shall be referred for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the employer suspects that a medical pathology of the ear is caused or aggravated by the wearing of hearing protectors.

1910.95(g)(8)(ii)(D)

The employee is informed of the need for an otological examination if a medical pathology of the ear that is unrelated to the use of hearing protectors is suspected.

1910.95(g)(8)(iii)

If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA of 90 decibels indicates that a standard threshold shift is not persistent, the employer:

1910.95(g)(8)(iii)(A)

Shall inform the employee of the new audiometric interpretation; and

1910.95(g)(8)(iii)(B)

May discontinue the required use of hearing protectors for that employee.

1910.95(g)(9)

"Revised baseline." An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or physician who is evaluating the audiogram:

1910.95(g)(9)(i)

The standard threshold shift revealed by the audiogram is persistent; or

1910.95(g)(9)(ii)

The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

1910.95(g)(10)

"Standard threshold shift."

1910.95(g)(10)(i)

As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

1910.95(g)(10)(ii)

In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging

(presbycusis) to the change in hearing level by correcting the annual audiogram according to the procedure described in Appendix F: "Calculation and Application of Age Correction to Audiograms."

1910.95(h)

"Audiometric test requirements."

1910.95(h)(1)

Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including as a minimum 500, 1000, 2000, 3000, 4000, and 6000 Hz. Tests at each frequency shall be taken separately for each ear.

1910.95(h)(2)

Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that meet the specifications of, and are maintained and used in accordance with, American National Standard Specification for Audiometers, S3.6-1969, which is incorporated by reference as specified in Sec. 1910.6.

1910.95(h)(3)

Pulsed-tone and self-recording audiometers, if used, shall meet the requirements specified in Appendix C: "Audiometric Measuring Instruments."

1910.95(h)(4)

Audiometric examinations shall be administered in a room meeting the requirements listed in Appendix D: "Audiometric Test Rooms."

1910.95(h)(5)

"Audiometer calibration."

1910.95(h)(5)(i)

The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 decibels or greater require an acoustic calibration.

1910.95(h)(5)(ii)

Audiometer calibration shall be checked acoustically at least annually in accordance with Appendix E: "Acoustic Calibration of Audiometers." Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check. Deviations of 15 decibels or greater require an exhaustive calibration.

1910.95(h)(5)(iii)

An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1.2; 4.1.3.; 4.1.4.3; 4.2; 4.4.1; 4.4.2; 4.4.3; and 4.5 of the American National Standard Specification for Audiometers, S3.6-1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this calibration.

1910.95(i)

"Hearing protectors."

1910.95(i)(1)

Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

Hearing Conservation – Attachment B

1910.95(i)(2)

Employers shall ensure that hearing protectors are worn:

1910.95(i)(2)(i)

By an employee who is required by paragraph (b)(1) of this section to wear personal protective equipment; and

1910.95(i)(2)(ii)

By any employee who is exposed to an 8-hour time-weighted average of 85 decibels or greater, and who:

1910.95(i)(2)(ii)(A)

Has not yet had a baseline audiogram established pursuant to paragraph (g)(5)(ii); or

1910.95(i)(2)(ii)(B)

Has experienced a standard threshold shift.

1910.95(i)(3)

Employees shall be given the opportunity to select their hearing protectors from a variety of suitable hearing protectors provided by the employer.

1910.95(i)(4)

The employer shall provide training in the use and care of all hearing protectors provided to employees.

1910.95(i)(5)

The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

1910.95(j)

"Hearing protector attenuation."

1910.95(j)(1)

The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used. The employer shall use one of the evaluation methods described in Appendix B: "Methods for Estimating the Adequacy of Hearing Protection Attenuation."

1910.95(j)(2)

Hearing protectors must attenuate employee exposure at least to an 8-hour time-weighted average of 90 decibels as required by paragraph (b) of this section.

1910.95(j)(3)

For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposure to an 8-hour time-weighted average of 85 decibels or below.

1910.95(j)(4)

The adequacy of hearing protector attenuation shall be re-evaluated whenever employee noise exposures increase to the

extent that the hearing protectors provided may no longer provide adequate attenuation. The employer shall provide more effective hearing protectors where necessary.

1910.95(k)

"Training program."

1910.95(k)(1)

The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 decibels, and shall ensure employee participation in such program.

1910.95(k)(2)

The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to be consistent with changes in protective equipment and work processes.

1910.95(k)(3)

The employer shall ensure that each employee is informed of the following:

1910.95(k)(3)(i)

The effects of noise on hearing;

1910.95(k)(3)(ii)

The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care; and

1910.95(k)(3)(iii)

The purpose of audiometric testing, and an explanation of the test procedures.

1910.95(l)

"Access to information and training materials."

1910.95(l)(1)

The employer shall make available to affected employees or their representatives copies of this standard and shall also post a copy in the workplace.

1910.95(l)(2)

The employer shall provide to affected employees any informational materials pertaining to the standard that are supplied to the employer by the Assistant Secretary.

1910.95(l)(3)

The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to the Assistant Secretary and the Director.

1910.95(m)

"Recordkeeping" -

Hearing Conservation – Attachment B

1910.95(m)(1)

"Exposure measurements." The employer shall maintain an accurate record of all employee exposure measurements required by paragraph (d) of this section.

1910.95(m)(2)

"Audiometric tests."

1910.95(m)(2)(i)

The employer shall retain all employee audiometric test records obtained pursuant to paragraph (g) of this section:

1910.95(m)(2)(ii)

This record shall include:

1910.95(m)(2)(ii)(A)

Name and job classification of the employee;

1910.95(m)(2)(ii)(B)

Date of the audiogram;

1910.95(m)(2)(ii)(C)

The examiner's name;

1910.95(m)(2)(ii)(D)

Date of the last acoustic or exhaustive calibration of the audiometer; and

1910.95(m)(2)(ii)(E)

Employee's most recent noise exposure assessment.

1910.95(m)(2)(ii)(F)

The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms.

1910.95(m)(3)

"Record retention." The employer shall retain records required in this paragraph (m) for at least the following periods.

1910.95(m)(3)(i)

Noise exposure measurement records shall be retained for two years.

1910.95(m)(3)(ii)

Audiometric test records shall be retained for the duration of the affected employee's employment.

1910.95(m)(4)

"Access to records." All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee, and the Assistant Secretary. The provisions of 29 CFR 1910.20 (a)-

(e) and (g)-

1910.95(m)(4)(i)

apply to access to records under this section.

1910.95(m)(5)

"Transfer of records." If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in paragraph (m)(3) of this section.

1910.95(n)

"Appendices."

1910.95(n)(1)

Appendices A, B, C, D, and E to this section are incorporated as part of this section and the contents of these appendices are mandatory.

1910.95(n)(2)

Appendices F and G to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

1910.95(o)

"Exemptions." Paragraphs (c) through (n) of this section shall not apply to employers engaged in oil and gas well drilling and servicing operations.

1910.95(p)

"Startup date." Baseline audiograms required by paragraph (g) of this section shall be completed by March 1, 1984.

[39 FR 23502, June 27, 1974, as amended at 46 FR 4161, Jan. 16, 1981; 46 FR 62845, Dec. 29, 1981; 48 FR 9776, Mar. 8, 1983; 48 FR 29687, June 28, 1983; 54 FR 24333, June 7, 1989; 61 FR 5507, Feb. 13, 1996; 61 FR 9227, March 7, 1996]

Hearing Conservation – Attachment B

Regulations (Standards - 29 CFR)

Noise exposure computation - 1910.95 App A

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95 App A
- **Title:** Noise exposure computation

This Appendix is Mandatory

I. Computation of Employee Noise Exposure

(1) Noise dose is computed using Table G-16a as follows:

(i) When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by: D=100 C/T where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table G-16a or by the formula shown as a footnote to that table.

(ii) When the workshift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by:

D = 100 (C(1)/T(1) + C(2)/T(2) + ... + C(n)/T(n)),

where C(n) indicates the total time of exposure at a specific noise level, and T(n) indicates the reference duration for that level as given by Table G-16a.

(2) The eight-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula: TWA = 16.61 log(10) (D/100) + 90. For an eight-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

(3) A table relating dose and TWA is given in Section II.

TABLE G-16A

A-weighted sound level, L (decibel)	Reference duration, T (hour)
80	32
81	27.9
82	24.3
83	21.1
84	18.4
85	16
86	13.9
87	12.1
88	10.6
89	9.2
90	8
91	7.0
92	6.1
93	5.3

94	4.6
95	4
96	3.5
97	3.0
98	2.6
99	2.3
100	2
101	1.7
102	1.5
103	1.3
104	1.1
105	1
106	0.87
107	0.76
108	0.66
109	0.57
110	0.5
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.125
121	0.11
122	0.095
123	0.082
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041
129	0.036
130	0.031

In the above table the reference duration, T, is computed by

$$T = \frac{8}{2^{(L-90)/5}}$$

where L is the measured A-weighted sound level.

II. Conversion Between "Dose" and "8-Hour Time-Weighted Average"

Sound Level

Compliance with paragraphs (c)-(r) of this regulation is determined by the amount of exposure to noise in the workplace. The amount of such exposure is usually measured with an audiodosimeter which gives a readout in terms of "dose." In order to better understand the requirements of the amendment, dosimeter readings can be converted to an "8-hour time-weighted average sound level." (TWA).

In order to convert the reading of a dosimeter into TWA, see Table A-1, below. This table applies to dosimeters that are set by the manufacturer to calculate dose or percent exposure according to the relationships in Table G-16a. So, for example, a dose of 91 percent over an eight hour day results in a

Hearing Conservation – Attachment B

TWA of 89.3 dB, and, a dose of 50 percent corresponds to a TWA of 85 dB.

If the dose as read on the dosimeter is less than or greater than the values found in Table A-1, the TWA may be calculated by using the formula: TWA = 16.61 log(10) (D/100) + 90 where TWA=8-hour time-weighted average sound level and D = accumulated dose in percent exposure.

TABLE A-1 - CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)

Dose or percent noise exposure	TWA
10	73.4
15	76.3
20	78.4
25	80.0
30	81.3
35	82.4
40	83.4
45	84.2
50	85.0
55	85.7
60	86.3
65	86.9
70	87.4
75	87.9
80	88.4
81	88.5
82	88.6
83	88.7
84	88.7
85	88.8
86	88.9
87	89.0
88	89.1
89	89.2
90	89.2
91	89.3
92	89.4
93	89.5
94	89.6
95	89.6
96	89.7
97	89.8
98	89.9
99	89.9
100	90.0
101	90.1
102	90.1
103	90.2
104	90.3
105	90.4
106	90.4
107	90.5
108	90.6
109	90.6
110	90.7

Hearing Conservation – Attachment B

111	90.8
112	90.8
113	90.9
114	90.9
115	91.1
116	91.1
117	91.1
118	91.2
119	91.3
120	91.3
125	91.6
130	91.9
135	92.2
140	92.4
145	92.7
150	92.9
155	93.2
160	93.4
165	93.6
170	93.8
175	94.0
180	94.2
185	94.4
190	94.6
195	94.8
200	95.0
210	95.4
220	95.7
230	96.0
240	96.3
250	96.6
260	96.9
270	97.2
280	97.4
290	97.7
300	97.9
310	98.2
320	98.4
330	98.6
340	98.8
350	99.0
360	99.2
370	99.4
380	99.6
390	99.8
400	100.0
410	100.2
420	100.4
430	100.5
440	100.7
450	100.8
460	101.0
470	101.2
480	101.3
490	101.5
500	101.6
510	101.8

Hearing Conservation – Attachment B

520	101.9
530	102.0
540	102.2
550	102.3
560	102.4
570	102.6
580	102.7
590	102.8
600	102.9
610	103.0
620	103.2
630	103.3
640	103.4
650	103.5
660	103.6
670	103.7
680	103.8
690	103.9
700	104.0
710	104.1
720	104.2
730	104.3
740	104.4
750	104.5
760	104.6
770	104.7
780	104.8
790	104.9
800	105.0
810	105.1
820	105.2
830	105.3
840	105.4
850	105.4
860	105.5
870	105.6
880	105.7
890	105.8
900	105.8
910	105.9
920	106.0
930	106.1
940	106.2
950	106.2
960	106.3
970	106.4
980	106.5
990	106.5
999	106.6

Hearing Conservation – Attachment B

Regulations (Standards - 29 CFR)

Methods for estimating the adequacy of hearing protector attenuation - 1910.95 App B

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95 App B
- **Title:** Methods for estimating the adequacy of hearing protector attenuation

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This Appendix is Mandatory

For employees who have experienced a significant threshold shift, hearing protector attenuation must be sufficient to reduce employee exposure to a TWA of 85 dB. Employers must select one of the following methods by which to estimate the adequacy of hearing protector attenuation.

The most convenient method is the Noise Reduction Rating (NRR) developed by the Environmental Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This appendix describes four methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection among the four procedures is dependent upon the employer's noise measuring instruments.

Instead of using the NRR, employers may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety and Health (NIOSH), which are described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37. These methods are known as NIOSH methods No. 1, No. 2 and No. 3. The NRR described below is a simplification of NIOSH method No. 2. The most complex method is NIOSH method No. 1, which is probably the most accurate method since it uses the largest amount of spectral information from the individual employee's noise environment. As in the case of the NRR method described below, if one of the NIOSH methods is used, the selected method must be applied to an individual's noise environment to assess the adequacy of the attenuation. Employers should be careful to take a sufficient number of measurements in order to achieve a representative sample for each time segment.

NOTE: The employer must remember that calculated attenuation values reflect realistic values only to the extent that the protectors are properly fitted and worn.

When using the NRR to assess hearing protector adequacy, one of the following methods must be used:

(i) When using a dosimeter that is capable of C-weighted measurements:

(A) Obtain the employee's C-weighted dose for the entire workshift, and convert to TWA (see appendix A, II).

(B) Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(ii) When using a dosimeter that is not capable of C-weighted measurements, the following method may be used:

(A) Convert the A-weighted dose to TWA (see appendix A).

(B) Subtract 7 dB from the NRR.

(C) Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iii) When using a sound level meter set to the A-weighting network:

(A) Obtain the employee's A-weighted TWA.

(B) Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iv) When using a sound level meter set on the C-weighting network:

(A) Obtain a representative sample of the C-weighted sound levels in the employee's environment.

(B) Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

(v) When using area monitoring procedures and a sound level meter set to the A-weighing network.

(A) Obtain a representative sound level for the area in question.

(B) Subtract 7 dB from the NRR and subtract the remainder from the A-weighted sound level for that area.

(vi) When using area monitoring procedures and a sound level meter set to the C-weighting network:

(A) Obtain a representative sound level for the area in question.

(B) Subtract the NRR from the C-weighted sound level for that area.

Hearing Conservation – Attachment B

Regulations (Standards - 29 CFR)

Audiometric measuring instruments - 1910.95 App C

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95 App C
- **Title:** Audiometric measuring instruments

This Appendix is Mandatory

1. In the event that pulsed-tone audiometers are used, they shall have a tone on-time of at least 200 milliseconds.

2. Self-recording audiometers shall comply with the following requirements:

(A) The chart upon which the audiogram is traced shall have lines at positions corresponding to all multiples of 10 dB hearing level within the intensity range spanned by the audiometer. The lines shall be equally spaced and shall be separated by at least 1/4 inch. Additional increments are optional. The audiogram pen tracings shall not exceed 2 dB in width.

(B) It shall be possible to set the stylus manually at the 10-dB increment lines for calibration purposes.

(C) The slewing rate for the audiometer attenuator shall not be more than 6 dB/sec except that an initial slewing rate greater than 6 dB/sec is permitted at the beginning of each new test frequency, but only until the second subject response.

(D) The audiometer shall remain at each required test frequency for 30 seconds (+ or - 3 seconds). The audiogram shall be clearly marked at each change of frequency and the actual frequency change of the audiometer shall not deviate from the frequency boundaries marked on the audiogram by more than + or - 3 seconds.

(E) It must be possible at each test frequency to place a horizontal line segment parallel to the time axis on the audiogram, such that the audiometric tracing crosses the line segment at least six times at that test frequency. At each test frequency the threshold shall be the average of the midpoints of the tracing excursions.

Hearing Conservation – Attachment B

Regulations (Standards - 29 CFR)

Audiometric test rooms - 1910.95 App D

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95 App D
- **Title:** Audiometric test rooms

This Appendix is Mandatory

Rooms used for audiometric testing shall not have background sound pressure levels exceeding those in Table D-1 when measured by equipment conforming at least to the Type 2 requirements of American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976), and to the Class II requirements of American National Standard Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets, S1.11-1971 (R1976).

TABLE D-1 - MAXIMUM ALLOWABLE OCTAVE-BAND SOUND PRESSURE LEVELS FOR AUDIOMETRIC TEST ROOMS

Octave-band center frequency (Hz).....	500	1000	2000	4000	8000
Sound pressure level (dB) ...	40	40	47	57	62

Hearing Conservation – Attachment B

Regulations (Standards - 29 CFR)

Acoustic calibration of audiometers - 1910.95 App E

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95 App E
- **Title:** Acoustic calibration of audiometers

This Appendix is Mandatory

Audiometer calibration shall be checked acoustically, at least annually, according to the procedures described in this appendix. The equipment necessary to perform these measurements is a sound level meter, octave-band filter set, and a National Bureau of Standards 9A coupler. In making these measurements, the accuracy of the calibrating equipment shall be sufficient to determine that the audiometer is within the tolerances permitted by American Standard Specification for Audiometers, S3.6-1969.

(1) "Sound Pressure Output Check"

A. Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler.

B. Set the audiometer's hearing threshold level (HTL) dial to 70 dB.

C. Measure the sound pressure level of the tones at each test frequency from 500 Hz through 6000 Hz for each earphone.

D. At each frequency the readout on the sound level meter should correspond to the levels in Table E-1 or Table E-2, as appropriate, for the type of earphone, in the column entitled "sound level meter reading."

(2) "Linearity Check"

A. With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70 dB.

B. Measure the sound levels in the coupler at each 10-dB decrement from 70 dB to 10 dB, noting the sound level meter reading at each setting.

C. For each 10-dB decrement on the audiometer the sound level meter should indicate a corresponding 10 dB decrease.

D. This measurement may be made electrically with a voltmeter connected to the earphone terminals.

(3) "Tolerances"

When any of the measured sound levels deviate from the levels in Table E-1 or Table E-2 by + or - 3 dB at any test frequency between 500 and 3000 Hz, 4 dB at 4000 Hz, or 5 dB at 6000 Hz, an exhaustive calibration is advised. An exhaustive calibration is required if the deviations are greater than 15 dB or greater at any test frequency.

TABLE E-1 - REFERENCE THRESHOLD LEVELS FOR TELEPHONICS - TDH-39 EARPHONES

Frequency, Hz	Reference threshold level for TDH-39 earphones, dB	Sound level meter reading, dB
500	11.5	81.5
1000	7	77
2000	9	79
3000	10	80
4000	9.5	79.5
6000	15.5	85.5

TABLE E-2 - REFERENCE THRESHOLD LEVELS FOR TELEPHONICS - TDH-49 EARPHONES

Frequency, Hz	Reference threshold level for TDH-49 earphones, dB	Sound level meter reading, dB
500	13.5	83.5
1000	7.5	77.5
2000	11	81.0
3000	9.5	79.5
4000	10.5	80.5
6000	13.5	83.5

Hearing Conservation – Attachment B

Regulations (Standards - 29 CFR)

Calculations and application of age corrections to audiograms - 1910.95 App F

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95 App F
- **Title:** Calculations and application of age corrections to audiograms

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This Appendix Is Non-Mandatory

In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging to the change in hearing level by adjusting the most recent audiogram. If the employer chooses to adjust the audiogram, the employer shall follow the procedure described below. This procedure and the age correction tables were developed by the National Institute for Occupational Safety and Health in the criteria document entitled "Criteria for a Recommended Standard . . . Occupational Exposure to Noise," ((HSM)-11001).

For each audiometric test frequency;

(i) Determine from Tables F-1 or F-2 the age correction values for the employee by:

(A) Finding the age at which the most recent audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz;

(B) Finding the age at which the baseline audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz.

(ii) Subtract the values found in step (i)(B) from the value found in step (i)(A).

(iii) The differences calculated in step (ii) represented that portion of the change in hearing that may be due to aging.

EXAMPLE: Employee is a 32-year-old male. The audiometric history for his right ear is shown in decibels below.

Employee's age	Audiometric test frequency (Hz)				
	1000	2000	3000	4000	6000
26	10	5	5	10	5
*27	0	0	0	5	5
28	0	0	0	10	5
29	5	0	5	15	5
30	0	5	10	20	10
31	5	10	20	15	15
*32	5	10	10	25	20

The audiogram at age 27 is considered the baseline since it shows the best hearing threshold levels. Asterisks have been used to identify the baseline and most recent audiogram. A threshold shift of 20 dB exists at 4000 Hz between the audiograms taken at ages 27 and 32.

(The threshold shift is computed by subtracting the hearing threshold at age 27, which was 5, from the hearing threshold at age 32, which is 25). A retest audiogram has confirmed this shift. The contribution of aging to this change in hearing may be estimated in the following manner:

Go to Table F-1 and find the age correction values (in dB) for 4000 Hz at age 27 and age 32.

Hearing Conservation – Attachment B

	Frequency (Hz)				
	1000	2000	3000	4000	6000
Age 32.....	6	5	7	10	14
Age 27.....	5	4	6	7	11
Difference	1	1	1	3	3

The difference represents the amount of hearing loss that may be attributed to aging in the time period between the baseline audiogram and the most recent audiogram. In this example, the difference at 4000 Hz is 3 dB. This value is subtracted from the hearing level at 4000 Hz, which in the most recent audiogram is 25, yielding 22 after adjustment. Then the hearing threshold in the baseline audiogram at 4000 Hz (5) is subtracted from the adjusted annual audiogram hearing threshold at 4000 Hz (22). Thus the age-corrected threshold shift would be 17 dB (as opposed to a threshold shift of 20 dB without age correction).

TABLE F-1 - AGE CORRECTION VALUES IN DECIBELS FOR MALES

Years	Audiometric Test Frequency (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	5	3	4	5	8
21	5	3	4	5	8
22	5	3	4	5	8
23	5	3	4	6	9
24	5	3	5	6	9
25	5	3	5	7	10
26	5	4	5	7	10
27	5	4	6	7	11
28	6	4	6	8	11
29	6	4	6	8	12
30	6	4	6	9	12
31	6	4	7	9	13
32	6	5	7	10	14
33	6	5	7	10	14
34	6	5	8	11	15
35	7	5	8	11	15
36	7	5	9	12	16
37	7	6	9	12	17
38	7	6	9	13	17
39	7	6	10	14	18
40	7	6	10	14	19
41	7	6	10	14	20
42	8	7	11	16	20
43	8	7	12	16	21
44	8	7	12	17	22
45	8	7	13	18	23
46	8	8	13	19	24
47	8	8	14	19	24
48	9	8	14	20	25
49	9	9	15	21	26
50	9	9	16	22	27
51	9	9	16	23	28
52	9	10	17	24	29
53	9	10	18	25	30
54	10	10	18	26	31

55	10	11	19	27	32
56	10	11	20	28	34
57	10	11	21	29	35
58	10	12	22	31	36
59	11	12	22	32	37
60 or older	11	13	23	33	38

TABLE F-2 - AGE CORRECTION VALUES IN DECIBELS FOR FEMALES

Years	Audiometric Test Frequency (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	7	4	3	3	6
21	7	4	4	3	6
22	7	4	4	4	6
23	7	5	4	4	7
24	7	5	4	4	7
25	8	5	4	4	7
26	8	5	5	4	8
27	8	5	5	5	8
28	8	5	5	5	8
29	8	5	5	5	9
30	8	6	5	5	9
31	8	6	6	5	9
32	9	6	6	6	10
33	9	6	6	6	10
34	9	6	6	6	10
35	9	6	7	7	11
36	9	7	7	7	11
37	9	7	7	7	12
38	10	7	7	7	12
39	10	7	8	8	12
40	10	7	8	8	13
41	10	8	8	8	13
42	10	8	9	9	13
43	11	8	9	9	14
44	11	8	9	9	14
45	11	8	10	10	15
46	11	9	10	10	15
47	11	9	10	11	16
48	12	9	11	11	16
49	12	9	11	11	16
50	12	10	11	12	17
51	12	10	12	12	17
52	12	10	12	13	18
53	13	10	13	13	18
54	13	11	13	14	19
55	13	11	14	14	19
56	13	11	14	15	20
57	13	11	15	15	20
58	14	12	15	16	21
59	14	12	16	16	21
60 or older	14	12	16	17	22

Hearing Conservation – Attachment B

Regulations (Standards - 29 CFR)

Monitoring noise levels non-mandatory informational appendix - 1910.95 App G

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95 App G
- **Title:** Monitoring noise levels non-mandatory informational appendix

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This appendix provides information to help employers comply with the noise monitoring obligations that are part of the hearing conservation amendment.

WHAT IS THE PURPOSE OF NOISE MONITORING?

This revised amendment requires that employees be placed in a hearing conservation program if they are exposed to average noise levels of 85 dB or greater during an 8 hour workday. In order to determine if exposures are at or above this level, it may be necessary to measure or monitor the actual noise levels in the workplace and to estimate the noise exposure or "dose" received by employees during the workday.

WHEN IS IT NECESSARY TO IMPLEMENT A NOISE MONITORING PROGRAM?

It is not necessary for every employer to measure workplace noise. Noise monitoring or measuring must be conducted only when exposures are at or above 85 dB. Factors which suggest that noise exposures in the workplace may be at this level include employee complaints about the loudness of noise, indications that employees are losing their hearing, or noisy conditions which make normal conversation difficult. The employer should also consider any information available regarding noise emitted from specific machines. In addition, actual workplace noise measurements can suggest whether or not a monitoring program should be initiated.

HOW IS NOISE MEASURED?

Basically, there are two different instruments to measure noise exposures: the sound level meter and the dosimeter. A sound level meter is a device that measures the intensity of sound at a given moment. Since sound level meters provide a measure of sound intensity at only one point in time, it is generally necessary to take a number of measurements at different times during the day to estimate noise exposure over a workday. If noise levels fluctuate, the amount of time noise remains at each of the various measured levels must be determined.

To estimate employee noise exposures with a sound level meter it is also generally necessary to take several measurements at different locations within the workplace. After appropriate sound level meter readings are obtained, people sometimes draw "maps" of the sound levels within different areas of the workplace. By using a sound level "map" and information on employee locations throughout the day, estimates of individual exposure levels can be developed. This measurement method is generally referred to as "area" noise monitoring.

A dosimeter is like a sound level meter except that it stores sound level measurements and integrates these measurements over time, providing an average noise exposure reading for a given period of time, such as an 8-hour workday. With a dosimeter, a microphone is attached to the employee's clothing and the exposure measurement is simply read at the end of the desired time period. A reader may be used to read-out the dosimeter's measurements. Since the dosimeter is worn by the employee, it measures noise levels in those locations in which the employee travels. A sound level meter can also be positioned within the immediate vicinity of the exposed worker to obtain an individual exposure estimate. Such procedures are generally referred to as "personal" noise monitoring.

Area monitoring can be used to estimate noise exposure when the noise levels are relatively constant and employees are not mobile. In workplaces where employees move about in different areas or where the noise intensity tends to fluctuate over time, noise exposure is generally more accurately estimated by the personal monitoring approach.

In situations where personal monitoring is appropriate, proper positioning of the microphone is necessary to obtain accurate measurements. With a dosimeter, the microphone is generally located on the shoulder and remains in that position for the

entire workday. With a sound level meter, the microphone is stationed near the employee's head, and the instrument is usually held by an individual who follows the employee as he or she moves about.

Manufacturer's instructions, contained in dosimeter and sound level meter operating manuals, should be followed for calibration and maintenance. To ensure accurate results, it is considered good professional practice to calibrate instruments before and after each use.

HOW OFTEN IS IT NECESSARY TO MONITOR NOISE LEVELS?

The amendment requires that when there are significant changes in machinery or production processes that may result in increased noise levels, remonitoring must be conducted to determine whether additional employees need to be included in the hearing conservation program. Many companies choose to remonitor periodically (once every year or two) to ensure that all exposed employees are included in their hearing conservation programs.

WHERE CAN EQUIPMENT AND TECHNICAL ADVICE BE OBTAINED?

Noise monitoring equipment may be either purchased or rented. Sound level meters cost about $500 to $1,000, while dosimeters range in price from about $750 to $1,500. Smaller companies may find it more economical to rent equipment rather than to purchase it. Names of equipment suppliers may be found in the telephone book (Yellow Pages) under headings such as: "Safety Equipment," "Industrial Hygiene," or "Engineers-Acoustical." In addition to providing information on obtaining noise monitoring equipment, many companies and individuals included under such listings can provide professional advice on how to conduct a valid noise monitoring program. Some audiological testing firms and industrial hygiene firms also provide noise monitoring services. Universities with audiology, industrial hygiene, or acoustical engineering departments may also provide information or may be able to help employers meet their obligations under this amendment.

Free, on-site assistance may be obtained from OSHA-supported state and private consultation organizations. These safety and health consultative entities generally give priority to the needs of small businesses.

Hearing Conservation – Attachment B

Regulations (Standards - 29 CFR)

Availability of referenced documents - 1910.95 App H

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95 App H
- **Title:** Availability of referenced documents

Paragraphs (c) through (o) of 29 CFR 1910.95 and the accompanying appendices contain provisions which incorporate publications by reference. Generally, the publications provide criteria for instruments to be used in monitoring and audiometric testing. These criteria are intended to be mandatory when so indicated in the applicable paragraphs of 1910.95 and appendices.

It should be noted that OSHA does not require that employers purchase a copy of the referenced publications. Employers, however, may desire to obtain a copy of the referenced publications for their own information.

The designation of the paragraph of the standard in which the referenced publications appear, the titles of the publications, and the availability of the publications are as follows:

Paragraph designation	Referenced publication	Available from --
Appendix B	"List of Personal Hearing Protectors and Attenuation Data," HEW Pub. No. 76-120, 1975. NTIS-PB267461.	National Technical Information Service, Port Royal Road, Springfield, VA 22161.
Appendix D	"Specification for Sound Level Meters," S1.4-1971 (R1976).	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
1910.95(k)(2), Appendix E ...	"Specifications for Audiometers," S3.6-1969.	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
Appendix D	"Specification for Octave, Half-Octave and Third-Octave Band Filter Sets," S1.11-1971 (R1976).	Back Numbers Department, Dept. STD, American Institute of Physics, 333 E. 45th St., New York, NY

Hearing Conservation – Attachment B

10017;
American National
Standards
Institute, Inc.,
1430 Broadway,
New York, NY
10018.

The referenced publications (or a microfiche of the publications) are available for review at many universities and public libraries throughout the country. These publications may also be examined at the OSHA Technical Data Center, Room N2439, United States Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210, (202) 219-7500 or at any OSHA Regional Office (see telephone directories under United States Government - Labor Department).

Hearing Conservation – Attachment B

Regulations (Standards - 29 CFR)

Definitions - 1910.95 App I

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** G
- **Subpart Title:** Occupational Health and Environment Control
- **Standard Number:** 1910.95 App I
- **Title:** Definitions

These definitions apply to the following terms as used in paragraphs (c) through (n) of 29 CFR 1910.95.

Action level - An 8-hour time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently, a dose of fifty percent.
Audiogram - A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.
Audiologist - A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners.
Baseline audiogram - The audiogram against which future audiograms are compared.
Criterion sound level - A sound level of 90 decibels.
Decibel (dB) - Unit of measurement of sound level.
Hertz (Hz) - Unit of measurement of frequency, numerically equal to cycles per second.
Medical pathology - A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear, which should be treated by a physician specialist.
Noise dose - The ratio, expressed as a percentage, of (1) the time integral, over a stated time or event, of the 0.6 power of the measured SLOW exponential time-averaged, squared A-weighted sound pressure and (2) the product of the criterion duration (8 hours) and the 0.6 power of the squared sound pressure corresponding to the criterion sound level (90 dB).
Noise dosimeter - An instrument that integrates a function of sound pressure over a period of time in such a manner that it directly indicates a noise dose.
Otolaryngologist - A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.
Representative exposure - Measurements of an employee's noise dose or 8-hour time-weighted average sound level that the employers deem to be representative of the exposures of other employees in the workplace.
Sound level - Ten times the common logarithm of the ratio of the square of the measured A-weighted sound pressure to the square of the standard reference pressure of 20 micropascals. Unit: decibels (dB). For use with this regulation, SLOW time response, in accordance with ANSI S1.4-1971 (R1976), is required.
Sound level meter - An instrument for the measurement of sound level.
Time-weighted average sound level - That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured.

HEARING CONSERVATION

ATTACHMENT C

AUDIOMETRIC STANDARD THRESHOLD SHIFT NOTIFICATION

Audiometric STS Notification Form

Employee's Name: _____ SS No. _____

Employees Job Title: _____ Location: _____

General Comments (e.g., medical referral details): _____

_____

_____

A hearing test was conducted on _____/_____/_____ and the results indicate that (check appropriate box below):

_____ A **preliminary Standard Threshold Shift (STS) has occurred** and your are to have a repeat hearing test within 30 days to determine if the hearing change was temporary.

_____ The follow-up hearing test has occurred and the **STS was not confirmed.** The change in your hearing was only temporary.

_____ The follow-up hearing test has occurred and the **STS was confirmed**. Your hearing has shown a significant change.

_____ **Medical Referral Only**: An unusual hearing loss pattern exists and it is suggested that you consult with your personal physician or an ear, nose and throat specialist. Expenses for further evaluations are your responsibility.

Note: A Standard Threshold Shift (STS) is a change in hearing threshold relative to the baseline audiogram of an average of 10 decibels or more at 2000, 3000, and 4000 Hertz in either ear. If you have questions regarding this notification, you should contact the Bureau EHS Personal.

I, _____, received this notification on _____/_____/_____.

(Employee Signature) (Date)

Employee notification was made:

by _____ _____ _____/_____/_____

(DEP Rep Print Name) (DEP Rep Signature) (Date)

(Attach Hearing Test Results)

Appendix K

NYCDEP Sanitation, Disease Prevention, and Hygiene

Sanitation, Disease Prevention, and Hygiene

Environmental Health & Safety Policies, Procedures and Guidelines

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Applies to:	All DEP Bureaus and Offices
EHS Policy Volume:	☐I ☐II ☑**III** ☐IV
Revision Number:	**0**
Document Type:	☑**Policy** ☐Procedure ☐Guideline ☐SOP
Effective Date:	**March 12, 2004**
Reviewed By:	
Approved By:	**OEHS**

Objective

This procedure outlines the responsibilities of personnel, requirements for sanitary facilities at manned locations, guidelines for working proximity to sewage/personal hygiene, addresses housekeeping, prevention of mosquito and other vector-borne diseases, and the procedure for reporting occurrences of disease.

Purpose

This procedure defines how DEP promotes awareness of known biological hazards in the workplace and effective hygiene and protective measures that may be employed to prevent or minimize injuries and illnesses from these hazards.

Health and Safety Coordination Committee Approval

The New York City Department of Environmental Protection's Health and Safety Coordination Committee has reviewed this document and by the Chair's signing below agree that it adequately defines the program necessary to address regulatory requirements for their Bureau/Office operations and commit to the policies and/or procedures contained within (or substantially equivalent procedures, if Bureau/Office specific amendment is required and it is approved by the Health and Safety Coordination Committee).

Revision / Action	Signature of Committee Chair	
Revision 0, Authorization	Timothy P. Hoey	Date: 3-12-04
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:

DEP Office of Environmental, Health and Safety Compliance Authorization

I, a duly authorized representative of the DEP Office of Environmental Health and Safety Compliance, have reviewed this document, have found it to be acceptable and authorize its use for all DEP operations.

Revision / Action	Signature	
Revision 0, Authorization		Date: 3/15/04
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:

Table of Contents

1 PURPOSE 1
2 SCOPE 1
3 DEFINITIONS 1
4 RESPONSIBILITIES 2
4.1 OEHSC 2
4.2 Bureau EHS Personnel 2
4.3 Responsible Manager 2
4.4 Employees 3
5 PROCEDURE 3
5.1 Sanitary Facilities Required at Manned Locations 3
5.2 Guidelines for Working in Proximity to Sewage/Personal Hygiene 4
5.3 Housekeeping 4
5.4 Prevention of Mosquito and Other Vector-Borne Diseases 5
5.5 Reporting Occurrences of Disease 5
6 TRAINING 5
7 RECORD KEEPING 6
8 ATTACHMENT 6
8.1 Attachment A – Relevant Guidelines for Working in Proximity to Sewage 6

1 Purpose

The purpose of this procedure is to ensure that DEP employees have access to appropriate sanitary facilities and are advised of good hygiene and other work practices appropriate to the location(s), tasks, and biological hazards encountered in the workplace to prevent or minimize injuries and illnesses from these hazards. It is also intended to provide guidance for employees that work in close proximity to sewage (e.g., workers who enter sewers) and to describe DEP's approach for informing employees who perform outdoor duties that involve risk of occupational exposure to mosquitoes (West Nile virus), ticks (Lyme disease) and other vectors that transmit diseases such as, Hepatitis, Tuberculosis (TB), and giardia, etc.

2 Scope

This procedure applies to all affected DEP employees who work in sewers or otherwise in close proximity to raw sewage or who are exposed to outdoor natural biological hazards. It also addresses providing sanitary facilities in accordance with regulatory requirements (29 CFR 1910.141). It describes how DEP promotes awareness of known biological hazards in the workplace and effective hygiene and protective measures that may be employed to prevent or minimize injuries and illnesses from these hazards.

3 Definitions

Permanent Place of Employment (i.e., Manned Facility or Establishment) – A single physical location where … services … are performed. … For firms engaged in activities such as agriculture, construction, transportation, communications, and electric, gas and sanitary services, which may be physically dispersed, records may be maintained at a place to which employees report each day. [excerpted from 29 CFR 1904.12 (g) Recordkeeping]

Potable water - water which meets the quality standards prescribed in the U.S. Public Health Service Drinking Water Standards, published in 42 CFR Part 72, or water which is approved for drinking purposes by the State or local authority having jurisdiction.

Toilet facility - a fixture maintained within a toilet room for the purpose of defecation or urination, or both.

Toilet room - a room maintained within or on the premises of any place of employment, containing toilet facilities for use by employees.

Toxic material - a material in concentration or amount which exceeds the applicable limit established by a standard, such as 1910.1000 and 1910.1001 or, in the absence of an applicable standard, which is of such toxicity so as to constitute a recognized hazard that is causing or is likely to cause death or serious physical harm.

Water closet - a toilet facility maintained within a toilet room for the purpose of both defecation and urination and which is flushed with water.

Wet process - any process or operation in a workroom which normally results in surfaces upon which employees may walk or stand becoming wet.

4 Responsibilities

4.1 OEHSC

The Office of Environmental, Health and Safety Compliance (OEHSC) responsibilities include:

- When OEHSC receives reports of diseases that could have resulted from exposure on the job or occurrences of communicable diseases that could affect co-workers, OEHSC is responsible for determining what actions are required by applicable health regulations (e.g., Department of Health) and will work with ***Bureau EHS*** and the facilities to implement required actions.

4.2 Bureau EHS Personnel

- Provide support to the ***Responsible Managers*** of facilities and field operations involving potential health and hygiene hazards to ensure that employees have access to sanitary facilities and are informed of good hygiene practices.

4.3 Responsible Manager

The highest ranking manager or supervisor within each DEP Bureau at each facility (or whose employees perform field operations outside of fixed facilities) is the ***Responsible Manager*** for that Bureau's operation. If a Bureau is working in a facility "owned" by another Bureau, all other Bureau ***Responsible Managers*** must coordinate with the owning Bureau's ***Responsible Manager*** and provide them with information regarding known biological hazards found in the workplace. The ***Responsible Manager*** has the following responsibilities.

- Ensure that employees have access to sanitary facilities in any permanent place of employment (i.e., manned facilities) and apply voluntary guidelines for disease prevention as appropriate.
- Ensure these facilities are maintained in a sanitary condition and appropriate cleansing agents are provided and replenished.
- Work with ***Bureau EHS*** to identify any known workplace biological hazards and address them in accordance with DEP's Personal Protective Equipment procedure and other DEP procedures, as applicable,
- Inform affected employees of known hazards and good hygiene practices that can be used to prevent or minimize risk of illness,
- Refer to the Hazcom/Right-to-Know and/or PPE procedures, as applicable, for training on disease prevention and providing appropriate PPE for specific jobs involving close contact with sewage.

The ***Responsible Manager*** may delegate implementation tasks (e.g., to the EH&S Liaison or other staff), as appropriate.

4.4 Employees

All DEP employees are responsible to:

- Use applicable safe work practices and PPE required for their facilities and field operations, as communicated in training and by their supervisor.

5 Procedure

5.1 Sanitary Facilities Required at Manned Locations

All DEP staff responsible for providing and/or maintaining buildings as manned facilities shall ensure that they provide adequate sanitary facilities in accordance with 29 CFR 1910.141 including providing potable water for drinking washing, and eating areas.

Construction of non-potable water or any other non-potable substance systems shall prevent backflow or backsiphonage into a potable water system. All outlets for non-potable water (e.g., raw water sampling stations or firewater) shall be posted or otherwise marked in a manner that will indicate clearly that the water is unsafe and shall not be used for drinking, washing, cooking, food preparation, cleaning food areas, or washing clothes.

Toilet rooms separate for each sex shall be provided unless toilet rooms will be occupied by no more than one person at a time, can be locked from the inside, and contain at least one water closet. Each water closet shall occupy a separate compartment with a door and walls or partitions between fixtures sufficiently high to assure privacy. The number of facilities to be provided for each sex shall be based on the maximum number of employees of that sex on any one shift for whom the facilities are furnished and in accordance with the table below. They will have hand soap (germicidal soap for work with sewage) and hot and cold running water or tepid running water. They shall have convenient access to warm air hand driers, individual paper towels or clean sections of continuous cloth toweling.

Table J-1 from 29 CFR 1910.141

Number of employees	Minimum number of water closets (1)
1 to 15	1
16 to 35	2
36 to 55	3
56 to 80	4
81 to 110	5
111 to 150	6
Over 150	(2)

Notes: (1) Where toilet facilities will not be used by women, urinals may be provided instead of water closets, except that the number of water closets in such cases shall not be reduced to less than 2/3 of the minimum specified.
(2) One additional fixture for each additional 40 employees.

Lavatory requirements do not apply to mobile crews or to normally unattended work locations if employees working at these locations have transportation readily available to nearby washing facilities which meet the requirements.

Showers and change rooms are sometimes required by particular OSHA standards for employees that must wear protective clothing because of the possibility of contamination with toxic substances, but these provisions generally do not apply to routine DEP operations. DEP guidelines for those who work in sewers or otherwise work in close proximity to sewage suggest (but do not require) providing access to showers, change rooms with separate storage compartments for work or protective clothing, and high temperature clothes washers and driers.

[Note: where they are required by regulations - one shower with hot and cold water feeding a common discharge line shall be provided for each 10 employees of each sex, or fraction thereof, required to shower during the same shift and employees shall be provided with individual clean towels. Change rooms required by regulations due to the use of protective clothing for exposure to toxic materials shall be equipped with storage facilities for street clothes and separate storage facilities for the protective clothing.]

The facility ***Responsible Manager*** shall ensure that these facilities are maintained in a sanitary condition, that appropriate cleansing agents are provided and are replenished. No employee shall be allowed to store or consume food or beverages in a toilet room or in any work area where toxic materials are present.

Any portable drinking water dispensers shall be designed, constructed, and serviced so that sanitary conditions are maintained, shall be capable of being closed and equipped with a tap.

5.2 Guidelines for Working in Proximity to Sewage/Personal Hygiene

Safety and public health agencies have weighed the very small risk of disease (from pooled human sewage) against the very small risk of adverse effects (and cost) of specific protective measures and immunization. These agencies have left it to the employer to determine how to meet its responsibilities to protect employees from potential biological hazards of sewage. Relevant guidelines that are not regulatory requirements are provided in Attachment A, for information only. Each Bureau is responsible for determining whether any of the guidelines will be used in its operations.

5.3 Housekeeping

All DEP employees responsible for providing buildings as manned facilities shall ensure that every enclosed workplace is constructed, equipped, and maintained, so far as reasonably practicable, as to prevent the entrance or harborage of rodents, insects, and other vermin. A continuing and effective extermination program shall be instituted where their presence is detected. Rodenticides shall be used in accordance with the DEP Pesticide procedure.

The ***Responsible Manager*** shall ensure that the facility is kept clean to the extent that the nature of the work allows. Keep floors and passageways free from protruding nails, splinters, loose boards, and unnecessary holes and openings to facilitate cleaning.

Keep floors dry, so far as this is practicable. Where wet processes are used, drainage shall be maintained and false floors, platforms, mats, or other dry standing places shall be provided, where practicable, or appropriate waterproof footgear shall be provided.

Routinely remove sweepings, solid or liquid wastes, refuse, and garbage as often as necessary to avoid creating a health or fire hazard and to maintain sanitary conditions. Receptacles used for putrescible solid or liquid waste or refuse shall be so constructed that it does not leak and may be thoroughly cleaned and maintained in a sanitary condition. Such a receptacle shall be equipped with a solid tight-fitting cover, unless it can be maintained in a sanitary condition without a cover.

5.4 Prevention of Mosquito and Other Vector-Borne Diseases

DEP will follow the *City of New York Procedures to Prevent the Transmission of Vector-Borne Diseases to City Employees and the Occupational Exposure to Pesticides and Related Chemicals Used to Control Such Diseases* for employees that:

- Perform activities to control mosquitoes or other vectors that transmit West Nile Virus or other vector-borne diseases;
- Maintain or inspect sites that may be treated habitat's for such vectors (e.g., Catch Basins); or
- Have outdoor duties that result in possible occupational exposure to such vectors.

Prudent measures will be taken for vector control (e.g., long sleeves, long pants, socks, repellent) and personal protective equipment appropriate for potential exposure to sources treated with pesticides will be used (generally gloves and the option to use goggles and other PPE if jobs can result in greater exposure due to expected direct physical contact).

5.5 Reporting Occurrences of Disease

Occurrences of diseases that the employee or Supervisor believes could have resulted from exposure on the job or occurrences of communicable diseases that could affect co-workers must be immediately reported by Supervisors to the ***Responsible Managers***. The ***Responsible Managers*** will immediately report such occurrences to ***Bureau EHS*** and ***OEHSC***. ***OEHSC*** will determine what actions are required by applicable health regulations (e.g., Department of Health) and will work with ***Bureau EHS*** and the facilities to implement required actions.

6 Training

Training on these procedures shall be provided during HazCom/Right-to-Know annual training when appropriate based on the employees' potential work place exposures. It will include

prudent measures for vector control and personal protective equipment appropriate for potential exposure to sources treated with pesticides, when applicable.

7 Record Keeping

Maintain all training records in accordance with DEP procedures on Document Tracking & Recordkeeping.

8 Attachment

8.1 Attachment A – Relevant Guidelines for Working in Proximity to Sewage

Attachment A

Relevant Guidelines for Working in Proximity to Sewage

Sewage and wastewater contain bacteria, funguses, parasites, and viruses that can cause intestinal, lung, and other infections. Exposure generally requires ingestion or contact with an open cut. Careful work habits can help protect employees performing most jobs, although Personal Protective Equipment (PPE) may be warranted (e.g., gloves, goggles, a face shield, water-resistant suit, etc.) for jobs that are likely to involve splashing and other intensive contact with sewage. In these cases, a hazard evaluation should be conducted under DEP's PPE procedure to determine appropriate PPE for the job.

The guidelines below are not regulatory requirements but are provided in this Attachment for information only. Guidelines are not enforceable and each Bureau is responsible for determining what measures to take to prevent exposure to disease causing agents in its operations.

The following are general guidelines:

1. Frequent, routine hand washing is the most important safeguard in preventing infection by agents present in sewage.
2. Protective clothing (i.e., work clothes, coveralls, boots, and--when appropriate, gloves and plastic face shields) while doing jobs in which there is a chance of being splashed by raw sewage or sludge (e.g., cleaning pumps) is recommended. Such work clothes should not be worn home or outside the immediate work environment.
3. Immunization for Tetanus-diphtheria (Td). All adults, and especially sewage workers, should be up-to-date on Td immunization. For those who have completed the basic series of three immunizations, a booster should be given every ten years. No other immunizations are routinely recommended at the present.

More specific guidelines that bureaus may use (as applicable to their situation) to develop their own Bureau, facility or work group safe work practices for affected employees include:

- Most important: Wash your hands well with clean water and soap before you eat or smoke and after work, using a germicidal soap where available.
- Do not touch your nose, mouth, eyes, or ears with your hands, unless you have just washed. Most of the time, people get these diseases when they have germs on their hands and they touch their mouth or nose or eyes.
- Keep your fingernails short; use a stiff soapy brush to clean under your nails.
- Leave soiled gloves, jackets, boots and hard hats outside the kitchen before you enter.
- Wear waterproof elbow length gloves when you clean pumps or screens and when you handle wastewater, sludge, grit, or materials that have been contaminated by sewage or sludge.

- Use appropriate protective equipment, such as face shields, while doing jobs that can cause splashing by raw sewage or sludge (e.g., water blasting equipment containing sewage).
- Always wear gloves when your hands are chapped or burned or you have a rash or a cut.
- Do not handle or remove hypodermic needles or other medical waste unless trained and authorized to do so. Report it immediately to your supervisor who will mobilize appropriate staff to manage the situation.
- Change out of work clothes before you leave work. Keep your work clothes and street clothes in separate lockers or compartments. Keep your clean and soiled clothes in the color coded laundry bags you have been issued.
- Change into a clean set of work clothes on a regular basis. If work clothes are accidentally soaked in sewage containing liquids through to the skin – showering is recommended prior to leaving work.
- Wash your work clothes at work, using the special high temperature washers and dryers provided. The high temperature (160^{o}F) machines will destroy any amebic cyst adhering to your work clothes, immediately. Washers and dryers found at home or in commercial laundromats are probably not as effective.
- Report any injury or illness you think you got from work right away and tell your doctor you work in around sewage to help the doctor know what to look for.

These guidelines were formulated with information derived from publications by California Department of Health Services; an AFL CIO Hazard Alert “Biological Hazards in Sewage and Wastewater Treatment Plants” and the Bureau of Wastewater Treatment (BWT) Amebiasis Fact Sheet.

Appendix L

NYCDEP PCB Management

PCB Management

Environmental Health & Safety Policies, Procedures and Guidelines

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Applies to:	All DEP Bureaus and Offices
EHS Policy Volume:	☐I ☐II ☐III ☑**IV**
Revision Number:	**1**
Document Type:	☑**Policy** ☐Procedure ☐Guideline ☐SOP
Effective Date:	**August 15, 2007**
Approved By:	**OEHS**

Objective

This procedure outlines the responsibilities of personnel, PCB prohibitions, identification and tracking of PCB items, registration, inspection and maintenance of PCB transformers, spill or fire/explosion response, disposal of capacitors and fluorescent light ballasts, and remediation and disposal of PCB materials.

Purpose

This procedure defines how New York City Department of Environmental Protection (DEP) personnel will manage all Polychlorinated Biphenyls (PCB) regulated items.

Environmental Coordination Committee Approval

The New York City Department of Environmental Protection's Environmental Coordination Committee has reviewed this document and by the Chair's signing below agrees that it adequately defines the program necessary to address regulatory requirements for their Bureau operations and commit to the policies and/or procedures contained within (or substantially equivalent procedures, if a Bureau specific amendment is required).

Revision / Action	Signature of Committee Chair	
Revision 0, Authorization		Date: October 28, 2003
Revision 1, Authorization		Date: July 30th, 2007
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:

DEP Office of Environmental, Health and Safety Compliance Authorization

I, a duly authorized representative of the DEP Office of Environmental Health and Safety Compliance, have reviewed this document, have found it to be acceptable and authorize its use for all DEP operations.

Revision / Action	Signature	
Revision 0, Authorization		Date: October 28, 2003
Revision 1, Authorization		Date: July 30, 2007
		Date:
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		Date:

Table of Contents

1 PURPOSE 1
2 SCOPE 1
3 DEFINITIONS 1
4 RESPONSIBILITIES 4
4.1 Bureau EHS 4
4.2 Responsible Individual 4
4.3 Contract Supervisor 5
5 PROHIBITIONS 5
6 IDENTIFICATION AND TRACKING OF PCB ITEMS 6
7 MARKING REQUIREMENTS 6
8 REGISTRATION OF PCB TRANSFORMERS 6
9 INSPECTION AND MAINTENANCE 7
10 SPILL OR FIRE/EXPLOSION RESPONSE 7
11 DISPOSAL OF SMALL CAPACITORS AND FLUORESCENT LIGHT BALLASTS 8
12 DISPOSAL OF PCB ARTICLES AND OTHER PCB HAZARDOUS WASTE 8
13 PAINT CONTAINING PCBS 9
14 REMEDIATION AND DISPOSAL 9
15 RECORDKEEPING 9
16 ATTACHMENTS 9
16.1 Attachment A – Disposal Requirements for Fluorescent Light Ballasts 9

1 PURPOSE

This procedure defines how New York City Department of Environmental Protection (DEP) personnel will manage all Polychlorinated Biphenyls (PCB) regulated items.

2 SCOPE

This procedure applies to all DEP facilities where PCB items may exist or are known to exist. For the purposes of this procedure, PCB items are defined by the Toxic Substance Control Act (TSCA) and presented in 40 CFR 761.3. In addition, NYSDEC regulates PCB wastes under 6 NYCRR Part 371. DEP personnel shall perform all PCB management activities in accordance with 40 CFR 761 and 6 NYCRR Part 371. Complying with PCB requirements is complex and this procedure cannot address every potential situation involving PCBs. Facilities are encouraged to consult with ***Bureau EHS*** when they have any questions about compliance with regulations or DEP policies and procedures.

3 Definitions

Capacitor - A device for accumulating and holding a charge of electricity and consisting of conducting surfaces separated by a dielectric. Types of capacitors are as follows:

(1) Small capacitor means a capacitor which contains less than 1.36 kg (3 lbs.) of dielectric fluid. The following assumptions may be used if the actual weight of the dielectric fluid is unknown. A capacitor whose total volume is less than 1,639 cubic centimeters (100 cubic inches) may be considered to contain less than 1.36 kg (3 lbs.) of dielectric fluid and a capacitor whose total volume is more than 3,278 cubic centimeters (200 cubic inches) must be considered to contain more than 1.36 kg (3 lbs.) of dielectric fluid. A capacitor whose volume is between 1,639 and 3,278 cubic centimeters may be considered to contain less then 1.36 kg (3 lbs.) of dielectric fluid if the total weight of the capacitor is less than 4.08 kg (9 lbs.).

(2) Large high voltage capacitor means a capacitor which contains 1.36 kg (3 lbs.) or more of dielectric fluid and which operates at 2,000 volts (AC or DC) or above.

(3) Large low voltage capacitor means a capacitor which contains 1.36 kg (3 lbs.) or more of dielectric fluid and which operates below 2,000 volts (AC or DC).

Excluded PCB – PCB materials which appear at concentrations less than 50 ppm, including materials listed in the definition given in 40 CFR 761.3 for Excluded PCB

Fluorescent light ballast - A device that electrically controls fluorescent light fixtures and that includes a capacitor containing 0.1 kg or less of dielectric.

Leak or leaking - Any instance in which a PCB Article, PCB Container, or PCB Equipment has any PCBs on any portion of its external surface.

Non-PCB Transformer - Any transformer that contains less than 50 ppm PCB; except that any transformer that has been converted from a PCB Transformer or a PCB-Contaminated

Transformer cannot be classified as a non-PCB Transformer until reclassification has occurred, in accordance with the requirements of 40 CFR 761.30(a)(2)(v).

PCB and PCBs - Any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees or any combination of substances which contains such substance. Refer to 40 CFR 761.3 for definitions applicable to inadvertently generated non-Aroclor PCBs.

PCB Article - Any manufactured article, other than a PCB Container, that contains PCBs and whose surface(s) has been in direct contact with PCBs. ''PCB Article'' includes capacitors, transformers, electric motors, pumps, pipes and any other manufactured item (1) which is formed to a specific shape or design during manufacture, (2) which has end use function(s) dependent in whole or in part upon its shape or design during end use, and (3) which has either no change of chemical composition during its end use or only those changes of composition which have no commercial purpose separate from that of the PCB Article.

PCB Bulk Product Waste - waste derived from manufactured products containing PCBs in a non-liquid state, at any concentration where the concentration at the time of designation for disposal was ≥50 ppm PCBs. PCB bulk product waste does not include PCBs or PCB Items regulated for disposal under § 761.60(a) through (c), § 761.61, § 761.63, or § 761.64. [This Federal definition applies to PCB Items that are not defined as PCB Hazardous Waste in NY State (see definition below). See 761.3 for balance of lengthy definition.]

PCB Capacitor - Any capacitor that contains ≥500 ppm PCB. Concentration assumptions applicable to capacitors appear under 40 CFR 761.2.

PCB Container - Any package, can, bottle, bag, barrel, drum, tank, or other device that contains PCBs or PCB Articles and whose surface(s) has been in direct contact with PCBs.

PCB-Contaminated means a non-liquid material containing PCBs at concentrations ≥50 ppm but <500 ppm; a liquid material containing PCBs at concentrations ≥50 ppm but <500 ppm or where insufficient liquid material is available for analysis, a non-porous surface having a surface concentration >10 µg/100 cm2 but <100 µg/100 cm2, measured by a standard wipe test as defined in 40 CFR 761.123.

PCB-Contaminated Electrical Equipment - Any electrical equipment including, but not limited to, transformers, capacitors, circuit breakers, reclosers, voltage regulators, switches (including sectionalizers and motor starters), electromagnets, and cable, that contains PCBs at concentrations of ≥50 ppm and <500 ppm in the contaminating fluid. In the absence of liquids, electrical equipment is PCB-Contaminated if it has PCBs at >10 µg/100 cm2 and <100 µg/100 cm2 as measured by a standard wipe test (as defined in 40 CFR 761.123) of a non-porous surface.

PCB Equipment - Any manufactured item, other than a PCB Container or a PCB Article Container, which contains a PCB Article or other PCB Equipment, and includes microwave ovens, electronic equipment, and fluorescent light ballasts and fixtures.

PCB Item - Any PCB Article, PCB Article Container, PCB Container, PCB Equipment, or anything that deliberately or unintentionally contains or has as a part of it any PCB or PCBs.

PCB Hazardous Waste (NYSDEC) - All solid wastes containing 50 parts per million (ppm) by weight (on a dry weight basis for other than liquid wastes) or greater of PCBs are listed hazardous wastes, excluding small capacitors as defined in 6 NYCRR Part 371(e)(3) and PCB Articles drained in accordance with 6 NYCRR Part 371(e)(2)(ii) and (iii). Oils in or from electrical equipment whose PCB concentration is unknown, except circuit breakers, reclosers, and cable must be assumed to contain between 50 and 500 ppm PCB and are listed hazardous waste. Refer to 6 NYCRR Part 371(e) for Hazardous Waste Codes applicable to PCB wastes.

PCB Remediation Waste – waste containing PCBs as a result of a spill, release, or other unauthorized disposal, at the following concentrations: Materials disposed of prior to April 18, 1978, that are currently at concentrations ≥50 ppm PCBs, regardless of the concentration of the original spill; materials which are currently at any volume or concentration where the original source was ≥500 ppm PCBs beginning on April 18, 1978, or ≥50 ppm PCBs beginning on July 2, 1979; and materials which are currently at any concentration if the PCBs are spilled or released from a source not authorized for use under 40 CFR 761. PCB remediation waste means soil, rags, and other debris generated as a result of any PCB spill cleanup (Note: disposal of non-liquid cleaning materials and personal protective equipment waste such as rags, gloves, booties, other disposable personal protective Personal Protective Equipment is governed by 40 CFR 761.61(a)(5)(v)(A)), including, but not limited to:

(1) Environmental media containing PCBs, such as soil and gravel; dredged materials, such as sediments, settled sediment fines, and aqueous decantate from sediment.

(2) Sewage sludge containing < 50 ppm PCBs and not in use according to §761.20(a)(4); PCB sewage sludge; commercial or industrial sludge contaminated as the result of a spill of PCBs including sludges located in or removed from any pollution control device; aqueous decantate from an industrial sludge.

(3) Buildings and other man-made structures (such as concrete floors, wood floors, or walls contaminated from a leaking PCB or PCB-Contaminated Transformer), porous surfaces, and non-porous surfaces.

PCB Transformer - Any transformer that contains ≥500 ppm PCBs. For PCB concentration assumptions applicable to transformers containing 1.36 kilograms (3 lbs.) or more of fluid other than mineral oil, see 40 CFR 761.2. For provisions permitting reclassification of electrical equipment, including PCB Transformers, containing ≥500 ppm PCBs to PCB-Contaminated Electrical Equipment, see 40 CFR 761.30(a) and (h).

Porous surface - Any surface that allows PCBs to penetrate or pass into itself including, but not limited to, paint or coating on metal; corroded metal; fibrous glass or glass wool; unglazed ceramics; ceramics with a porous glaze; porous building stone such as sandstone, travertine, limestone, or coral rock; low-density plastics such as Styrofoam and low-density polyethylene; coated (varnished or painted) or uncoated wood; concrete or cement; plaster; plasterboard; wallboard; rubber; fiberboard; chipboard; asphalt; or tar paper. For purposes of cleaning and disposing of PCB remediation waste, porous surfaces have different requirements than non-porous surfaces.

Posing an exposure risk to food or feed - Being in any location where human food or animal feed products could be exposed to PCBs released from a PCB Item. A PCB Item poses an exposure risk to food or feed if PCBs released in any way from the PCB Item have a potential pathway to human food or animal feed. EPA considers human food or animal feed to include items regulated by the U.S. Department of Agriculture or the Food and Drug Administration as human food or animal feed; this includes direct additives. Food or feed is excluded from this definition if it is used or stored in private homes.

4 RESPONSIBILITIES

4.1 Bureau EHS

- Coordinate with each facility's ***Responsible Individual*** to identify all known and potential PCB articles located at the facility.
- Prepare and maintain an inventory to track the presence of PCB Transformers and Large Capacitors present in each facility.
- Whenever PCB containing materials are tested or removed, work with the Bureau liaison to the DEP Legacy Program and the OEHSC ***Legacy Program Manager*** to update the inventory of known PCB containing materials and tests of materials in the workplace.

4.2 Responsible Individual

The highest-ranking manager or supervisor within each DEP Bureau at each facility (or whose employees perform field operations outside of fixed facilities) is the ***Responsible Individual*** for that Bureau's operation [Note: Procedures issued before November 2006 refer to this individual as the Responsible Manager]. If a Bureau is working in a facility "owned" by another Bureau, all other Bureau ***Responsible Individuals*** must coordinate with the owning Bureau's ***Responsible Individual*** and provide them with information on PCB management. The ***Responsible Individual*** has the following responsibilities.

- Confirm that all regulated PCB Transformers are registered with EPA and PCB Transformers present near (within 30 meters/98 feet) or in a commercial building (non-DEP facility) are registered with the building owner.
- Provide ***Bureau EHS*** with information necessary to prepare and maintain an inventory to track the presence of PCB Transformers and Large Capacitors present at the facility. Communicate with ***Bureau EHS*** whenever PCB containing materials are tested or removed.
- Coordinate with ***Bureau EHS*** regarding registration, inspection, and maintenance activities associated with PCB Transformers and for PCB spill response.
- Coordinate with ***Bureau EHS*** and, as necessary, contractors (e.g., transporters, disposal facilities, etc.) to properly manage and dispose of PCB Items including fluorescent light ballasts.

- Provide information to employees and contractors under the Hazard Communication program regarding their work involving the presence of PCBs in paint.

The ***Responsible Individual*** may delegate implementation tasks (e.g., to a facility Safety Officer, EHS Liaison or other staff), as appropriate.

4.3 Contract Supervisor

The ***Contract Supervisor*** is the person responsible for managing and overseeing the Contract. The ***Contract Supervisor*** is assigned by the Bureau management based on the type, scale and phase of the project (e.g., Project Manager, Construction Manager, Resident Engineer, Chief, Deputy Chief, etc.). The ***Contract Supervisor*** shall:

- Prior to design of work that may demolish, disturb or remove building materials or equipment, first obtain available information on the presence of materials, equipment, and paint containing hazardous substances (i.e., Legacy constituents).
- Include evaluation/removal/abatement of Legacy constituents in the scope of work as necessary to safely complete the work or, in consultation with the operating Bureau, if abatement is to be included in the scope of work to reduce long-term management obligations.
- Coordinate with ***Bureau EHS*** to provide updated Legacy information to the OEHSC ***Legacy Program Manager*** whenever removal/abatement changes the presence and location of Legacy constituents at any DEP facility.

5 Prohibitions

The PCB regulations are complex and there are numerous prohibitions. Some prohibitions that could be relevant to DEP operations include, but are not limited to (40 CFR 761.30):

(i) Use and storage for reuse of PCB Transformers that pose an exposure risk to food or feed;

(ii) Use of network PCB Transformers with secondary voltages $\geq$ 480 volts (including 480/277 volt systems) in or near commercial buildings; and

(iii) Except as otherwise provided, the installation of PCB Transformers, which have been placed into storage for reuse or which have been removed from another location, in or near commercial buildings.

While drinking water is not included in the definition for "pose an exposure risk to food or feed", DEP's policy is to remove any PCB Transformer that could contaminate the water supply if it leaks or explodes based on it having a drainage pathway to the water supply.

DEP's policy is to not procure or reuse any PCB article or item, except for transformers where reclassification has occurred, in accordance with the requirements of 40 CFR 761.30(a)(2)(v).

6 Identification and Tracking of PCB Items

Bureau EHS shall coordinate with each facility's ***Responsible Individual*** to identify large PCB Items (e.g., transformers, large capacitors, etc.) located within each facility and prepare and maintain an inventory (e.g., table, database or spreadsheet) of these items. The inventory will contain the type of article, the article installation date, the concentration and weight of PCBs containing fluids, and the regulatory status of current PCB articles. The facility will maintain records that identify the date of removal, remediation or retrofit and the location of documentation of these activities for any item on the initial inventory and for articles known to exist prior to the initial inventory, when available. Other PCB-containing materials, equipment, and paint are tracked through the Legacy Program.

7 Marking Requirements

The facility's ***Responsible Individual*** will ensure that all PCB items listed in 40 CFR 761.40 and 761.45 meet the marking requirements as defined in those regulations. Items requiring marking as illustrated in Figure 1 in 40 CFR 761.45(a) include, but are not limited to:

(1) PCB Containers;

(2) PCB Transformers;

(3) PCB Large High Voltage Capacitors;

(4) Equipment containing a PCB Transformer or a PCB Large High Voltage Capacitor;

(5) PCB Large Low Voltage Capacitors at the time of removal from use;

(6) Electric motors using PCB coolants;

(7) Hydraulic systems using PCB hydraulic fluid;

(8) Heat transfer systems (other than PCB Transformers) using PCBs;

(9) PCB Article Containers containing the above articles or equipment that must be marked;

(10) Each storage area used to store PCBs and PCB Items for disposal.

Many of the above articles must also be marked if PCB Contaminated (i.e., between 50 and 500 ppm); however, marking of PCB-Contaminated Electrical Equipment is not required.

8 Registration of PCB Transformers

In accordance with 40 CFR 761.30, the ***Responsible Individual*** shall confirm that all regulated PCB Transformers are registered with the Environmental Protection Agency (National Program Chemicals Division, Office of Pollution Prevention and Toxics (7404), 1200 Pennsylvania Ave., NW, Washington DC 20460) or shall register them. The ***Responsible Individual*** shall maintain a record of each PCB Transformer's registration (a copy of the registration and the return receipt signed by the EPA) with the inspection and maintenance records described in Section 13.

If a DEP PCB Transformer is present near (within 30 meters/98 feet) or in a commercial building (non-DEP facility), the ***Responsible Individual*** shall register the PCB Transformer

with the building owner(s) of record by formally transmitting the following information to the building owner(s):

- The specific location of the PCB Transformer(s);
- The principal constituent of the dielectric fluid in the transformer(s) (e.g., PCBs, mineral oil, or silicone oil); and
- The type of transformer installation (e.g., 208/120 volt network, etc.).

9 Inspection and Maintenance

The facility's ***Responsible Individual*** shall perform visual inspections of all PCB Transformers in use or stored at least once every three months in accordance with 40 CFR 761.30(a)(1)(ix). Such inspections may take place any time during the three-month periods: January-March, April-June, July-September, and October-December as long as there is a minimum of 30 days between inspections. The visual inspection shall include investigation for any leak of dielectric fluid on or around the transformer. The extent of the visual inspection will depend on the physical constraints of each transformer installation and should not require an electrical shutdown of the transformer being inspected.

The facility's ***Responsible Individual*** shall maintain copies of each PCB Transformer's inspection records and maintenance history for at least three years after disposing of the transformer. Records shall contain the following information:

- The location of the PCB Transformer;
- The date of each visual inspection;
- The date a leak was discovered, if different from the inspection date;
- The location of any leak(s);
- An estimate of the amount of dielectric fluid released from any leak;
- The date of any cleanup, containment, or repair performed;
- The results of any containment and daily inspection required for uncorrected active leaks;
- Record of the registration of the PCB Transformer (Section 4); and
- Records of transfer of ownership or disposal of the PCB Transformer.

10 Spill or Fire/Explosion Response

Upon discovery of a leaking PCB Transformer or other PCB Item, the facility shall respond to the leak in accordance with DEP's Spill Prevention, Environmental Release Reporting and Investigation Procedure. Any fire-related incident involving a PCB Transformer or any spill of more than the Reportable Quantity for PCBs of 1 lb. must be reported as defined in that procedure including to NYSDEC, the National Response Center and, if in NYC, to DEP Hazmat. Address PCB Transformer fire-related incidents in accordance with 40 CFR 761.30(a)(1)(x) and 761.30(a)(1)(ix), NYSDEC requirements and policies, and applicable New York City policies.

For PCB spills involving >50 ppm material, DEP must also notify the EPA regional office (the

Office of Prevention, Pesticides and Toxic Substances Branch) and/or initiate cleanup in the shortest possible time after discovery, but in no case later than 24 hours after discovery (40 CFR 761.125) in the following cases:

(i) Spill directly contaminates surface water, sewers, or drinking water supplies (40 CFR 761.120(d)).	Notify and obtain guidance for appropriate cleanup measures.
(ii) Spill directly contaminates grazing lands or vegetable gardens (40 CFR 761.120(d)).	Notify and actions per 40 CFR 761.125 (b) or (c), depending on the source of the spill.
(iii) Spill exceeds 10 lbs. PCBs by weight and is not addressed in paragraph (i) or (ii) above.	Notify and proceed to decontaminate the spill area per 40 CFR 761.125.
(iv) Spills of 10 pounds or less, which are not addressed in paragraph (i) or (ii) above.	Clean up per 40 CFR 761.125 (to avoid EPA enforcement liability), but EPA notification is not required.

Cleanup of the released transformer PCBs in accordance with the regulations and applicable EPA and NYSDEC guidance must be initiated as soon as possible, but in no case later than 24 hours of its discovery. Until appropriate action is completed, any active leak of PCBs must be contained to prevent exposure of humans or the environment and inspected daily to verify containment of the leak. Trenches, dikes, buckets, and pans are examples of proper containment measures.

11 Disposal of Small Capacitors and Fluorescent Light Ballasts

Fluorescent light ballasts and small capacitors (see definitions in Section 3) are not hazardous waste under NYS DEC regulations (6 NYCRR 371.3(e)) but they must be disposed of under PCB Bulk Product Waste regulations unless marked "No PCBs". The facility's ***Responsible Individual*** and, as necessary, contractors (e.g., transporters, disposal facilities, etc.) shall dispose of fluorescent light ballasts and small capacitors in accordance with the requirements presented in **Attachment A**. In order to avoid sampling of ballasts and small capacitors that are not marked "No PCBs", ***Bureau EHS*** may opt to manage them in accordance with 40 CFR 761.62 (a) in facilities using a TSCA Incinerator, TSCA/RCRA Landfill, Alternate Destruction Method, decontamination, or coordinated approval management methods.

12 Disposal of PCB Articles and Other PCB Hazardous Waste

Bureau EHS shall coordinate with the facility's ***Responsible Individual*** and, as necessary, contractors (e.g., transporters, disposal facilities, etc.) to dispose of all PCB articles and other NYS PCB hazardous wastes in accordance with 40 CFR 761 and DEP's Hazardous Waste Management Procedures.

Other PCB wastes (e.g., construction debris, **dried or old paints**, varnishes and other construction materials) which contain PCBs above 50 ppm are considered hazardous wastes in New York State and must be disposed in accordance with New York State hazardous waste regulations.

13 Paint Containing PCBs

Work on paint containing PCBs or whose PCB content is unknown can be safely conducted by following the DEP Lead Management procedure "Low Risk" job guidelines. ***Responsible Individuals*** must provide information to employees and contractors under the Hazard Communication program regarding their work involving the presence of PCBs in paint.

Prior to design of work that may demolish, disturb or remove building materials or equipment, obtain available Legacy Program information on the presence of materials, equipment, and paint containing hazardous substances (i.e., Legacy constituents). It may be necessary to include evaluation/removal/abatement of Legacy constituents to safely complete the work. When paint is abated or removed on building materials, the ***Contract Supervisor*** or ***Responsible Individual*** managing the project must coordinate with ***Bureau EHS*** to provide the OEHSC ***Legacy Program Manager*** with updated Legacy database information.

14 Remediation and Disposal

When PCB regulated items are remediated and disposed, the regulatory requirements are complex and the beyond the scope of a management procedure to fully define. The facility ***Responsible Individual*** or ***Contract Supervisor*** managing the project shall ensure that all work performed by DEP and its contractors and subcontractors meet the regulatory requirements of 40 CFR 761, NYSDEC remediation requirements and policies, New York City Department of Health policies and other relevant requirements. Generally, any remediation waste containing 50 ppm by weight or more of PCBs are hazardous wastes. PCB remediation waste also includes all waste and cleanup media (e.g., rinsate) regardless of concentration, if the concentration of the original material (released after July 2, 1979) was over 50 ppm (see definition for spills before this date). Disposal of non-liquid cleaning materials and personal protective equipment waste such as rags, gloves, booties, other disposable personal protective Personal Protective Equipment is governed by 40 CFR 761.61(a)(5)(v)(A). Remediation requirements are detailed in 40 CFR 761.61, including site characterization, notification, cleanup standards, verification and disposal.

15 Recordkeeping

All inventory and registration records (including registration with building owners, for commercial buildings with DEP owned transformers within 30 meters/98 feet) will be maintained by the facility ***Responsible Individual***. Inspection and maintenance records will be maintained for at least three years after the PCB regulated item is disposed of. Records of remediation and removal efforts should be maintained as long as DEP owns the facility as a good management practice.

16 Attachments

16.1 Attachment A – Disposal Requirements for Fluorescent Light Ballasts

ATTACHMENT A

TSCA Disposal Requirements for Fluorescent Light Ballasts [1, 2]

PCB Capacitor	PCB Potting Material[3]	Labeling, Transportation and Manifesting for Disposal	Disposal Reference in §761	Disposal Options
"No PCBs" label		Not regulated under TSCA	N/A	Not regulated under TSCA
None	<50 ppm	Not regulated under TSCA	N/A	Not regulated under TSCA
Intact and non-leaking or none	≥50 ppm	Is a PCB bulk product waste. No labeling is required. Manifesting is required for disposal in accordance with 761.62 (a); is not required under 761.62 (b); may be required under 761.62 (c).	.50(b)(2)(ii) .62(a)-(c)	761.62 (a): TSCA Incinerator, TSCA/RCRA Landfill, Alternate Destruction Method, Decontamination (761.65(d) storage approval may be required), Coordinated approval, 761.62 (b): State approved landfill (leach test required), 761.62 (c): Risk-based approval
Intact and non-leaking	<50 ppm	No labeling or manifesting required.	50(b)(2)(i) 60(b)(2)(ii)	As municipal solid waste 40 CFR 761 subpart D options
Leaking	<50 ppm or ≥50 ppm	Disposal as PCB bulk product waste. No labeling is required. Manifesting is required for disposal in accordance with §761.62(a); may be required under §761.62(c).	.62(a) or (c)	761.62 (a): TSCA Incinerator, TSCA/RCRA Landfill, Alternate Destruction Method, Decontamination (§761.65(d) storage approval may be required), Coordinated approval 761.62 (c): Risk-based approval

Source: www.epa.gov

1. Small capacitors as defined by 6 NYCRR 371.4(e)(3)(ii), are exempted from the New York State hazardous waste regulations. Disposal is governed by Federal requirements for management and disposal of Fluorescent light ballast.

2. Fluorescent light ballast have two potential sources of PCBs, the capacitor contained within the ballast and the potting material used to insulate the capacitor.

3. According to data submitted in the TSCA Section 21 petition, ballasts manufactured prior to July 1978, have a better than 50% chance of containing PCBs at 50 parts per million (ppm) or greater in their potting material. (Federal Register Vol. No. 124 page 35404).

Training Briefing on Revision 1 Changes to DEP PCB Management Procedure

Procedure Section	Summary of Changes	Discussion of Affect on DEP Staff	Regulatory Requirement	Effect on Contractor Work Rules
Throughout	Changed "Responsible Manager" to "Responsible Individual"	Global change to all procedures so bureaus not using the term "manager" are represented.	NA	NA
Section 3 – Definitions	Removed unneeded definitions for EPA ID No., Facility, Generator, and Totally Enclosed. Shortened some very long definitions by referencing the regulations and deleting parts not relevant to DEP operations. Added a definition for PCB Remediation Waste.	Provides all regularly needed definitions and shortens, where appropriate.	NA	NA
Section 4 – Responsibilities	Removed implicit coordination and support responsibilities that are part of Bureau EHS and Resp. Indiv. general roles. Removed "Resp. Personnel" and used standard RI delegation reference. Added informing employees/contractors. Clarified the inventory is for PCB Transformers/Large Capacitors. Added coordination to advise the Legacy Program of new data and PCB removals so data is up to date. Contract Supervisor section added to define integration of inventory/ testing/ abatement/ post-work changes in the presence and location of PCBs into planning, specs, and execution of projects.	Clarified Roles and delegation but few substantive changes. RI or designee responsibility to inform employees and contractors of PCB presence has been part of HazCom and RTK training, but is not explicitly referenced. The Legacy Program is maintaining information on paint. If the Legacy Program's database is to remain useful, Bureau EHS must provide new test data and information on removal of PCB items to Legacy and Legacy must load it into the Legacy database. Formally communicates current known ad hoc practices regarding any work that demolish, disturb or remove building materials or equipment, and paint containing hazardous substances.	NA	NA
Section 6 - Identification and Tracking of PCB Items	Clarified the inventory is for PCB Transformers/Large Capacitors and that the Legacy Program database tracks other PCB-containing materials, equipment, and paint.	Clarifies that the responsibilities for inventories of other PCB-containing materials, equipment, and paint resides with the Legacy Program, with information on changes coming from the Bureaus..	NA	NA
Section 8 - Registration of PCB Transformers	Responsibility to confirm that all regulated PCB Transformers are registered with the EPA shifted from Bureau EHS to Responsible Individual.	Clarifies that the responsibilities for inventories of other PCB-containing materials, equipment, and paint resides with the Legacy Program, with information on changes coming from the Bureaus..	NA	NA
Section 9 – Inspection and Maintenance	Inspection records are now only kept by Responsible Individual the and not Bureau EHS.	The RI will no longer have to send copies of quarterly inspection to Bureau EHS.	NA	NA

Training Briefing on Revision 1 Changes to DEP PCB Management Procedure

Procedure Section	Summary of Changes	Discussion of Affect on DEP Staff	Regulatory Requirement	Effect on Contractor Work Rules
Section 10 – Spill or Fire/Explosion Response	Extensive reformatting to improve clarity and provide a tabular format.	No change to what is done.	NA	NA
Section 11 – Disposal of Small Capacitors and Fluorescent Light Ballasts	Editing to improve clarity.	No change to what is done.	NA	NA
Section 13 – Paint Containing PCBs	New section. Advises that "Low Risk" work can be conducted on PCB painted surfaces by following the DEP Lead Management procedure guidelines for Low Risk work. Formally states the obligation of the RI to advise employees/contractors. Defines obligations for conducting any work that will demolish, disturb or remove building materials or equipment, and paint containing hazardous substances.	Establishes that work on PCB painted surfaces requires similar precautions and procedures as for Lead paint. Previously part of HazCom and RTK training, but is now explicitly referenced. Formally states that whoever conducts such work must integrate inventory/ testing/ abatement/ post-work changes in the presence and location of PCBs into planning, specs, and execution of projects.	NA	NA
Section 14 – Remediation and Disposal	Added clarification of hazardous waste status in NYS for remediation waste >50 ppm PCBs. PCB remediation waste includes all waste and cleanup media (e.g., rinsate) regardless of concentration, if the original material >50 ppm. Disposal of PPE is governed by 40 CFR 761.61(a)(5)(v)(A).	This does not change the requirements but provides waste management information in the procedure. Remediation activities require referring to 40 CFR 761.61, for all site characterization, notification, cleanup standards, verification and disposal requirements.	40 CFR 761.61(a)(5)(v)(A)	NA
Section 15 – Record Keeping	Changed retention of all inventory and registration records (including registration with building owners, for commercial buildings with DEP owned transformers within 30 meters/98 feet) from 3 years after removing the last PCB transformer to as long as DEP owns the facility. Records of remediation and removal efforts maintained as long as DEP owns the facility was added as a good management practice.	Change to indefinite record keeping on registration and remediation for purposes of due diligence on potential future property turnover. NOTE, REVISION IS NOT QUITE RIGHT. IT DROPPED INSPECTION RECORDS AND IS ACTUALLY SILENT ON REGISTRATION RECORDS – NEEDS FURTHER REVIEW.	40 CFR 761.61(a)(1)(xii) None on remediation.	NA

Appendix M

NYCDEP Personal Protective Equipment

Personal Protective Equipment (Also see Respiratory Protection)

Environmental Health & Safety Policies, Procedures and Guidelines

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Applies to:	All DEP Bureaus and Offices
EHS Policy Volume:	☐I ☐II ☑**III** ☐IV
Revision Number:	**1**
Document Type:	☑**Policy** ☐Procedure ☐Guideline ☐SOP
Effective Date:	**August 15, 2007**
Reviewed By:	**OEHS**
Approved By:	**OEHS**

Objective

This procedure outlines the responsibilities of personnel, defines assessment by workplace, work area or job, work area PPE hazard assessments (required), job task hazard assessments for special/unusual jobs/hazards, addresses the employer's obligation to provide PPE and supply and proper use of PPE.

Purpose

This procedure defines a hazard assessment process for "routine workplace activities" as well as a process for assessing specialized activities or job tasks and non-routine hazards that don't fall within the "routine workplace activity hazard assessment", in order to prevent workplace injuries/illnesses and meet regulatory requirements.

Health & Safety Coordination Committee approval

The New York City Department of Environmental Protection's (DEP) H&S Coordination Committee has reviewed this document and by signing below agrees that it adequately defines the program necessary to address regulatory requirements for their Bureaus/Office operations and commit to the policies and/or procedures contained within (or substantially equivalent procedures, if Bureau/Office specific amendment is required and it is approved by the H&S Coordination Committee).

Revision / Action	Signature of Committee Chair	
Revision 0, Authorization	[signature]	Date: 12/6/02
Revision1, Authorization	John Weithmeyer, CIH	Date: 7/19/07
		Date:
		Date:
		Date:
		Date:
		Date:
		Date:

DEP Agency Compliance Office Authorization

I, a duly authorized representative of the DEP Agency Compliance Office, have reviewed this document, have found it to be acceptable and authorize its use for all DEP operations.

		Date:
Revision0, Authorization	[signature]	Date: 12/6/02
Revision1, Authorization	[signature]	Date: 7/16/07
		Date:
		Date:
		Date:
		Date:
		Date:

Table of Contents

1. PURPOSE 1
2. SCOPE 1
3. RESPONSIBILITIES 1
3.1 BUREAU EHS 1
3.2 RESPONSIBLE INDIVIDUAL 2
3.3 ALL SUPERVISORS 2
3.4 ALL EMPLOYEES 3
4 PROCEDURE 3
4.1 ASSESSMENT BY WORKPLACE, WORK AREA, OR JOB 3
4.2 WORK AREA PPE HAZARD ASSESSMENTS (REQUIRED) 4
4.3 JOB TASK HAZARD ASSESSMENTS FOR SPECIAL/UNUSUAL JOBS/HAZARDS 5
4.4 REASSESSMENT WHEN CHANGES OCCUR 7
4.5 GUIDANCE ON SELECTING PPE APPROPRIATE FOR THE HAZARDS 8
4.6 EMPLOYER'S OBLIGATION TO PROVIDE PPE 8
4.7 SUPPLY AND PROPER USE OF PPE 9
5 TRAINING 9
6 RECORDKEEPING 10
7 ATTACHMENTS 10
7.1 ATTACHMENT A – WORK AREA PPE HAZARD ASSESSMENT FORM 10
7.2 ATTACHMENT B – JOB/TASK SPECIFIC PPE HAZARD ASSESSMENT FORM 10
7.3 ATTACHMENT C – JOB SAFETY ANALYSIS FORM 10
7.4 ATTACHMENT D – PPE SELECTION GUIDANCE 10

1. Purpose

This procedure defines how DEP will perform hazard assessments, selects the Personal Protective Equipment (PPE) necessary to protect against workplace hazards and provide training to employees on the appropriate use of the PPE. The purpose of this program is to prevent workplace injuries/illnesses and meet regulatory requirements (29 CFR 1910.132, 133, 135, 136, and 138 for general industry and 1926.95 for construction). 29 CFR 1910.132(d)(1) states:

"*The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE)…*"

Regulations require that engineering and administrative controls be applied, when feasible, to eliminate or minimize respiratory hazards (29 CFR 134 (a)(1)) and DEP endeavors to apply these controls to other types of occupational hazards to reduce risk of employee injury and improve operating efficiency. These controls should be considered during facility design and when commissioning safety reviews, as well as during PPE hazard assessments. Even with engineering controls, it is often necessary to provide PPE (head, eye, face, hand, foot, or body protection) to mitigate potential impacts of the remaining hazards.

2. Scope

This procedure applies to all DEP workplaces. It defines a hazard assessment process for "routine workplace activities" as well as a process for assessing specialized activities or job tasks and non-routine hazards that don't fall within the "routine workplace activity hazard assessment". It also summarizes OSHA guidance regarding the employer's obligation to pay for PPE and DEP's approach to ensuring that PPE for which the employer has no obligation to pay is used when required.

3. Responsibilities

3.1 Bureau EHS

- Coordinate with Bureau managers responsible for facilities and field operations to select and procure PPE to promote consistency, effective performance and cost-efficiency;
- Provide technical and training support to ***Responsible Individuals*** (e.g., training materials for widely used PPE, information on break-thru times to facilitate PPE not being used past its point of providing effective protection, etc.); and
- Verify that hazard assessments are completed at each Bureau operation and that they identify PPE appropriate for every routinely performed job as well as specialized activities or job tasks and non-routine hazards that don't fall within the routine workplace hazard assessment.

3.2 Responsible Individual

The highest ranking manager or supervisor within each DEP Bureau at each facility (or whose employees perform field operations outside of fixed facilities) is the "***Responsible Individual***" for that Bureau's operation [Note: Procedures issued before November 2006 refer to this individual as the Responsible Manager]. ***Responsible Individuals*** have the following responsibilities:

- Perform and document hazard assessments covering routinely performed jobs at each of their facilities, for all of their employees, and for all jobs involving likely or present hazards and make this information available to facility safety and emergency response representatives;
- Perform and document hazard assessments for specialized activities or job tasks and non-routine hazards that don't fall within the routine workplace hazard assessment;
- Select and procure the appropriate PPE which the employer is responsible for providing or which DEP has otherwise decided to provide (see Section 4.6), according to the hazards identified;
- Provide any necessary site/job specific training for supervisors and affected employees on the hazards and appropriate PPE use (initially and when necessary due to changes or inadequate performance);
- Identify when new jobs/facilities/conditions/hazards require a new or modified hazard assessment;
- Communicate PPE requirements to visiting DEP staff, contractors, and authorized visitors; and
- Maintain facility based training records and forward copies to ***Bureau EHS***.

The ***Responsible Individual*** may delegate implementation tasks (e.g., to a facility Safety Officer, EHS Liaison or other staff), as appropriate.

3.3 All Supervisors

All DEP supervisors are responsible for:

- Understanding the workplace hazards and PPE that must be used by their staff;
- Communicating to employees the PPE required for their jobs;
- Communicating to employees proper PPE maintenance and care;
- Communicating to employees the length of time PPE can be used before chemical break-thru is anticipated;
- Ensuring that employees regularly inspect PPE;
- Ensuring that PPE is provided to employees as recommended by the hazard assessment for their jobs;

- Maintaining engineering and administrative controls that prevent work place hazards; and
- Monitoring and enforcing the use of applicable safe work practices and PPE as recommended by the hazard assessment for their jobs.
- Ensuring that all employees who are required to wear PPE are trained in accordance with Section 5 of this policy.

3.4 All Employees

All DEP employees are responsible for:

- Becoming familiar with the hazards associated with their jobs;
- Using applicable safe work practices and PPE required for their facilities and field operations, as communicated in training and by their supervisor;
- Following PPE care, maintenance, use and disposal instructions;
- Routinely inspecting PPE prior to use to ensure it is in proper working condition;
- Turning in damaged, defective or expired PPE to their supervisor for replacement; and
- Exchanging PPE that doesn't fit properly.

4 Procedure

4.1 Assessment by Workplace, Work Area, or Job

Hazards can vary by individual job task but some hazards are present in the workplace to an extent that warrants PPE use at all times. PPE can be assigned as follows:

- PPE ALWAYS USED in the regular work area (non-office)
- PPE for SPECIFIC TASKS that have hazards requiring additional PPE

Some workplaces include multiple buildings and operations that may have such different hazard characteristics that work areas and operations should be separately assessed. The first step is to determine whether to (a) complete an assessment for an entire Facility/Operation or to (b) divide the Facility/Operation into separate Work Areas/Workgroups to perform the assessments.

There are cases in which a separate detailed assessment should be conducted for individual job tasks (e.g., if they involve multiple or more severe hazards and warrant special precautions). Use the following as a guideline, but consider the specifics of each operation:

Simple Facilities – One Assessment	At least one assessment must be performed per facility or field operation. Simple facilities may only need to perform one assessment that specifies PPE for the work area/activity (e.g., long sleeve shirt, safety shoes and safety glasses) and for routine tasks that require additional PPE (e.g., goggles for machining).

Complex Facilities – Assess Work Areas/ Work Groups	In cases in which hazards and activities change based on building/activity (e.g., vehicle repair shop and a plant on same property), separate assessments should be performed for each part of the facility with a very different hazard profile that may require different "ALWAYS USED" PPE.
Special Hazard Job Tasks – Assess Job Task	Separately assess individual job activities in cases where the job task or activity involves unusual procedures/hazards, multiple hazards, higher inherent hazards or is believed to involve the potential for very serious incident.

Two PPE Hazard Assessment tools are provided, as follows:

- ***Attachment A***: Work Area PPE Hazard Assessment Form: Apply to all facility-wide or work area/work group assessments per Section 4.2 below.
- ***Attachments B/C***: Job Task Hazard Assessment Form: Apply to job tasks that involve multiple or more severe hazards and warrant detailed assessment and special precautions.

Non-routine work (e.g., inspectors that may encounter hazardous field conditions) may be handled using the above tools for hazard conditions that can be expected from experience (e.g., low hanging pipes, dogs, etc.). This can be augmented by developing safe work practices that incorporate safeguards, awareness of when the hazard can exceed the protections available, and a policy of withdrawal and notification of the owner and supervisors when such a hazard exists.

Alternative assessment tools may be used, so long as they provide equivalent documentation of the process of workgroup/job task/hazard identification, evaluation and PPE selection based on the type and degree of hazard as provided in the DEP tools and the development process described below. Review/approval of alternative forms by OEHSC in advance of their use is recommended.

4.2 Work Area PPE Hazard Assessments (Required)

For each DEP facility, the ***Responsible Individual*** and ***Bureau EHS*** must ensure that at least one initial Work Area PPE hazard assessment is performed and documented for work activities involving likely or present hazards conducted at the facility and at field worksites (e.g., sewer cleaning). ***Responsible Individuals*** may delegate their involvement to an employee with experience assessing hazards and selecting PPE.

With the involvement of the ***Responsible Individual*** and experienced supervisors, characterize the facility, work areas, and types of work performed using the first page of Attachment A. Then check off all the work hazards present for all work areas and job tasks included in the assessment. Determine the appropriate PPE to protect against these hazards. Next, identify any PPE that should ALWAYS be used in these work areas with an "A" in

the notes column. If the PPE is needed only for selected job tasks, list the job task numbers from page 1 of the form in the notes column.

Designate PPE as ALWAYS if:

- The hazard is usually present;
- The hazard is in so many areas that donning/doffing PPE is impractical; or
- It is considered a more reliable way to ensure employees use it when needed.

Field observation will be helpful for any assessment, especially if it is led by Bureau EHS staff who has not worked at the facility. Walk through all work areas and representative field worksites including shops, warehouses, offices, labs, storerooms, and other areas where the potential exists for hazards requiring PPE. Also, consider observing and interviewing employees engaged in routine work activities. Consider hazards from both performing the job/task itself or the environment where the task is performed.

Finally, complete the Facility/Work Area/Workgroup PPE Summary on the last page by noting the PPE "Always Used" and the additional PPE required for each other task identified at the beginning of the worksheet. This final summary of what PPE is required for what activities is the most important step because this (or equivalent presentation material) is what must be conveyed to employees. The rest of the assessment form serves to guide and document the process and need not be conveyed to all employees.

Once the hazard assessment is completed and documented, sign and date the certification.

4.3 Job Task Hazard Assessments for Special/Unusual Jobs/Hazards

A job/task specific hazard assessment shall be performed for all jobs/tasks that involve special or unusual hazards or procedures that are significantly different from routine job tasks and that may require special precautions and PPE identified in the Work Area PPE Hazard Assessments. Additional factors that suggest a job/task specific hazard assessment should be performed are:

- Frequency of Accidents. A job that has repeatedly resulted in accidents or illnesses is a candidate for a hazard assessment. The greater the number of accidents associated with a given job, the higher the priority for a hazard assessment.
- Disabling Injuries/Illnesses. Every job that has produced disabling injuries should be given a high priority for hazard assessment. Subsequent injuries after a hazard assessment should prompt a review and revision of the hazard assessment as preventative measures may not be sufficient.
- Severity Potential. Some jobs may not have a history of accidents but may have the potential for severe or catastrophic injury or equipment damage.

To perform a job/task specific hazard assessment, use the optional Job/Task Hazard Assessment Forms found in Attachments B and/or C. Attachment B utilizes a thorough hazard identification/ranking to identify PPE. Attachment C utilizes a Job Safety Analysis

(JSA) approach of reviewing the steps of the job as a means of identifying associated hazards and necessary precautionary procedures and PPE.

For the most rigorous assessment, use Attachment B or both B and C in sequence. Because they have a thorough understanding of the full range of potential hazards contained in the checklists in Attachment B, Health and Safety staff can complete an effective assessment using only Attachment C.

JOB-SPECIFIC PPE HAZARD ASSESSMENT USING ATTACHMENT B

Complete Attachment B, *Job/Task Specific PPE Hazard Assessment Form* to thoroughly identify possible hazards paying special attention to note "What justifies the risk level?" and "What PPE is warranted by the hazard?" These help the thought process and provide valuable information when jobs/tasks or hazards change and assessments are revalidated. Ask operators and supervisors if they know of any accidents or near misses associated with the specific job/task and summarize same on the form in order to provide insight into potential hazards and how best to avoid those hazards.

The "Summary of PPE Required for Job" table at the end of the form should list:

- General activities being performed in the "Required When:" column;
- Personnel who must wear specified PPE in the "Required For:" column (can be split if necessary for multiple personnel categories);
- PPE currently used for the job task listed in the "Existing PPE" column; and
- Any new or revised PPE required in the "Recommended Additional/Changed PPE" column.

When appropriate, make recommendations for further evaluation (e.g., noise assessments are needed to fully determine the need for hearing protection) or for operational/procedural changes (these should be noted and then added to the recommendations section of the JSA form when completed).

JOB SAFETY ANALYSIS (JSA) USING ATTACHMENT C

When using only Attachment C, complete the first page (see relevant instructions for Attachment B above). When also completing Attachment B, skip the first page of Attachment C.

Determine the Job Steps

Determine job steps by interview, observation or both. Observation provides the best method for assessing hazards in a job/task because the assessor has the opportunity to observe the task first hand. However, for highly hazardous or infrequent tasks, this may not be practical, and interviews of those who perform the task should suffice.

Complete the JSA Form

In the first column, list the basic job tasks or steps necessary to perform the job. In the second or middle column list the hazards/potential incidents associated with these specific

job steps. In the third column, list the existing and/or proposed engineering controls, administrative controls, safe work procedures/steps and PPE necessary to avoid or control the hazards. Non-procedural recommendations to further assess the hazards or implement engineering or administrative controls must also be listed at the end of the form in a table that also provides for assigning and tracking their completion.

Attachment C provides more detailed guidance on using the JSA form to identify and eliminate or minimize hazards in the workplace. The JSA instructions row on Page 2 of the Attachment C template should be deleted to produce a clean final copy or your JSA.

Completion of Recommendations

Complete the "Final Required PPE" section adding any new PPE identified as required in the analysis. Additional space is provided to document long-term recommendations, such as engineering controls or administrative controls that will require follow-up action beyond providing PPE and training employees on its use. The ***Responsible Individual*** must work with others at DEP, as necessary, to ensure timely completion of the recommended actions. Whenever a recommendation is not implemented, the assigned individual must provide a written explanation which documents that the recommendation was either: (1) based on factual errors; (2) not necessary to protect employee, contractor or public health; (3) replaced by a protective alternative measure; or (4) not feasible.

The recommendation will remain open in the table until it is resolved and documented. The ***Responsible Individual*** will notify ***Bureau EHS*** when all the recommended actions are complete. ***Bureau EHS*** will review how the recommendations were addressed and must ensure that any explanations for rejecting recommendations give valid reasons. Both the ***Responsible Individual*** and ***Bureau EHS*** will sign the Closeout section of the form when all items are satisfactorily completed.

4.4 Reassessment When Changes Occur

Follow-up Hazard Assessments shall be conducted when new hazards which may require different PPE are introduced into the workplace. Reassessment should be done, at a minimum, when:

- Hazardous materials or chemical processes are added or removed,
- Different equipment or tools are added,
- Accident records indicate the need for reassessment,
- Job tasks/procedures/responsibilities are added/modified, or
- Changes to 29 CFR 1910.132, 133, 135, 136, and 138 and 1926.95 occur.

Both initial and follow-up hazard assessments can be used to train employees on the hazards to which they are exposed and how the PPE used can protect them from those hazards.

4.5 Guidance on Selecting PPE Appropriate for the Hazards

Before you select PPE, first determine if exposure to the hazard can be reduced or eliminated using administrative or engineering controls. For example:

- Are there guards for the machinery or equipment?
- Can a shield, barrier, or guard be manufactured or purchased that will contain or control exposure to the hazard?
- Can the worksite layout be changed to eliminate or reduce exposure to the hazard?
- Can the product or chemical be replaced with a less hazardous one?
- Can exposure to airborne chemicals or dust be controlled with exhaust ventilation?

If the answer to any of these questions is "yes", it may be possible to use administrative or engineering controls to eliminate or reduce such hazards.

Hazards remaining after engineering and administrative controls may require specifying head, eye and face, hand, foot and body protection based on specific job activities and the degree of hazard. The general procedure for selecting PPE is to:

- Review the types of protective equipment that are available.
- Compare the specifics of the hazard (how heavy and/or fast the object is moving, shape, the type of light being emitted, duration of exposure, etc.) against the capabilities of the available equipment.
- Select PPE that provides an adequate level of protection for the employee from the hazard based on manufacturer's (of chemical, equipment, etc.,) recommendations and Material Safety Data Sheets.

Refer to Attachment D for more detailed information on various types and application of PPE along with PPE Selection Guidance. Additionally, Bureau EHS staff can be consulted for specific questions regarding PPE selection.

4.6 Employer's Obligation to Provide PPE

DEP ascribes to OSHA's guidance regarding the Employer's obligation to pay for PPE. OSHA's personal protective standards 29 CFR 1910.132 through 1910.138 establish the employer's obligation to provide personal protective equipment to employees. In particular, 29 CFR 1910.132(a) states as follows:

Protective equipment, including personal protective equipment for eyes, face, head and extremities, protective clothing, respiratory devices and protective shields and barriers, shall be provided, used and maintained in a sanitary and reliable condition wherever it is necessary by reasons of hazards of process or environment, chemical hazards, radiological hazards or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

The "worker-provided" clause in the general industry PPE standard, 1910.132(b), and also the construction industry standard, 1926.95(b), reads as follows:

Employee-owned equipment. Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.

OSHA provides the following explanation for the apparent inconsistency and delineates when employers are required to pay for PPE (OSHA STD 1-6.6):

In order to accommodate those work situations where it is customary for workers to provide their own PPE without compromising employee protection, 29 CFR 1910.132(b) provides that the employer must assure the adequacy of such equipment.

The PPE standard requires employers to provide and to pay for personal protective equipment required by the company for the worker to do his or her job safely and in compliance with OSHA standards.

Where equipment is personal in nature and may be used by workers off the job, the matter of who pays for the PPE may be left to labor-management negotiations.

Examples of PPE that would not normally be used away from the worksite include, but are not limited to: welding gloves, wire mesh gloves, respirators, hard hats, specialty glasses and gloves (e.g., designated for laser or ultraviolet radiation protection), specialty foot protection (such as metatarsal shoes and linemen's shoes with built in gaffs), face shields and rubber gloves, blankets, cover-ups, hot sticks and other live-line tools used by power generation workers.

Examples of PPE that is personal in nature and often used away from the worksite include non-specialty safety glasses, safety shoes, and cold-weather outer wear of the type worn by construction workers.

4.7 Supply and Proper Use of PPE

If PPE is required, the employee must use only DEP approved and/or issued PPE to ensure that only the proper equipment is used. Users must be made aware of all warning labels and be trained as outlined in Section 5. Failure to use PPE or improper use of PPE could result in loss of sight, hearing, extremities, and life. For example: vented goggles do not provide protection from vapors and a hard hat worn backwards may not deflect a falling object safely. ***Supervisors*** must initiate disciplinary action, in accordance with DEP disciplinary policies and procedures, if ***Employees*** fail to use PPE properly when instructed to do so.

5 Training

Training in accordance with 29 CFR 1910.132(f) shall be provided to each employee who is required to wear PPE, including any necessary site/job-specific PPE training. At a minimum, training shall include:

- When PPE is necessary.

- What PPE is necessary.
- How to properly don, remove, adjust and wear PPE.
- Limitations of PPE.
- Proper care, maintenance, useful life and return/exchange/disposal of PPE.

An employee shall be trained and/or retrained if there is any reason to believe that the employee does not have the understanding or skills required to properly wear and use PPE. Retraining shall also be required whenever:

- Workplace or PPE changes render previous training obsolete.
- Employees have not retained the necessary PPE understanding or skills.

Employees must demonstrate competency in proper use and selection of required PPE.

All training shall be documented, including:

- Employee name.
- Date of training.
- PPE addressed.
- Verification of understanding.
- Signature of person conducting training.

6 Recordkeeping

Each Hazard Assessment shall be documented, certified and include the location, date of assessment and any recommendations. The documentation requirements can be accomplished by completing the PPE Hazard Assessment and JSA Forms attached. The ***Responsible Individual*** shall keep a copy of all PPE Hazard Assessments and Job Safety Analyses onsite.

A copy of all training records will be maintained by ***Bureau EHS***. If training is provided by facility staff, the ***Responsible Individual*** will forward a copy to ***Bureau EHS***.

7 Attachments

7.1 Attachment A – Work Area PPE Hazard Assessment Form

7.2 Attachment B – Job/Task Specific PPE Hazard Assessment Form

7.3 Attachment C – Job Safety Analysis Form

7.4 Attachment D – PPE Selection Guidance

PERSONAL PROTECTIVE EQUIPMENT

ATTACHMENT A

WORK AREA PPE HAZARD ASSESSMENT

Work Area PPE Hazard Assessment

Bureau/Division		Date Conducted:	
Facility/Workgroup/Area:			
Assessment Performed By:		Certified By:	

Facility/Work Area/Workgroup Characterization		
Do all workgroups perform similar activities involving similar hazards in all work areas?	❑ Yes – Assessment FACILITY-WIDE ❑ No – Assessment by WORKGROUP/AREA (one form for each Workgroup/Work Area with different hazard profile)	
List types of positions/job functions within facility/work area/workgroup analyzed [for example see Job Functions below]		
List regular and occasional "Job Tasks" done by facility/work area/work group analyzed	1.	2.
	3.	4.
	5.	6.
	7.	8.
	9.	10.
	11.	12.
	13.	14.
	15.	16.
	17.	18.
	19.	20.
What do you consider to be your most hazardous/job tasks/ employee exposures?		
List any "Special" job tasks that <u>will be analyzed separately</u> from this facility/ workgroup (i.e., using task-specific analysis tools such as Attachment B or C).		

Example Job Functions

- ❑ Construction Laborer
- ❑ Electrician
- ❑ Engineer/Tech/Mgmt.
- ❑ Env. Controls Tech.
- ❑ Env. Sampling
- ❑ Flusher Program
- ❑ Instrument Technician
- ❑ Laboratory Worker
- ❑ Laborer
- ❑ Mechanical Maint./Machinist
- ❑ Motor Vehicle Mechanic
- ❑ Motor Vehicle Operator
- ❑ Office Work
- ❑ Pipe Caulker
- ❑ Plant Operator
- ❑ Police
- ❑ Sewer Basin Cleaner
- ❑ Watershed Protection
- ❑ Welder

Work Area PPE Hazard Assessment

Bureau/Division		Date Conducted:	
Facility/Workgroup/Area:			
Assessment Performed By:		Certified By:	

Check hazards present in Facility/Work Area/Workgroup assessed for all job tasks included in this assessment. Check PPE required to the right of the hazard. In notes column list "A" if PPE must be worn ALWAYS whenever employees are in work areas (i.e., non-office). If only worn for selected Job Tasks, list the Job Task by name or list the Job Task number from above.

Part of Body	Hazard	Potential PPE	When Required / Type / Notes
Hands	❑ Penetration-sharp objects	❑ Leather/cut resistant gloves	
	❑ Penetration-animal bites	❑ Leather/cut resistant gloves	
	❑ Penetration-rough objects	❑ General purpose work gloves	
	❑ Chemical(s) _____	❑ Chemical resistant gloves; ❑ Type _____	
	❑ Extreme cold	❑ Insulated gloves	
	❑ Extreme heat	❑ Heat/flame resistant gloves	
	❑ Blood	❑ Latex or nitrile gloves	
	❑ Electrical shock	❑ Insulated rubber gloves; ❑ Type _____	
	❑ Vibration-power tools	❑ Cotton, leather or anti-vibration gloves	
	❑ Welding	❑ Welders Gloves	
	❑ Other _____	❑ Other _____	
Eyes and Face	❑ Impact-flying objects, chips, sand or dirt	❑ Safety glasses w/side shields ❑ Glasses/goggles w/face shield ❑ Impact goggles	
	❑ Nuisance dust	❑ Goggles	
	❑ UV light-welding, cutting, torch brazing or soldering	❑ Welding goggles ❑ Welding helmet/shield w/safety glasses & side shields	
	❑ Chemical-splashing liquid	❑ Chemical goggles/ face shield	
	❑ Chemical-irritating mists	❑ Chemical goggles	
	❑ Hot sparks-grinding	❑ Safety glasses w/side shields ❑ Glasses/goggles w/face shield	
	❑ Splashing molten metal	❑ Heat resistant helmet/face shield & safety goggles w/side shield	
	❑ High Intensity light	❑ Shaded safety glasses	
	❑ Laser operations	❑ Laser spectacles or goggles	
	❑ Other _____	❑ Other _____	

Work Area PPE Hazard Assessment

Bureau/Division		Date Conducted:	
Facility/Workgroup/Area:			
Assessment Performed By:		Certified By:	

Part of Body	Hazard	Potential PPE	When Required / Type / Notes
Ears	❑ Exposure to noise levels (> 85 dBA 8-hour TWA)	❑ Ear muffs, plugs or ear caps	
	❑ Exposure to sparks	❑ Leather welding hood	
	❑ Other _____	❑ Other _____	
Respir-atory System (requires eng./ admin. control)	❑ Nuisance dust/mist	❑ Disposable dust/mist mask	
	❑ Welding fumes	❑ Welding respirator	
	❑ Asbestos	❑ Respirator w/HEPA filter	
	❑ Pesticides	❑ Respirator w/pesticide cartridges	
	❑ Paint spray	❑ Respirator w/paint spray cartridges	
	❑ Organic vapors	❑ Respirator w/organic cartridges	
	❑ Acid gases	❑ Full-face Respirator w/acid gas cartridges	
	❑ Oxygen deficient/toxic or IDLH atmosphere (e.g., chlorine)	❑ SCBA or Type C airline respirator	
	❑ Other_____	❑ Other_____	
Feet	❑ Impact-heavy objects	❑ Steel toe safety shoes	
	❑ Compression-rolling or pinching objects/vehicles	❑ Steel toe safety shoes w/metatarsal guards	
	❑ Slippery or wet surface	❑ Slip resistant soles	
	❑ Penetration-sharp objects	❑ Puncture resistant soles	
	❑ Penetration-chemical	❑ Chemical resistant boots/covers	
	❑ Splashing-chemical	❑ Impervious boots/closed toe impervious shoes	
	❑ Exposure to extreme cold	❑ Insulated boots or shoes	
	❑ Other_____	❑ Other_____	

Work Area PPE Hazard Assessment

Bureau/Division		Date Conducted:	
Facility/Workgroup/Area:			
Assessment Performed By:		Certified By:	

Part of Body	Hazard	Potential PPE	When Required / Type / Notes
Head	❑ Struck by falling object	❑ Hard hat	
	❑ Struck against fixed object	❑ Hard hat – Class A, B, or C (no electrical prot.)/bump cap	
	❑ Electrical-contact with exposed wires/conductors	❑ Class A Hard hat (<2,200 V) ❑ Class B Hard hat (<20,000 V)	
	❑ Other_____	❑ Other_____	
Body	❑ Impact-flying objects	❑ Long sleeves/ apron/ coat	
	❑ Moving vehicles	❑ Traffic vest	
	❑ Penetration-sharp objects	❑ Cut-resistant sleeves, wristlets	
	❑ Electrical-static discharge	❑ Static control coats/coveralls	
	❑ Hot metal or sparks	❑ Flame-resistant jacket/ pants	
	❑ Chemical(s)_____ _____	❑ Lab coat or apron/sleeves ❑ Rain Gear ❑ Disposable protective clothing	
	❑ Exposure to extreme cold	❑ Insulated jacket, hood, coverall	
	❑ Unprotected elevated walking/working surface	❑ Body harness and lanyard	
	❑ Other_____	❑ Other_____	

Facility/Work Area/Workgroup PPE Summary

Summarize PPE to be used for each job task listed at the top of the form as well as PPE ALWAYS used whenever employees are in work areas (i.e., non-office). Add rows as needed. This is the information that must be communicated to employees.

Activity	PPE Required
Always Used	
1.	
2.	
3.	
4.	
5.	

PERSONAL PROTECTIVE EQUIPMENT

ATTACHMENT B

JOB/TASK – SPECIFIC PPE HAZARD ASSESSMENT

Job/Task-Specific PPE Hazard Assessment

Job Title:		Date Conducted:	
Bureau/Division			
Workgroup/Facility:			
Assessment Team Members:		Certified By:	

JOB TASK DESCRIPTION SUMMARY

EQUIPMENT REQUIRED/USED (Be specific, e.g., hand tools, heavy equipment, instruments, specialized tools)

PPE CURRENTLY USED (Give specific type, e.g., Hand: Nitrile gloves)

☐ Head:	☐ Flotation:
☐ Eye & Face:	☐ Hand:
☐ Respiratory:	☐ Work Uniform:
☐ Foot :	☐ Apron/Sleeves:
☐ Hearing:	☐ Whole Body:
☐ Fall Protection:	☐ Other:

HISTORY OF INCIDENTS AND NEAR MISSES

(Provide a brief description of any incident or near miss that has or could easily have involved an injury, illness or property loss.)

BIOLOGICAL HAZARD(S)

Poison Plant	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Insect Bites (tick, mosquito, etc.)	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Venomous Snake Bites	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Animal Bites (dog, racoon, etc.)	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Sewage/Pathogen/Animal Droppings	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A

What Justifies Risk Level?

What PPE is warranted by hazard?

RADIATION HAZARD(S) (Ionizing, UV, IR, RF, Microwave, etc.)				
Type: _____	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
What Justifies Risk Level?				
What PPE is warranted by hazard?				

ENVIRONMENTAL HAZARD(S)				
Noise	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Vibration	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Cold	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Heat	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Deep Water/Wet/Slip	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Dust	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Vapor/Mist/Fume	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Confined Space	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
What Justifies Risk Level?				
What PPE is warranted by hazard?				

PHYSICAL HAZARD(S)				
Lifting/Carrying: 10-50 lbs.	Frequency: ☐ Continuous 75-100%	☐ Frequent 25-50%	☐ Occasional 1-25%	☐ N/A
Pushing/Pulling	Frequency: ☐ Continuous 75-100%	☐ Frequent 25-50%	☐ Occasional 1-25%	☐ N/A
Kneeling/Squatting	Frequency: ☐ Continuous 75-100%	☐ Frequent 25-50%	☐ Occasional 1-25%	☐ N/A
Reaching	Frequency: ☐ Continuous 75-100%	☐ Frequent 25-50%	☐ Occasional 1-25%	☐ N/A
Bending	Frequency: ☐ Continuous 75-100%	☐ Frequent 25-50%	☐ Occasional 1-25%	☐ N/A
Grasping	Frequency: ☐ Continuous 75-100%	☐ Frequent 25-50%	☐ Occasional 1-25%	☐ N/A
Repetitive Motion	Frequency: ☐ Continuous 75-100%	☐ Frequent 25-50%	☐ Occasional 1-25%	☐ N/A
Other:	Frequency: ☐ Continuous 75-100%	☐ Frequent 25-50%	☐ Occasional 1-25%	☐ N/A
What Justifies Risk Level?				
What PPE is warranted by hazard?				

CHEMICAL HAZARD(S) (List each chemical used or potentially exposed to.)

Chemical(s)	Flammable	Explosive	Corrosive	Oxid./Reactive	Toxic	Carcinogen	Other

Respiratory	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Eye/Skin	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Skin Absorption	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Ingestion	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Fire/Explosion	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Oxygen Deficiency	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A

What Justifies Risk Level?

What PPE is warranted by hazard?

OSHA-SPECIFIC HAZARDOUS SUBSTANCES – ☐ N/A

(The following substances may require specific medical, training, or monitoring based upon concentration or evaluation of risk.)

☐ 1910.1001 Asbestos	☐ 1910.1006 Methyl chloromethyl ether	☐ 1910.1008 bis-Chloromethyl ether
☐ 1910.1003 13 Carcinogens	☐ 1910.1017 Vinyl chloride	☐ 1910.1018 Inorganic arsenic
☐ 1910.1025 Lead	☐ 1910.1027 Cadmium	☐ 1910.1028 Benzene
☐ 1910.1030 Bloodborne pathogens*	☐ 1910.1045 Acrylonitrile	☐ 1910.1048 Formaldehyde
☐ 1910.1051 1,3-Butadiene	☐ 1910.1052 Methylene chloride	☐ 1910.1052 Methylene chloride

* See Biological Hazard(s)

**Above are some commonly encountered substances with implementation standards, also check for other "1000" standards, as appropriate. The absence of a "1000-series" implementation standard does not mean that there are no other relevant standards.

KINETIC ENERGY HAZARD(S)

Pulleys/Belts/Gears/Pinch Points	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Shears/Sharp Edges	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Vehicles/Mobile Equipment	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A
Mass in Motion (heavy or fast)	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A

What Justifies Risk Level?

What PPE is warranted by hazard?

POTENTIAL ENERGY HAZARD(S)					
Working at Heights/Above Cavity or Hole	Risk Level: ☐ High–Known	☐ Med.–Suspect/Possible	☐ Low–Unlikely	☐ N/A	
Falling Objects	Risk Level: ☐ High–Known	☐ Med.–Suspect/Possible	☐ Low–Unlikely	☐ N/A	
Excavation/Trenching	Risk Level: ☐ High–Known	☐ Med.–Suspect/Possible	☐ Low–Unlikely	☐ N/A	
What Justifies Risk Level?					
What PPE is warranted by hazard?					
THERMAL ENERGY HAZARD(S)					
Steam, Fire or Hot Surfaces	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
Friction	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
Cryogenic	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
What Justifies Risk Level?					
What PPE is warranted by hazard? .					
PRESSURE ENERGY HAZARD(S)					
High Pressure Lines/Vessels	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
Compressed Gas Cylinders	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
What Justifies Risk Level?					
What PPE is warranted by hazard?					
ELECTRICAL ENERGY HAZARD(S)					
Hazardous Voltage	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
Exposed Conductors	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
Static/Induction	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
Magnetic Fields	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
Underground/Drilling	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
Overhead w/Heavy Equipment	Risk Level: ☐ High – Known	☐ Med. – Suspect/Possible	☐ Low – Unlikely	☐ N/A	
What Justifies Risk Level?					
What PPE is warranted by hazard?					

SAFETY PROCEDURES REQUIRED AND/OR FIELD OPERATIONS UTILIZED

-
-
-
-
-
-
-
-
-
-

SUMMARY OF PPE REQUIRED FOR JOB[1]

Required When:	Required For:	Total PPE Required for Job[2]	
		Existing PPE[3]	Recommended Additional/Changed PPE[4]
		☒	☒
		☒	☒
		☒	☒
		☒	☒
		☒	☒
		☒	☒
		☒	☒
		☒	☒
		☒	☒

[1] This table defines requirements and recommendations for PPE only. If recommendations were identified during the PPE hazard assessment for other controls such as administrative or engineered controls, those are listed with the JSA recommendations below.
[2] The combination of these two columns defines the PPE required for the task(s) listed.
[3] This column details the existing PPE for the task(s) listed.
[4] This column details any new or revised PPE required for the task(s) listed based on this hazard assessment.

PERSONAL PROTECTIVE EQUIPMENT

ATTACHMENT C

JOB SAFETY ANALYSIS

Volume III	**Personal Protective Equipment Attachment C**	Revision: 1 Effective Date: 7/15/07

Job Safety Analysis

Job Task Name:		Date Conducted:	
Bureau/Division			
Facility/Workgroup:			
Assessment Team Members:		Certified by:	

Note: If completing both Attachment B and C, this page can be omitted.

JOB TASK DESCRIPTION SUMMARY

GENERAL NOTES AND APPLICABLE STANDARDS

EQUIPMENT REQUIRED/USED
(Be specific, e.g., hand tools, heavy equipment, instruments, specialized tools)

PPE CURRENTLY PROVIDED / USED
(Used prior to JSA, e.g., Hand: Nitrile gloves)

☐Head:	☐Flotation:
☐Eye & Face:	☐Hand:
☐Respiratory:	☐Work Uniform:
☐Foot:	☐Aprons/sleeves:
☐Hearing:	☐Whole Body:
☐Fall Protection:	☐Other:

History of Incidents and Near Misses
(Description of incidents or near misses that had or potentially could have resulted in injury, illness, or property loss)

Volume III	**Personal Protective Equipment** **Attachment C**	Revision: 1 Effective Date: 7/15/07

Job Safety Analysis

Job Task Name:		Date Conducted:	
Bureau/Division			
Facility/Workgroup:			
Assessment Team Members:		Certified by:	

Job Step	Potential Hazards / Incidents	Safe Work Procedures / PPE
Note: This row with instructions can be deleted t o produce your job task specific analysis. Divide the job into steps. Each of the steps of a job should accomplish some major task. The task will consist of a set of movements. Look at the first set of movements used to perform a task, and then determine the next logical set of movements. For example, the job might be to move a box from a conveyor in the receiving area to a shelf in the storage area. How does that break down into job steps? Picking up the box from the conveyor and putting it on a hand truck is one logical set of movements, so it is one job step. Everything related to that one logical set of movements is part of that job step. The next logical set of movements might be pushing the loaded hand truck to the storeroom. Removing the boxes from the truck and placing them on the shelf is another logical set of movements. And finally, returning the hand truck to the receiving area might be the final step in this type of job. Be sure to list all the steps in a job. Some steps might not be done each time – checking the casters on a hand truck, for example. However, that task is a part of the job as a whole, and should be listed and analyzed.	Identify the hazards associated with each step. Examine the actions, conditions and possibilities that could lead to an accident. It is not enough to look at the obvious hazards. It is also important to look at the entire environment and discover every conceivable hazard that might exist. Be sure to list health hazards as well, even though the harmful effect may not be immediate. A good example is the harmful effect of inhaling a solvent or chemical dust over a long period of time. It is important to list all hazards. Hazards contribute to accidents, injuries and occupational illnesses. In order to effectively identify Safe Work Procedures / PPE in the next column, you must identify potential and existing hazards. It is important to distinguish between a hazard, an accident and an injury or illness. Each of these terms has a specific meaning. HAZARD – A potential danger. Oil on the floor is a hazard. ACCIDENT – An unintended happening that may result in injury, loss or damage. Slipping on the oil is an accident. INJURY –The result of an accident. A sprained wrist from the fall would be an injury. ILLNESS – Work related illnesses are those resulting from work exposures Some people find it easier to identify possible accidents and illnesses and work back from them to the hazards. If you do that, you can list the accident and illness types in parentheses to following the hazard. But be sure you also consider the hazard for developing recommended actions and safe work procedures. Documenting both the accident scenario and basic hazard is preferable.	Using the first two columns as a guide, decide what actions are necessary to eliminate or minimize the hazards that could lead to an accident, injury, or occupational illness. List existing as well as proposed controls. Possible actions include: **Engineering Controls:** • Find a new way/eliminate the source of the hazard. • Change the physical conditions that create the hazards or result in exposure to the hazards. **Administrative Controls** • Change the work procedure including specific safe work steps, whenever possible, and/or more general measures (e.g., housekeeping). • Reduce the necessity of doing a job or frequency that it must be performed. This is particularly helpful in maintenance and material handling. • Use job rotation for hazards caused by repetitive stress or employees infrequently performing a task. • Train on the hazards and on the steps and precautions necessary to safely complete the work. **Personal Protective Equipment** • Provide PPE or other mitigation to protect from or reduce the consequences of a hazardous condition. List recommended safe operating procedures on the form, and also list required or recommended personal protective equipment for each step of the job. Be specific. State exactly what needs to be done to correct the hazard, such as, "lift, using your leg muscles." Avoid general statements like, "be careful." Give a recommended action or procedure for every hazard. If the hazard is identified as serious, it should be corrected immediately. The JSA should then be changed to reflect the new conditions.

Volume III	**Personal Protective Equipment** **Attachment C**	Revision: 1 Effective Date: 7/15/07

Job Safety Analysis

Job Task Name:		Date Conducted:	
Bureau/Division			
Facility/Workgroup:			
Assessment Team Members:		Certified by:	

Job Step	Potential Hazards / Incidents	Safe Work Procedures / PPE

Job Safety Analysis

Job Task Name:		Date Conducted:	
Bureau/Division			
Facility/Workgroup:			
Assessment Team Members:		Certified by:	

FINAL REQUIRED PPE (Give specific type, e.g., Hand: Nitrile gloves)

☐Head:	☐Flotation:
☐Eye & Face:	☐Hand:
☐Respiratory:	☐Work Uniform:
☐Foot:	☐Aprons/sleeves:
☐Hearing:	☐Whole Body:
☐Fall Protection:	☐Other:

SUMMARY OF JSA LONG-TERM RECOMMENDATIONS (e.g., Engineering or Administrative Controls)

Job Step	Description of Hazard/Issue	Recommendations	Assigned to	Target Date	Date Resolved	Resolution/Comments

CLOSEOUT: The following individuals confirm that the above Recommendations have been satisfactorily addressed:

Facility Manager: _____ (Name) _____ (Signature) _____ (Date)

Bureau EHS Representative: _____ (Name) _____ (Signature) _____ (Date)

PERSONAL PROTECTIVE EQUIPMENT

ATTACHMENT D

PPE SELECTION GUIDANCE

Contents

PERSONAL PROTECTIVE EQUIPMENT I
ATTACHMENT D I
PPE SELECTION GUIDANCE I
1 EYE AND FACE PROTECTION 2
1.1 COMPLIANCE WITH NATIONAL STANDARDS 2
1.2 GENERAL REQUIREMENTS 2
1.3 TYPES OF EYE AND FACE PROTECTION 3
1.4 STORAGE AND CARE 4
2 HEAD PROTECTION 9
2.1 COMPLIANCE WITH NATIONAL STANDARDS 9
2.2 GENERAL REQUIREMENTS 9
2.3 TYPES OF HEAD PROTECTION 9
2.4 STORAGE AND CARE 11
3 FOOT PROTECTION 12
3.1 COMPLIANCE WITH NATIONAL STANDARDS 12
3.2 GENERAL REQUIREMENTS 12
3.3 STORAGE AND CARE 15
4 HAND PROTECTION 17
4.1 COMPLIANCE WITH NATIONAL STANDARDS 17
4.2 GENERAL REQUIREMENTS 17
4.3 SELECTION 17
5 PROTECTIVE CLOTHING AND BODY PROTECTION 23
5.1 COMPLIANCE WITH NATIONAL STANDARDS 23
5.2 GENERAL REQUIREMENTS 23
6 FALL PROTECTION, HEARING PROTECTION, RESPIRATORY PROTECTION, AND ELECTRICAL PROTECTIVE DEVICES 25
6.1 FALL PROTECTIVE DEVICES 25
6.2 HEARING PROTECTIVE DEVICES 25
6.3 RESPIRATORY PROTECTIVE DEVICES 26
6.4 ELECTRICAL PROTECTIVE DEVICES 26

1 EYE AND FACE PROTECTION

1.1 Compliance with National Standards

All personal protective clothing and equipment must be of safe design and construction for the work to be performed and must be maintained in a sanitary and reliable condition.

- Eye and face protection used by employees must meet NIOSH or ANSI (American National Standards Institute) standards as follows:
- Protective eye and face devices purchased after July 5, 1994 must comply with ANSI Z87.1-1989,"American National Standard Practice of Occupational and Education Eye and Face Protection".
- Eye and face protective device purchased before July 5, 1994 must comply with the ANSI Z87.1-1968 "USA Standard for Occupational and Educational Eye and Face Protection."

The referenced standards do not apply to hazards related to X-rays, gamma rays, high-energy particulate radiation, microwaves, radio-frequency radiation, or work with lasers and masers. Information on PPE required for work involving these hazards is available through the Bureau/Office EHS Division.

1.2 General Requirements

Employees must use appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, acids or caustic liquids or other liquid chemicals, chemical gases or vapors, or potentially hazardous light radiation.

Each affected employee must use eye protection that provides side protection when there is a hazard from flying objects. Detachable side protectors (e.g. clip-on or slide-on shields) are acceptable if they meet the ANSI requirements.

Eye and face PPE must be marked to identify the manufacturer.

Face shields must be used in combination with goggles when there is a potentially significant chemical splash hazard.

Face shields must be worn over primary eye protection (safety glasses or goggles) when there is a potentially severe exposure to flying fragments or objects, hot sparks from furnace operations, potential splash from molten metal, or extreme temperatures.

The Selection Chart for Eye and Face Protection below provides guidance on how to select appropriate PPE for the hazards that you identify during the hazard assessment process.

Each affected employee who wears prescription lenses, while engaged in operations that involves eye hazards, must either:

- Wear eye protection that incorporates the prescription in its design, or,
- Wear eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses.

Each affected employee must use equipment with filter lenses that have a shade number appropriate for the work being performed for protective from injurious light radiation. Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.

1.3 Types of Eye and Face Protection

Safety Glasses

Protective eyeglasses are made with safety frames, tempered glass or plastic lenses, temples and side shields which provide eye protection from moderate impact and particles encountered in job tasks such as carpentry, woodworking, grinding, scaling, etc. Prescription safety glasses and tinted lenses are also available.

Standard safety glasses are designed to protect against flying particles. Safety glasses have lenses that are impact resistant and frames that are far stronger than regular eyeglasses.

Safety Goggles

Vinyl framed goggles of soft pliable body design provides adequate eyes protection from many hazards. These goggles are available with clear or tinted lenses, perforated, port vented, or non-vented frames. Single lens goggles provide similar protection to spectacles and may be worn in combination with spectacles or corrective lenses to ensure protection along with proper vision.

Like safety glasses, goggles are impact resistant and are available with tinted lenses.

Goggles offer the best all-around impact protection of all eyewear types because they form a positive seal around the eye area.

Welders/Chippers Goggles

Welders and chippers goggles are available in rigid and soft frames to accommodate single or two-eyepiece lenses.

Welders' goggles provide protection from sparking, scaling, or splashing metals and harmful light rays. Lenses are impact resistant and are available in graduated shades of filtration.

Chippers/ Grinders goggles provide eye protection from flying particles. The dual protective eyecup house impact resistant clear lenses with individuals cover plates.

Appropriate shade numbers for various operations are listed in Table 1.

Face Shields

Face shields normally consist of an adjustable head gear and face shield of either tinted or transparent acetate or polycarbonate materials, or wire screen. Face shields are available in various sizes, tensile strength, impact/heat resistance and light ray filtering capacity.

Face shields are used in operations when the entire face needs protection and to protect the eyes and face against flying particles, metal sparks, and chemical or biological splash hazards.

Welding Helmets and Shields

The shield assemblies consist of a vulcanized fiber or glass fiber body, a ratchet or button type adjustable headgear or cap attachment, and a filter and cover plate holder.

These shields must be provided to protect workers' eyes and face from infrared or radiant light burns, flying sparks, metal spatter and slag chips encountered during welding, brazing, soldering, resistance welding, bare or shielded electrical arc welding and oxyacetylene work.

Appropriate shade numbers for various operations are listed in Table 1.

1.4 Storage and Care

Safety glasses and other eye and face protection should be stored carefully so they won't be scratched or damaged. In general, do not store this equipment where it would be exposed to high heat or sunlight.

Inspect eye and face protection prior to use. If the equipment is damaged or broken do not use it because it may not be able to fully resist impact.

Pitted lenses, like dirty lenses, make it more difficult for an employee to see and should be replaced. Lenses that are pitted or deeply scratched are more prone to break under impact and should be replaced.

Clean eye and face protection according to the manufacturer's instructions. If the manufacturer's instructions are not available, clean with a mild soap and water solution by soaking in the soap solution (maintained at 120°F) for ten minutes. Rinse thoroughly and allow to air dry.

PPE that has been previously used should be disinfected before being issued to another employee. PPE may be disinfected by completely immersing all parts in a solution of germicidal fungicide for 10 minutes. Remove the parts from the solution and allow to air dry at room temperature.

Table 1
Filter Lenses for Protection against Radiant Energy

Operations	Electrodes Size 1/32 Inches	Arc Current	Minimum* Protective Shade
Shielded metal arc welding	less than 3	less than 60	7
	3-5	60-160	8
	5-8	160-250	10
	more than 8	250-550	11
Gas metal arc welding and Flux cored arc welding		less than 60	7
		60-160	10
		160-250	10
		250-500	10
Gas Tungsten arc welding		less than 50	8
		50-150	8
		150-500	10
Air Carbon	Light	less than 500	10
Air cutting	Heavy	500-1000	11
Plasma arc welding		less than 20	6
		20-100	8
		100-400	10
		400-800	11
Plasma arc cutting	light**	less than 300	8
	medium**	300-400	9
	heavy**	400-800	10
Torch Brazing			3
Torch soldering			2
Carbon arc welding			14

* As a rule of thumb start with a shade that is too dark to see the weld zone then switch a lighter shade which gives sufficient view of the weld zone without going below the minimum shade allowed. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow (sodium line) in the visual light of the (spectrum) operation.

** These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the work piece.

Table 1 Continued

Filter Lenses for Protection against Radiant Energy

Operations	Plate thickness-inches	Plate thickness-mm	Minimum* Protective Shade
Gas Welding Light	Under 1/8	Under 3.2	4
Medium	1/8 to 1/2	3.2 to 12.7	5
Heavy	Over 1/2	Over 12.7	6
Oxygen cutting Light	Under 1	Under 25	3
Medium	1 to 6	25 to 150	4
Heavy	Over 6	Over 150	5

* As a rule of thumb start with a shade that is too dark to see the weld zone then switch a lighter shade which gives sufficient view of the weld zone without going below the minimum shade allowed. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow (sodium line) in the visual light of the (spectrum) operation.

Selection Chart for Eye and Face Protection

The following chart provides general guidance for the proper selection of eye and face protection for hazards associated with the listed hazard "source" operations.

Source	Type of Hazard	Protection
IMPACT-Chipping, grinding, machining, masonry work, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding.	Flying fragments, objects, large chips, particles, sand, dirt, etc.	Spectacles with side protection, goggles, and face shields. For severe exposure use face shield over primary eye protection.
HEAT-Furnace operations pouring, casting, hot dipping, welding, cutting and brazing.	Hot sparks	Face shields, goggles, and spectacles with side protection. For severe exposure use face shield. See Notes 1, 2, 3.
	Splash from molten metals	Face shields worn over goggles. See Note 1, 2, 3
	High temperature exposure	Screen face shields, reflective face shields. See note: 1, 2, 3
CHEMICALS- Acid and chemical handling, degreasing, plating	Splash	Goggle, eyecup and cover types. For severe exposure, use face shield. See notes 3,11
DUST - Woodworking, buffing, general dusty conditions	Irritating mists	Special-purpose goggles
	Nuisance dust	Goggle, eyecup and cover types. See note 8
LIGHT and/or **RADIATION** Welding Electric arc	Optical radiation	Welding helmets or welding shields. Typical shades (see Table 1 above): 10-14. See notes: 9,12
WELDING: Gas Cutting, Torch brazing, Torch soldering.	Optical radiation	Welding goggles face shield. Typical shades (see Table 1 above): gas welding 4-8, cutting 3-6, and brazing 3-4. See note 3 and 9.
GLARE	Poor vision	Spectacles or welding face shield. Typical shades see Table 1 above and notes 3 and 9. Spectacles with shaded or special-purpose lenses, as suitable. See notes 9 and 10.

Notes to Eye and Face Protection Selection Chart

1. Care should be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards should be provided. Protective devices do not provide unlimited protection.

2. Operations involving heat may also involve light radiation. When necessary, protection from other hazards must be provided.
3. Face shields should only be worn over primary eye protection (spectacles or goggles).
4. Filter lenses must meet the requirements for shade designations as outlined in the OSHA regulations and ANSI standards. Tinted and shaded lenses are not filter lenses.
5. Persons whose vision requires the use of prescription lenses must wear either protective devices fitted with prescription lenses or protective devices designed to be worn over regular prescription eyewear.
6. Wearers of contact lenses must also wear appropriate eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments might represent an additional hazard to contact lens wearers.
7. Caution should be exercised in the use of metal frame protective devices in electrical hazard areas.
8. Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.
9. Welding helmets or faces shields should be used only over primary eye protection (spectacles or goggles).
10. Non-side shield spectacles are available for frontal protection only, but are not acceptable eye protection for the sources and operations listed for "impact."
11. Eye and face protection should be designed and used so that it both provides adequate ventilation and protects the wearer from splash entry.
12. Protection from light radiation is directly related to filter lens density. See note (4). Select the darkest shade that allows the task to be performed.

2 HEAD PROTECTION

2.1 Compliance with National Standards

All personal protective clothing and equipment must be of safe design and construction for the work to be performed and must be maintained in a sanitary and reliable condition.

Only those items of protective clothing and equipment that meet NIOSH or ANSI (American National Standards Institute) standards may be used.

Every hard hat conforming to the requirements of ANSI Z 89.1-1986 must be appropriately marked to verify its compliance. The following information must be marked inside the hat: Manufacture's name; legend, "ANSI Z 89.1-1986; and, the class designation (A, B, or C).

Protective helmets purchased before July 5, 1994 must comply with the ANSI standard "American National Standard Safety Requirement for Industrial Head Protection," ANSI Z 89.1-1969.

Protective helmets purchased after September 1997 must comply with ANSI Z 89.1-1997, "American National Standard for Personnel Protection- Protective Headwear for Industrial Workers-Requirements."

2.2 General Requirements

Each affected employee must wear protective helmets when working in areas where there is a potential for injury to the head from falling objects or impact. Some examples of occupations for which head protection should be routinely considered are: carpenters, electricians, linemen, mechanics and repairers, plumbers and pipe fitters, welders, laborers, freight handlers, timber cutting and logging, warehouse operations, and construction or renovation operations.

Protective helmets designed to reduce electrical shock hazard must be worn by each affected employee when working near exposed electrical conductors which could contact the head.

Employees working at higher elevations must wear protective helmets with chinstraps. The chinstrap should be designed to prevent the hard hat from being bumped off the employees' head, but must not be so strong that it presents a strangulation hazard.

2.3 Types of Head Protection

The ANSI classification system for head protection changed significantly with the 1997 revision. This guide, therefore, provides a description of the classes and types of protective hats (helmets) referenced in both the 1986 and 1997 standards.

The 1986 standard requirements apply to helmets purchased prior to September 1997. A description of the type and class of helmets under the 1986 standard are shown in Table 2.

The 1997 standard requirements apply to helmets purchased after September 1997. A description of the type and class of helmets under the 1997 standard are shown Table 3.

Table 2
Description of Protective Helmets - 1986 Standard

Type 1	Helmets with a full brim
Type 2	Brimless helmets with a peak extending forward from the crown.
Class A	General service, limited voltage. Intended for protection against impact hazard. Used in mining, construction, and manufacturing. Provide electrical protection from low-voltage conductors roof tested to 2,200 volts).
Class B	Utility service, high voltage. Used by electrical workers and workers who also need protection from falling objects. Provides electrical protection from high-voltage conductors roof tested to 20,000 volts).
Class C	Special service, no voltage protection. Designed for lightweight comfort and impact protection. Used in certain construction, manufacturing, refineries, and where there is a possibility of bumping the head against a fixed object. This class of helmet may not be used around electrical hazards.

Table 3
Description of Protective Helmets - 1997 Standard

Type 1	Helmets providing crown impact protection
Type 2	Helmets providing lateral impact protection
Class G	General service, limited voltage. Intended for protection against impact hazard. Used in mining, construction, and manufacturing. Provide electrical protection from low-voltage conductors roof tested to 2,200 volts).
Class E	Utility service, high voltage. Used by electrical workers and workers who also need protection from falling objects. Provides electrical protection from high-voltage conductors roof tested to 20,000 volts).
Class C	Conductive - no electrical protection. Designed for lightweight comfort and impact protection. Used in certain construction, manufacturing, refineries, and where there is a possibility of bumping the head against a fixed object. This class of helmet ma not be used around electrical hazards.

Bump caps may be used when head (impact) protection isn't required, but where an employee may be exposed to minor head bumps or laceration hazards. Bump caps are not approved for use where impact protection is required.

2.4 Storage and Care

If a helmet needs to be cleaned it should be scrubbed with a mild detergent and rinsed in clear water. After rinsing, the shell, straps and cradle should be carefully inspected for damage.

The shell, cradle, headbands, sweatbands, and accessories should be visually inspected daily for signs of cracks, dents, damage, or wear that might reduce the protection of the device. Any helmet with worn, damaged, or defective parts should be removed from service until the defective part has been replaced per the manufacturer's instructions.

Tar, paint, oils, and some chemicals can damage the shell and reduce protection. Helmets should not be painted, and the manufacturer's instructions should be consulted if tars, paints, or similar materials need to be cleaned from the shell of the helmet.

Helmets must be worn properly and must be properly maintained to provide adequate protection. Do not:

- Drill holes for added ventilation.
- Paint or inscribe the helmet
- Allow the helmet to be exposed to extreme temperatures or direct sunlight for long periods of time. Don't, for example, store your helmet in the back window of your car.
- Wear the hard hat with the shell tilted to one side.
- Wear the hat backward (e.g., with the brim facing your back).
- Stickers can hide signs of deterioration in the hard hat shell and should not be placed on hard hats.

3 FOOT PROTECTION

3.1 Compliance with National Standards

All personal protective clothing and equipment must be of safe design and construction for the work to be performed and must be maintained in a sanitary and reliable condition.

Only those items of protective clothing and equipment that meet NIOSH or ANSI (American National Standards Institute) standards may be used.

Protective footwear purchased after July 5, 1994 must comply with ANSI Z41-1991, "American National Standard for Personal Protection-Protective Footwear". This standard was withdrawn by ANSI and replaced by ASTM F2413-05 Standard Specification for Performance Requirements for Foot Protection (with test methods provided in ASTM F2412-05) in April 2005. The ASTM standards had minor changes, including deletion of Type II for Static Dissipative and Class 30 for Impact and Compression requirements. Test methods and performance requirements were added for footwear providing electric shock resistance, conductive and static dissipative and dielectric properties, as well as chain saw protection.

Protective footwear complying with ASTM F2413-05 and F2412-05 meet and exceed the current OSHA regulatory requirement to comply with ANSI Z41. Suppliers currently manufacture, test and label their products to the ASTM standards.

Protective footwear purchased before July 5, 1994 must comply with the ANSI Standard "USA Standard for Men's Safety-Toe Footwear," Z41-1967.

3.2 General Requirements

Each affected employee must wear protective footwear when working in areas where there is a danger of foot injury due to falling or rolling objects, chemical hazards, objects piercing the sole or electrical hazards.

Employees who cannot wear safety shoes for medical reasons must furnish a letter to their supervisor from their physician stating the reason and the anticipated duration of the condition. Employees must wear toe or foot guards over regular work shoes until a proper safety shoe is purchased or the condition subsides. The guards provided under these conditions must be furnished at no cost to the employee.

Protective guards, such as shoe-caps and metatarsal guards, are designed to slip over street shoes. Protective guards are not recommended if an employee will frequently encounter foot hazards on the job. They are not intended to replace steel-toed safety shoes or boots. There are no approved ANSI standards for protective guards.

All footwear requires routine inspection for cuts, holes, tears, cracks, worn soles, and other damage that could compromise its' protective quality.

Types of Protective Footwear

There are three basic types of protective footwear:

- **General protective footwear** that is worn in place of regular shoes or boots.
- **Overshoes**, which are worn over regular footwear.
- **Protective guards**, or safety devices that are worn over regular shoes or boots.

The guidance provided in the Selection Chart for Foot and Leg Protection below will assist you in selecting PPE appropriate for the hazards that you identify during the hazard assessment process.

General Protective Footwear

The five main types of general protective footwear are:

1. **Safety Toe Shoe or Boot.** These shoes are designed to protect feet from common hazards, such as falling or rolling objects, cuts, and punctures. The entire toe box and insole are reinforced with steel (or similar), and steel, aluminum, or plastic materials protect the instep.

   Safety shoes are also available that insulate against temperature extremes and/or are equipped with special soles to guard against slips, chemicals, and/or electrical hazards (see below).

   The shoe or boot may incorporate metatarsal protection, or a shield that protects the upper surface of the foot from impact or compression hazards. This type of footwear would generally be required for work around heavy pipes, activities involving manual material carts, or similar activities where heavy loads could drop on or roll over an employee's feet.

   Safety boots offer more protection when splash or spark hazards (chemicals, molten materials) are present.

   Chemical protective safety shoes and boots may be required to prevent or minimize chemical penetration when working with corrosives, caustics, cutting oils, or petroleum products.

   Safety shoes and boots may need to be used in conjunction with other PPE to provide greater protection against some work site hazards. For example, when exposed to molten metals or welding sparks, protect the lower legs and feet from heat hazards by using leather leggings or similar PPE. Safety snaps allow leggings to be removed quickly.

2. **Conductive footwear** - protects the wearer from static electricity by equalizing the differing electrical potentials.

- Type 1 conductive footwear controls static electricity generated on the body of the worker, thereby preventing sparks which could ignite nearby flammable gases or liquids.
- Type 2 conductive footwear is designed for linemen working with high-voltage lines where the electrical potential of the person and the energized equipment must be equalized.

NOTE. Conductive shoes are not general-purpose shoes and must be removed upon completion of the tasks for which they are required.

NOTE. Employees exposed to electrical hazards must never wear conductive shoes.

NOTE. Employees must be instructed not to use foot powder or wear socks made of silk, wool, or nylon with conductive shoes

3. **Electrical hazard footwear** - shoes or boots designed with non- conductive materials (other than the steel toe, which is properly insulated to protect the wearer, or a toe made from another material). This type of footwear insulates the worker from energized parts. It is intended for secondary protection only, for use on surfaces that are already substantially insulated.

NOTE. Non-conductive footwear must not be used in explosive or hazardous locations; in such locations, electrically conductive shoes are required.

NOTE. Employees using electrical hazard footwear must be trained to recognize that the insulating protection of electrical hazard, safety-toe shoes may be compromised if:

- The shoe is wet
- The rubber sole is worn through
- Metal particles become embedded in the sole or heel; or
- Other parts of the employees' body come into contact with conductive grounded items.

4. **Sole puncture resistant footwear** - provide protection from nails, wire, tacks, screws, large staples, or similar objects that, if stepped on, could penetrate the sole of the shoe and result in foot injury.

5. **Static dissipative footwear** - insulates the wearer from electrical hazards that may exist in areas where static dissipative footwear is required.

Overboots

Overboots protect a worker's boots and shoes from contact with acids, solvents, or other chemicals, or a dirty or wet working environment. Overboots do not generally offer impact or compression protection, and may need to be worn in conjunction with safety shoes to provide adequate protection against workplace hazards. If chemical protection is required, assure the overboot is compatible with, and will provide adequate protection against, the expected exposure.

Protective Guards

Protective guards consist of either shoe-caps or metatarsal guards. Protective guards can provide protection from foot injury, but should not be used to replace steel-toed safety footwear. Protective guards can be used where an employee is only occasionally exposed to foot hazards on the job.

Other Considerations

Other types of special footwear that may be required for an employee to perform their job safely include: shoes with skid resistant soles, waterproof footwear, chemical-resistant footwear, and combinations thereof. Foundry or "Gaiter" style boots, for example, feature quick-release fasteners or elasticized insets to allow quick removal of the footwear if a hazardous substance or material (such molten metal) were to get into the boot itself.

3.3 Storage and Care

Inspect safety footwear prior to each use. Defective or damaged personal protective equipment must not be used. Remove the damaged equipment from service and report the condition to your supervisor.

Follow the manufacturer's instructions for the care and maintenance of safety footwear.

Selection Chart for Foot and Leg Protection

The following chart provides general guidance for the proper selection of foot and leg protection for hazards associated with the listed hazard "source" operations.

Source	Typical Occupations Requiring Protection	Protection
IMPACT - Heavy tools, equipment, or objects that might roll or fall onto the feet of an employee.	Construction, demolition, or renovation operations; plumbing; building maintenance; trenching; utility work; grass cutting; materials handling.	Safety shoes or boots. Toe guards may be used over regular footwear only if an employee is infrequently exposed to this type of foot hazard.
PUNCTURE - Work where wire, tacks, staples, metal, or nails could be stepped on by employees causing a foot injury.	Construction, demolition, and renovation operations; building maintenance.	Safety shoes or boots with puncture protection.
COMPRESSION - Handling of unusually heavy objects or using heavy tools or equipment that present a compression hazard to the top of the foot.	Heavy materials handling, such as work activities involving skid trucks around heavy pipes; work using a jackhammer; pavement breaking.	Metatarsal footwear. Metatarsal guards may be used over regular footwear only if an employee is infrequently exposed to this type of foot hazard. Shin guards may be required for some operations where the lower leg is exposed to a rolling impact hazard.
HEAT- Exposure to molten metal or other super-heated fluids.	Furnace operations; pouring, casting, hot dipping; welding, cutting and brazing.	Foundry or heat resistant shoes or boots as appropriate. Leggings should be used as appropriate to protect the lower legs from molten metal or welding sparks.
CHEMICALS - Splash hazard or direct contact/ work with chemicals.	Acid and chemical handling, degreasing, plating. Chemical spill response.	Consult the manufacturer's literature for a chemical resistant boot appropriate for the chemical hazard. Footwear may need to incorporate a safety toe if an impact hazard is also present.
CONDUCTIVE – Work near or in explosive or hazardous atmospheres.	Explosives manufacturing, grain milling, spray painting or similar work with highly flammable materials.	Conductive footwear.
ELECTRICAL - Work with or near exposed energized electrical wiring or components.	Building maintenance; utility work; construction; wiring; work on or near communications, computer or similar equipment; and arc or resistance welding.	Electrical hazard safety-toe footwear.

4 HAND PROTECTION

4.1 Compliance with National Standards

All personal protective clothing and equipment must be of safe design and construction for the work to be performed and must be maintained in a sanitary and reliable condition.

Hand protection: There are no ANSI standards for glove selection. Glove selection, therefore, must be based on the performance characteristics of the glove in relation to the tasks to be performed.

4.2 General Requirements

The requirements outlined in this program are generally applicable to all operations. Personnel who are involved in operations or that are exposed to blood or other potentially infectious agents, however, should consult the Chemical Hygiene Plan or Bloodborne Pathogens Programs, as appropriate, for additional requirements. Information on these programs may be obtained by contacting the Bureau/Office EHS Division.

Supervisory personnel must select and require employees to use appropriate hand protection when the employee's hands are exposed to certain hazards. These hazards include, but are not limited to:

- Work with harmful substances that can be absorbed through the skin or that can cause skin irritation, chemical burns, or similar conditions. Examples would include strong acids or bases and organic solvents. Consult the Material Safety Data Sheet (MSDS) for the product or chemical to determine the type of hand protection that may be needed.
- Work with tools, equipment, or materials that can cause sever cuts, lacerations, punctures, fractures, amputations, or abrasions.
- Work where the employee is exposed to materials or agents that can cause thermal burns or that expose the employee to harmful temperature extremes.

4.3 Selection

Hand protection must be selected based upon a review of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified. General guidelines are as follows:

- Most accidents involving hand and arms can be classified under four main hazard categories: chemical, abrasion, cut, and burns.
- When protective hand wear is required for the job to be performed, make sure the gloves fit the employee well, are comfortable to wear, and are rated to guard against the particular hand hazards of the workplace.
- When selecting gloves for protection against chemical hazards, the toxic properties of the chemical(s) and the ability of the chemical to penetrate through the glove must be

determined. In particular, chemicals that can cause local effects on the skin and/or pass through the skin and cause systemic effects warrant a higher level of protection.

- There are no gloves that provide protection against all potential hand hazards, and commonly available glove materials may provide only limited protection against many chemicals. It is important, therefore, to select the most appropriate glove for a particular application and to determine how long it can be worn and whether it can be reused. Note that as long as the performance characteristics of the glove are acceptable, in many cases it may be more cost effective to regularly change cheaper gloves than to reuse more expensive types.
- Regardless of material or construction, no glove is completely puncture-proof, nor can any PPE be expected to take the place of proper engineering or work practice controls.
- Before purchasing gloves, the supervisor or designated departmental representative should review the work activities of the employee to determine the degree of dexterity required, the duration, frequency, and degree of exposure of the hazard, and the physical stresses that will be applied.
- Generally, any "chemical resistant" glove can be used for dry powders.
- For mixtures and formulated products (unless specific test data is available), a glove should be selected on the basis of the chemical component with the shortest breakthrough time, since it is possible for solvents to carry active ingredients through some glove materials.
- Employee must be able to remove the gloves in such a manner as to prevent skin contamination.
- Store gloves at room temperature-never in extreme heat or cold. Depending upon the material, some manufacturers may specify special storage requirements-check the accompanying literature or contact the supplier for information.
- Train employees to inspect gloves carefully for discoloration, holes, tears, wear, or other imperfections prior to each use, and require them to report any damage immediately to their supervisor or other designated person.
- PPE that is contaminated must be disposed of in a manner that will protect employees from exposure to the hazard.

Types of Hand Protection

Five general glove types are available: chemical resistant, disposable, cut or abrasion resistant, temperature resistant, or combinations thereof.

Chemical Resistant Gloves

These gloves may be made of rubber, neoprene, polyvinyl alcohol, vinyl, or other materials. The glove protects hands from corrosives, oils, and solvents. The selection of the proper chemical-resistant glove begins with an evaluation of the type of work to be performed and the chemical(s) that will be contacted by the employee.

Factors that will influence selection are:

- The type of chemicals) to be handled or used.
- Frequency and duration of chemical contact.
- Whether the contact will involve total immersion or splash hazards.
- Concentration of the chemical(s).
- Temperature of the chemical(s).
- Abrasion or resistance requirements.
- Puncture, snag, tear, and cut-resistance.
- Area to be protected and whether it involves only the hand, or if it also includes the forearm and/or arm (see section on Other Considerations).
- The amount of finger or hand dexterity that may be required to do the work.
- Grip requirements, or how well the glove needs to perform under dry, wet, or oily conditions.
- Whether the glove needs to show a color change if it has become contaminated.
- Thermal protection that may be required when handling, for example, cryogenic (i.e. very cold) or superheated materials or liquids.
- Size and comfort requirements.
- The price of the glove.

Different chemicals will affect the protective qualities of a glove in different ways. Select an appropriate glove material based upon:

- Permeation, or how quickly a chemical will pass through the glove material.
- Breakthrough time, or the time it takes for the chemical to pass to the inside of the glove.
- Degradation, or how the chemical will affect the physical properties of the glove material upon contact. Degradation can lead to softening, drying, swelling, shrinkage, or other undesirable side effects that could expose the employee to the chemical.

The type of chemical being used is the key factor for choosing the type of material from which the glove should be made. Some of the more common chemical-resistant glove materials are:

- Butyl. A synthetic rubber with good resistance to weathering and a wide variety of chemicals.
- Neoprene. A synthetic rubber having chemical and wear-resistance properties superior to those of natural rubber.
- Nitrile. A copolymer available in a wide range of acrylonitrile (propane nitrile) contents; chemical resistance and stiffness increases with higher acrylonitrile content.

- Polyethylene. A fairly chemical-resistant material used as a freestanding film or a fabric coating.
- Polyurethane. An abrasion-resistant rubber that is either coated into fabrics or formed into gloves or boots.
- Polyvinyl alcohol. A water-soluble polymer that exhibits exceptional existence to many organic solvents that rapidly permeates most rubbers.
- Polyvinyl chloride. A stiff polymer that is made softer and more suitable for protective clothing applications by the addition of plasticizers.
- Rubber. A highly flexible and conforming material made from a liquid tapped from rubber plants.

General guidelines for selecting chemical-resistant gloves are listed in the Selection Chart for Chemical Resistant Gloves. Consult the manufacturer's literature for information on the performance of the various classes of gloves versus specific chemicals.

Disposable Gloves

Disposable gloves are typically discarded after a single wearing, and are not designed to provide long term chemical protection. General types of disposable gloves are:

- Fabric gloves, usually made of cotton or nylon. These gloves will not generally provide adequate chemical protection, but function well as glove liners.
- Nitrile gloves are more chemically resistant than latex or vinyl, and offer good dexterity, elasticity, abrasion resistance, and conform well to the shape of the hand.
- Latex gloves offer dexterity and conformity, but should only be used in situations involving minimal chemical handling or contact. Some employees may experience an allergic reaction to latex.
- Polyethylene gloves are generally loose fitting and provide a high degree of dexterity.
- Vinyl gloves are not as flexible as latex, but offer a looser, less binding fit, and somewhat better chemical resistance than latex.

Cut and Abrasion-Resistant Gloves

General types of cut and abrasion-resistant gloves are:

- Leather gloves are used to guard against injuries from abrasions, cuts, extreme temperatures, and sparks (such as occur when welding) or burn hazards. They may used in combination with an insulated liner when working with electricity.
- Metal Mesh gloves are used to protect hands from accidental cuts and scratches from extremely sharp objects such as cutting tools or knives.
- Kevlar gloves offers exceptional abrasion and burn resistance.

- Aluminized Gloves. Gloves made of aluminized fabric are designed to insulate your hands from intense heat. Persons working with molten materials most commonly use these gloves.
- Fabric gloves, usually made from cotton or nylon, do not offer much protection against sharp-edged objects, and may present a snag hazard. These gloves are generally used to protect hands from minimal abrasion hazards, or contact with dirt, grease, or other contaminants.

Temperature-Resistant Gloves

General types of temperature-resistant gloves are:

- Leather is a natural insulator, and offers resistance to cuts and abrasion.
- Kevlar is cut and abrasion resistant, and will withstand temperatures up to 600oF.
- Cotton terrycloth will work effectively at temperatures up to 600oF, though dexterity may be a factor.
- Cryogenic gloves offer protection against extremely low temperatures, but are not suitable for immersion in liquid nitrogen or for use near open flames.
- Rubber offers protection against cold temperatures, but will not stand up well to heat.

Other temperature-resistant gloves, including Nomex©, Zetex®, and Flextra©, are available. The manufacturers' literature should be consulted for specific applications.

Selection Chart for Chemical Resistant Gloves*

TYPE	ADVANTAGES	DISADVANTAGES	USE AGAINST
Natural rubber	Low cost, good physical properties, good dexterity	Poor vs. oils, grease, organics. Frequently imported and may be of poor quality.	Bases, alcohol, dilute water solutions; fair versus aldehydes and ketones.
Natural rubber blends	Low cost, good dexterity, better chemical resistance than natural rubber versus some chemicals	Physical properties frequently inferior to natural rubber	Same as natural rubber
Polyvinyl chloride (PVC)	Low cost, very good physical properties, medium cost, medium chemical resistance	Plasticizers can be stripped; frequently imported and may be of poor quality	Strong acids and bases, salts, other water solutions, alcohol
Neoprene	Medium cost, medium chemical resistance, medium physical properties	NA	Oxidizing acids, aniline, phenol, glycol ethers

TYPE	ADVANTAGES	DISADVANTAGES	USE AGAINST
Nitrile	Low cost, excellent physical properties, dexterity	Poor versus benzene, methylene chloride, trichloroethylene, many ketones	Oils, greases, aliphatic chemicals, xylene, perchloroethylene, trichloroethane; fair versus toluene
Butyl	Specialty glove, polar organic	Expensive, poor versus hydrocarbons, chlorinated solvents	Glycol ethers, ketones, esters
Polyvinyl, alcohol (PVA)	Specialty glove, resists a very broad range of organics, good physical properties	Very expensive, water sensitive, poor versus light alcohols	Aliphatics, aromatics, chlorinated solvents, ketones (expect acetone), esters, ethers
Fluoro-elastomer-(viton®)	Specialty glove, organic solvents	Extremely expensive, poor physical properties, poor vs. some ketones, esters, amines	Aromatics, chlorinated solvents, also aliphatics and alcohols
Nofoil (silver shield®)	Excellent chemical resistance	Easily punctures, poor grip, stiff	Use for hazardous materials work, or work involving multiple chemical hazards

* Contact the supplier or manufacturer for information on glove materials that should be used for specific chemicals.

Other Considerations

Glove Linings

Glove linings will tend to improve comfort by absorbing perspiration, but may decrease dexterity. General types of linings consist of:

- Unlined gloves offer greater sensitivity and dexterity.
- Flock linings, or linings of shredded fibers, improve absorption of perspiration.
- Knit linings absorb perspiration, and may improve temperature protection.
- Jersey linings are generally more comfortable and provide better cushioning than other linings.
- Foam linings may be used to improve temperature protection for hot or cold conditions.
- Wool linings are natural insulators used outdoors for warmth in cold temperatures.

Glove length

- Finger cots - worn on the fingers alone when only minimal protection is required, such as when handling small parts that do not present a hazard to the rest of the hand.

- Wrist length (9-14") - protects both the hand and wrist from exposure.
- Elbow length (14-18") - provide protection if the hand must be immersed in a liquid or extra splash protection, and also shields the forearm from heat hazards, abrasions, or chemicals.
- Shoulder length (30-31") - protects the entire arm from exposure.

Cuff style

- Rolled cuffs - provide a barrier to keep chemicals on the glove from running onto your skin.
- Straight cuffs - provide extra length and a snug fit to protect from chemical run-off.
- Slip-on or open cuffs - make it easier to put on and take off the glove.
- Safety cuffs - provide additional wrist protection, and improve cut and abrasion resistance.
- Gauntlet-style cuffs - support a looser fit, and allow greater movement of the forearm to improve comfort.
- Knit wrist cuffs - improve the fit of the glove at the opening to prevent materials from entering the glove.

5 PROTECTIVE CLOTHING AND BODY PROTECTION

5.1 Compliance with National Standards

All personal protective clothing and equipment must be of safe design and construction for the work to be performed, and it must be maintained in a sanitary and reliable condition.

Standards are not currently available for all types of protective clothing or body protection. Where such standards do exist, only those items of protective clothing and equipment that meet the appropriate NIOSH, ANSI, ASTM, or NFPA standards may be used. Questions regarding the suitability of a specific item for a given hazard should be referred to the manufacturer.

5.2 General Requirements

Protective clothing that is subject to contamination with toxic or hazardous substances may not be removed from the work area, and must be disposed of properly and in a manner that protects employees from exposure to the hazard.

Care should be exercised in protective clothing selection, since some protective clothing has very limited resistance to chemicals or fire.

Consult the Material Safety Data Sheet (MSDS) to determine the recommended clothing for a particular chemical or chemical mixture.

Body protection must be provided for employees if they are threatened with bodily injury while performing their jobs, and if engineering, work practice, and administrative controls have failed to eliminate these hazards. Workplace hazards that could cause bodily injury include the following:

- Exposure to intense heat or cold. Note that cold weather clothing is generally considered to be normal wear clothing and is not covered by this program.
- Splashes of very cold or very hot metals or liquids.
- Impacts from tools, machinery, or materials.
- Cuts and/or abrasion.
- Exposure to hazardous chemicals.
- Contact with potentially infectious materials like blood.
- Radiation.
- Exposure to electrical arc hazards.

Types of Clothing and Body Protection

As with all protective equipment, protective clothing is available to protect against specific hazards.

The protective clothing provided must be constructed of material that will protect against the specific hazards in the workplace. Materials used in protective clothing include the following:

- Paper-like fiber. Disposable suits made of this material provide protection against dust and varying protection against splash hazards. Disposable suits may be coated with a material to increase chemical or water resistance. Uncoated disposable suits are typically only suitable for protection from contamination with particulate hazards (e.g., asbestos or lead).
- Treated wool and cotton. Protective clothing made from treated wool and cotton adapts well to changing workplace temperatures and is comfortable as well as fire resistant. Treated cotton and wool clothing protects against dust, abrasions, and rough and irritating surfaces.
- Duck. This closely woven cotton fabric protects employees against cuts and bruises while they handle heavy, sharp, or rough materials.
- Leather. Leather protective clothing is often used to protect against dry heat and flame such as are encountered during grinding and welding operations.
- Rubber, rubberized fabrics, neoprene, and plastics. Protective clothing made from these materials protects against certain acids and chemicals.
- Specialized protective clothing may incorporate Kevlar for cut resistance (for example, chainsaw chaps), aluminized coatings for protection from radiant heat, and flame-retardant or resistant coatings or materials.

- Electrical hazard clothing. Special clothing may be required for persons exposed to electrical arc hazards and/or extreme temperatures resulting from an electrical arc. This clothing is nonconductive and contains no metal hardware. Extreme exposure may necessitate use of an ultraviolet/infrared flash hood.
- Cooling vests or jackets. Cooling vests or jackets provide protection from heat exhaustion or heat stoke when employees work in very hot environments or conditions.

Be aware that different materials will protect against different chemical and physical hazards. When chemical or physical hazards are present, check with the clothing manufacturer to make sure that the material selected will provide protection from the specific chemical or physical hazards in your workplace.

Many types of protective clothing restrict airflow and impede perspiration. The risk of heat exhaustion or heat stroke, therefore, may be greatly increased with some types of protective clothing. Employee training on the symptoms of heat stress and the use of engineering controls (e.g., increasing ventilation), administrative controls (e.g., employee rotation), and personal protective equipment (e.g., cooling vests) may be essential to assuring employee safety in hot work environments.

6 FALL PROTECTION, HEARING PROTECTION, RESPIRATORY PROTECTION, AND ELECTRICAL PROTECTIVE DEVICES

6.1 Fall Protective Devices

Only personnel that have been trained in fall protection may perform work requiring the use of fall protective devices.

Personnel that perform work on a surface with an unprotected side or edge that is 6 feet or more above a lower level, or 10 feet or more on scaffolds, must be protected from falling by the use of guardrails, safety nets, or personal fall arrest systems. The exact requirements for when fall protective devices are required are outlined in the Fall Protection program.

The use of body belts for fall protection and the use of non-locking snaphooks are prohibited as of January 1,1998.

6.2 Hearing Protective Devices

Noise measurements must be made to determine if employees are being overexposed and to identify the machines or work processes that are contributing to the exposure. If it is discovered that a worker is exposed to an excessive amount of noise, these measurements are needed to determine the proper hearing protection device (HPD) that needs to be used and if engineering and/or administrative controls need to be implemented. Accurate exposure measurements are also needed so that the affected employee(s) can be included in the Hearing Conservation Program if they are exposed to excessive noise levels.

If you suspect that an employee may be exposed to excessive noise levels based upon the hazard assessment that you perform, contact Bureau/Office EHS Division for guidance. Until such time as the evaluation has been performed, you should provide the potentially exposed employee with hearing protective devices to limit his or her exposure.

6.3 Respiratory Protective Devices

Employees will be included in the Respiratory Protection Program when it is suspected that they are exposed to respiratory hazards that can not be alleviated with engineering controls (e.g. ventilation, process confinement, or material substitutions). Respirators may be used only in cases where alternative controls are not feasible or are in the process of being implemented. Respirators may not be provided to an employee if they are not enrolled in a medical monitoring program. Services that pertain specifically to the respiratory protection program include medical evaluation, fit testing, hazard monitoring, and training. These services are provided only when entry into the respiratory protection program is required due to hazards in the workplace. Respiratory protection will be required if it is determined that airborne contaminants which pose a health hazard are present in the workplace.

6.4 Electrical Protective Devices

If employee perform premise wiring or other electrical work on exposed energized electrical conductors, they must abide by the requirements outlined in the NYCDEP Hazardous Energy Control Program. These employees must be trained to the level of qualified person, use appropriate lockout and tagout procedures, and use appropriate electrical protective devices.

Summary on Revision 1 Changes to DEP PPE (Personal Protective Equipment) Procedure

Procedure Section	Summary of Changes	Discussion of Affect on DEP Staff	Regulatory Requirement	Effect on Contractor Work Rules
Throughout	Changed "Responsible Manager" to "Responsible Individual"	This change was to make the procedure applicable to all bureaus including those such as BWT where the term "manager" has a different meaning.	NA	NA
Section 2 – Scope	Added to the scope of the procedure to include OSHA guidance regarding the employer's obligation to pay for PPE and DEP's approach to ensuring that PPE for which the employer has no obligation to pay is used when required.	This is for clarity only and does not affect what DEP employees are doing currently.	NA	NA
Section 3 – Responsibilities	Added Bureau EHS responsibilities to include support for field operations' selection & procurement of PPE. Shifted responsibility for conducting training on widely used PPE from Bureau EHS to the Responsible Individual. Bureau EHS will now only verify that PPE hazard assessments for both routine and non-routine job tasks have been completed but will not perform or document them as before. RI's are now responsible for performing and documenting hazard assessments. Supervisors are now responsible for ensuring that all employees who are required to wear PPE are trained	This provides for technical consultation from Bureau EHS for Responsible Individuals who are now responsible for selection and procurement of PPE. Responsible individuals must now provide any necessary site/job specific training on job hazards and PPE. BEHS will still assist with training materials but RIs will conduct/arrange for supervior and employee training. Responsible individuals will now need to develop PPE hazard assessments and make these available to BEHS for verification. Supervisors will need to coordinate employee training with RI's to ensure that all employees have the necessary PPE and job hazard training.	NA	Special site PPE requirements remain a part of Contractor orientation per the Contractor Selection and Management procedure.

Summary on Revision 1 Changes to DEP PPE (Personal Protective Equipment) Procedure

Procedure Section	Summary of Changes	Discussion of Affect on DEP Staff	Regulatory Requirement	Effect on Contractor Work Rules
Section 4.1 – Assessment by Workplace, Work Area, or Job	Added allowance for using alternative assessment tools to conduct PPE hazard assessments so long as they provide equivalent documentation of the assessment process.	In some instances of non-routine work (e.g., inspectors that may encounter variable hazardous field conditions) traditional PPE hazard assessments are difficult. DEP staff can now use alternative methods to evaluate hazards and develop hazard controls strategies that include safe work practices/guidelines that incorporate safeguards, awareness of when the hazard can exceed the protections available, and a policy of withdrawal and notification of the owner and supervisors when such a hazard exists.	NA	NA
Section 4.2 - Work Area PPE Hazard Assessments (Required)	Clarified the need to complete the final summary of what PPE is required for what activities.	DEP staff indicated that the requirements for clearly listing the "Always Used" PPE and separately listing the additional task-specific PPE was unclear. This summary, if well completed, is all that needs to be communicated to the employees from the assessment.	NA	NA
Section 4.3 - Job Task Hazard Assessments for Special/Unusual Jobs/Hazards	Clarified how to best use Attachment B and C methods of conducting job specific PPE hazard assessments and JSAs.	For the most rigorous assessment, use Attachment B or both B and C in sequence. Because they have a thorough understanding of the full range of potential hazards contained in the checklists in Attachment B, Health and Safety staff can complete an effective assessment using only Attachment C.	NA	NA

Summary on Revision 1 Changes to DEP PPE (Personal Protective Equipment) Procedure

Procedure Section	Summary of Changes	Discussion of Affect on DEP Staff	Regulatory Requirement	Effect on Contractor Work Rules
Section 4.6 – Employer's Obligation to Provide PPE	Added this section to explain OSHA requirements regarding the Employer's obligation to pay for PPE, except for equipment that is personal in nature and which may be used by workers off the job. DEP's commitment to provide PPE when it is required has not changed.	The PPE standard requires employers to provide and to pay for personal protective equipment required by the company for the worker to do his or her job safely and in compliance with OSHA standards. DEP will continue to pay for this equipment. Where equipment is personal in nature and may be used by workers off the job, the matter of who pays for the PPE will continue to be left to labor-management negotiations.	29 CFR 1910.132 through 1910.138	NA
Section 5 – Training	Removed the discussion of the responsibility for training (discussed in section 3 – Responsibilities) and removed requirement to document training on the form in Attachment E (removed from the procedure).	This attachment was only for "default" use if there was no other documentation system and it is not used. Training will continue to be documented on DEP forms and Web Campus, as with all other EHS training. Documentation will continue to include Employee name; Date of training; PPE addressed; Verification of understanding; Signature of person conducting training.	29 CFR 1910.132(f)	NA
Attachment A - WORK AREA PPE HAZARD ASSESSMENT	Revised header to be visible on each page; deleted pick list of job tasks; added reference to task-specific analysis tools such as Attachment B or C; and clarified PPE summary instructions.	This is for clarity only and does not affect what DEP employees should be doing with these attachments. Those responsible for PPE Assessments should be sure that they have a complete listing of "Always Used" PPE and PPE required for each task included in their completed assessments.	NA	NA
Attachment B - JOB/TASK–SPECIFIC PPE HAZARD ASSESSMENT	Moved up HISTORY OF INCIDENTS AND NEAR MISSES to the first page.	This is for clarity only and does not affect what DEP employees are doing currently with these attachments.	NA	NA

Summary on Revision 1 Changes to DEP PPE (Personal Protective Equipment) Procedure

Procedure Section	Summary of Changes	Discussion of Affect on DEP Staff	Regulatory Requirement	Effect on Contractor Work Rules
Attachment C – JOB SAFETY ANALYSIS	Added the first 4 sections of the Attachment B to Attachment C to make it a stand alone tool for documenting PPE hazard assessments concurrent with JSA.	Attachment C can now be used independently of Attachment B to both conduct JSA and document PPE hazard assessment.	NA	NA
Attachment D – PPE SELECTION GUIDANCE	Added discussion on withdrawal of ANSI Z41.1-1991, "American National Standard for Personal Protection-Protective Footwear". This standard was withdrawn by ANSI and replaced by ASTM F2413-05 Standard Specification for Performance Requirements for Foot Protection (with test methods provided in ASTM F2412-05) in April 2005.	Employees must evaluate new footwear for conformance to ASTM Standards.	NA	NA
Attachment E – PPE Training Record	DELETED, obsolete.	See Section 5.	29 CFR 1910.132(f)	NA

New York City of Environmental Protection
Bureau of Wastewater Treatment - Marine Section

Personal Protective Equipment (PPE) Matrix

Any persons who are within Marine Section facilities or onboard Marine Section vessels must wear the PPE outfit defined below (1) and use the mimimum PPE as defined by this matrix and referenced requirements.

	Eye Protection					Head Protection	Foot Protection	Hand Protection					Hearing Protection	Body Protection			Other			
Marine Section Operations / Tasks	Safety Glasses w/Side Shields	Chemical Splash Goggles	Welding/Cutting Goggles	Face Shield	Welding Helmet	Hard Hat	Rubber (non-steel toed)	Latex, PVC or Nitrile Liner Gloves	Leather or Equivalent Work Gloves	Welding Gloves (suede)	Electrical Protective Gloves	Chemical Protective Gloves	Ear Plugs or Muffs	Tyvek QC or equivalent coveralls	Chemical Resistant Apron or Chemical Resistant Coveralls	Welding Jacket	Safety Harness	Respiratory Protection (5)	Turnout Gear	Personal Flotation Device (PFD)
Mooring / Line handling						●(2)(3)			○											●(2)
Anchoring / Tasks performed on-deck by anchor windlass	●																			
Cargo / Tasks performed on Dock including hose connecting-disconnecting, Blow back and draining line, Moving containment, etc.	●(6)					●(3)		●(4)	●											
Cargo / Packing cargo pumps, cleaning cargo spills or tasks with potential exposure to cargo		●		○			○	●						○						
Cormorant / Net dumping	●					●			●											
Small Boats / On-deck performing any tasks																				●
Maintenance / Welding, cutting or burning	●		●		●					●						●				
Maintenance / Chipping, scaling or grinding surfaces	●			○					●									●		
Maintenance / Painting	●	○						○						○				○		
Maintenance / Handling chemical substances including caustic or corrosive agents		●										●			○			○		
Maintenance / Operating power tools with cutting, drilling or machining components	●			○					●											
Maintenance / Tasks involving electrical components	●										●									
Maintenance / Working aloft -- tasks performed at a height greater than 4' from deck	●	○															●			
Maintenance-Operations / Lifting operations -- tasks with suspended loads overhead including forklift operations	●					●														
Operations / Working in Engine Room and performing tasks in spaces with operating machinery -- e.g. generator rooms, cargo pumproom, etc.	●												●							
Fire Fighting																			●(7)	
General Operations	*Refer to MOPP Standard Operating Procedures for task-specifc PPE requirements*																			
Shipyard	*Work clothes, work shoes, safety glasses and hard hat as a minimum or to exceed as specified by the shipyard.*																			
EH&S / Confined space entry, hot work, etc.	*Refer to EH&S Policies & Procedures - Marine Operations Policies & Procedures Manual (MOPP) Section 8 for specific details.*																			

● = Minimum PPE **○ = Suggested Supplemental PPE**

1) PPE outfit shall be work clothes, work shoes, portable UHF radio and an intrinsically safe flashlight. Work clothes must be non-synthetic and include pants (no shorts or sweatpants) and a shirt with sleeves that cover the shoulders. Work shoes include shoes (or boots) with sturdy leather uppers and chemical and slip resistant soles.

2) Hard hat shall be worn by shore-based line handlers during tie-up only. A PFD shall be worn by shore-based personnel whenever working within 6 feet from the waterside edge of a dock.

3) Hard hat is required on-deck at all times when the vessel is attending the North River WPCP and whenever in vicinity of cargo hose crane lifts. Hard hat is required on dock whenever in vicinity of cargo hose crane lifts.

4) PVC gloves shall be worn by personnel handling and connecting cargo hose ends.

5) See Respiratory Protection Procedure for specific details -- MOPP Section 8.6.

6) Use of safety glasses on deck during normal loading operations are not required but suggested.

7) Turnout Gear consists of a Helmet, Nomex Hood, Fire Suit, Fire rated Boots, Heat resistant Gloves and a Fire Rated SCBA.

Safety Glasses- ANSI Z87.1-1989
Chemical Splash Goggles- ANSI Z87.1
Welding/Cutting Goggles- ANSI Z87.1
Face Shield- ANSI Z87.1-1989
Welding Helmet- ANSI Z87.1
Hard Hat- ANSI Z89.1-1996
Rubber Boots- ANSI Z41.1-1991
Latex Nitrile Gloves- ANSI/ADA Spec. No. 102
Welding Gloves- ANSI Z49.1
Leather or Equivalent Work Gloves- ANSI/ISEA 105-2005
Chemical Protective Gloves- ANSI/ISEA 105-2000
Ear Plugs or Muffs- ANSI S3.19-1974
Tyvek or Equivalent Coveralls- ANSI/ISEA 101-1993
Body Harness & Rescue Retrieval Equipment- ANSI Z359.1
Personal Flotation Device- USCG Approved Type III
SCBA - NFPA - 1981 (2007 edition) Compliant
Fire Suit - NFPA - 1971 Compliant

Attachment C

Quality Assurance Project Plan



GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Quality Assurance Project Plan (QAPP)

Paerdegat Basin

Brooklyn, New York

Submitted by:
GEI Consultants, Inc., P.C.
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
860-368-5300

March 2015
Project 129600-1-1101

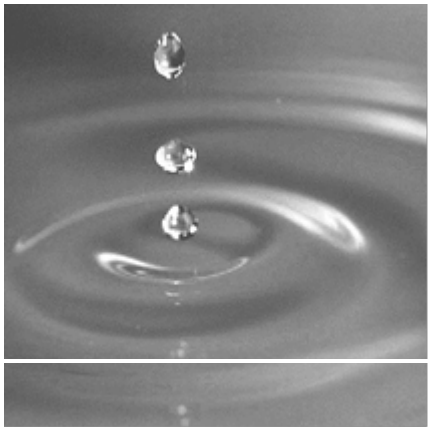


Table of Contents

Introduction 1

QAPP Worksheet #1 -- Title and Approval Page 2

QAPP Worksheet #2 -- QAPP Identifying Information 3

QAPP Worksheet #3 -- Distribution List 10

QAPP Worksheet #4 -- Project Personnel Sign-Off Sheet 12

QAPP Worksheet #5 – Project Organizational Chart 15

QAPP Worksheet #6 -- QAPP Communication Pathways 18

QAPP Worksheet #7 -- Personnel Responsibilities and Qualifications Table 19

QAPP Worksheet #8 -- Special Personnel Training Requirements Table 20

QAPP Worksheet #9 -- Project Scoping Session Participants Sheets 21

QAPP Worksheet #10 – Problem Definition 23

QAPP Worksheet #11 -- Project Quality Objectives/Systematic Planning Process 25

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) - Measurement Performance Criteria Table 27

QAPP Worksheet #13 – Secondary Data Criteria and Limitations 36

QAPP Worksheet #14 – Summary of Project Tasks 37

QAPP Worksheet #15 -- Reference Limits and Evaluation Tables 40

QAPP Worksheet #16 – Project Schedule/ Timeline Table 60

QAPP Worksheet #17 -- QAPP Sampling Design and Rationale 61

QAPP Worksheet #18 -- Sampling Locations and Methods/SOP Requirements Table 68

QAPP Worksheet #19 – Analytical SOP Requirements Table 69

QAPP Worksheet #20 -- Field Quality Control Sample Summary Table 71

QAPP Worksheet #21 – Project Sampling SOP Reference Table 72

QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing and Inspection Table 73

QAPP Worksheet #23 -- Analytical SOP References Table 74

QAPP Worksheet #24 -- Analytical Instrument Calibration Table 76

QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table 82

QAPP Worksheet #26 – Sample Handling System 86

QAPP Worksheet #27 -- Sample Custody Requirements 90

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table 94

QAPP Worksheet #29 -- Project Documents and Records Table 100

QAPP Worksheet #30 – Analytical Services Table 103

QAPP Worksheet #31 – Planned Project Assessment Table 104

QAPP Worksheet #32 – Assessment Findings and Response Actions 105

QAPP Worksheet #33 – Planned Project Assessment Table 107

QAPP Worksheet #34 – Sampling and Analysis Verification (Step 1) Process Table 108

QAPP Worksheet #35 – Sampling and Analysis Validation (Steps IIa and IIb) Process Table 109

QAPP Worksheet #36 – Sampling and Analysis Validation (Steps IIa and IIb) SummaryTable 110

QAPP Worksheet #37—Data Usability Assessment 111

References 112

Figures

1. Project Team Organization Chart

*All other noted Figures can be found in the Work Plan.

Attachments

A. Regulations and Guidance Documents (Electronic)
B. Field Standard Operating Procedures (Electronic)
C. Laboratory Standard Operating Procedures (Electronic)
D. Example Chain of Custodies
E. Field Change Order Form
F. Project Manager and Data Validation Resumes

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Introduction

This Quality Assurance Project Plan (QAPP) is intended to integrate the technical and quality control aspects of a surface sediment investigation at the Paerdegat Basin Site. This QAPP is supplemented by detailed information in the Surface Sediment and Tissue Sampling Work Plan and associated addendums. This QAPP details the planning processes for collecting data and describes the implementation of the quality assurance (QA) and quality control (QC) activities developed for this program. The purpose of this QAPP is to generate project data that are technically valid and legally defensible. The QAPP consists of four main components:

- Project Management.
- Measurement and Data Acquisition.
- Assessment and Oversight.
- Data Validation and Usability.

The above components will incorporate QA/QC requirements cited within the following United States Environmental Protection Agency (USEPA) and New York State Department of Environmental Conservation (NYSDEC) documents:

- USEPA Requirements for Quality Assurance Project Plans, USEPA QA/R-5, February 2006.
- USEPA Guidance for the Data Quality Objectives Process, QA/G-4, August 2000.
- USEPA, US Department of Defense, and US Department of Energy Uniform Federal Policy (UFP) for Quality Assurance Project Plans, Final Version March 2005.
- NYSDEC, 2010, DER-10 Technical Guidance for Site Investigation and Remediation.
- Analytical Services Protocol (ASP). NYSDEC.

QAPP Worksheet #1 -- Title and Approval Page

Site Name/Project Name: Paerdegat Basin Site

Site Location: Paerdegat Basin, Brooklyn, New York

Document Title: *QAPP for Paerdegat Basin*

Lead Organization: National Grid

Preparer's Name and Organization: Kimberly Bradley, GEI Consultants, Inc.

Preparer's Address, Telephone Number and E-mail Address:

455 Winding Brook Drive, Suite 201, Glastonbury, CT 06033,
kbradley@geiconsultants.com

Preparation Date: 03/19/13, Updated January 20, 2015

Organization	Name	Signature
Investigative Organization's Project Manager	Barry Giroux	
Investigative Organizations Project QC Officer	Brian Skelly	
Lead Organizations Project Manager	William Ryan	

Approval Signatures:_____

Printed Name/Title:_____

Approval Authority:_____

QAPP Worksheet #2 -- QAPP Identifying Information

Site Number/Code:

Operable Unit: Not Applicable

Contractor Name: GEI Consultants, Inc.

Contractor Number: Not Applicable

Contract Title: Not Applicable

Work Assignment Number: Not Applicable

1. **Identify guidance used to prepare QAPP:** Uniform Federal Policy for Quality Assurance Project Plans, NYSDEC Analytical Services Protocol (ASP), NYSDEC DER-10.

2. **Identify regulatory program:** New York State Department of Environmental Conservation (NYSDEC) Administrative Order on Content

3. **Identify approval entity:** New York State Department of Environmental Conservation (NYSDEC).

4. This QAPP is project Specific.

5. Scoping Sessions occurred in October 2012/January 2013.

6. **List dates and titles of QAPP documents written for previous site work, if applicable:**

7. **List organizational partners (stakeholders) and connection with lead organization:** The primary project organizational partners include representatives from National Grid and GEI Consultants, Inc. National Grid will provide project and contract management guidance.

8. **List data users:** New York State Department of Environmental Conservation, National Grid, and GEI Consultants, Inc.

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below:

QAPP Worksheet #2 -- QAPP Identifying Information (Continued)

Circle QAPP elements and required information that are not applicable to the project. Provide an explanation in the QAPP.

Required QAPP Element(s) and Corresponding QAPP Section(s)	Optional QAPP Worksheet # in QAPP Workbook	Required Information
Project Management and Objectives		
2.1 Title and Approval Page	1	- Title and Approval Page
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	2	- QAPP Identifying Information - Table of Contents
2.3 Distribution List and Project Personnel Sign Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	3 4	- Distribution List - Project Personnel Sign-Off Sheet
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	5 6 7 8	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table
Project Management and Objective		
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping)	9	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet

Required QAPP Element(s) and Corresponding QAPP Section(s)	Optional QAPP Worksheet # in QAPP Workbook	Required Information
2.5.2 Problem Definition, Site History, and Background	10	- Problem Definition, Site History, and Background - Site Maps (historical and present)
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process	11	- Site-Specific PQOs
2.6.2 Measurement Performance Criteria	12	- Measurement Performance Criteria Table
2.7 Secondary Data Evaluation	13	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table
2.8 Project Overview and Schedule	14	- Summary of Project Tasks
2.8.1 Project Overview	15	- Reference Limits and Evaluation Table
2.8.2 Project Schedule	16	- Project Schedule/Timeline Table

Required QAPP Element(s) and Corresponding QAPP Section(s)	Optional QAPP Worksheet # in QAPP Workbook	Required Information
Measurement/Data Acquisition		
3.1 Sampling Tasks	17	- Sampling Design and Rationale
3.1.1 Sampling Process Design and Rationale		- Sample Location Map
3.1.2 Sampling Procedures and Requirements	18	- Sampling Locations and Methods/ SOP Requirements Table
3.1.2.1 Sampling Collection Procedures		- Analytical Methods/SOP Requirements Table
3.1.2.2 Sample Containers, Volume, and Preservation	19	- Field Quality Control Sample Summary Table
3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures		- Sampling SOPs
3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures	20	- Project Sampling SOP References Table
3.1.2.5 Supply Inspection and Acceptance Procedures		- Field Equipment Calibration, Maintenance, Testing, and Inspection Table
3.1.2.6 Field Documentation Procedures	21	
	22	
3.2 Analytical Tasks		- Analytical SOPs
3.2.1 Analytical SOPs	23	- Analytical SOP References Table
3.2.2 Analytical Instrument Calibration Procedures	24	- Analytical Instrument Calibration Table
3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures		- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Required QAPP Element(s) and Corresponding QAPP Section(s)	Optional QAPP Worksheet # in QAPP Workbook	Required Information
3.2.4 Analytical Supply Inspection and Acceptance Procedures	25	
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures	26	- Sample Collection Documentation Handling, Tracking, and Custody SOPs
3.3.1 Sample Collection Documentation		- Sample Container Identification
3.3.2 Sample Handling and Tracking System		- Sample Handling Flow Diagram
3.3.3 Sample Custody		- Example Chain-of-Custody Form and Seal
3.4 Quality Control Samples	27	- QC Samples Table
3.4.1 Sampling Quality Control Samples		- Screening/Confirmatory Analysis Decision Tree
3.4.2 Analytical Quality Control Samples		
3.5 Data Management Tasks	28	- Project Documents and Records Table
3.5.1 Project Documentation and Records		- Analytical Services Table
3.5.2 Data Package Deliverables	29	- Data Management SOPs
3.5.3 Data Reporting Formats	30	
3.5.4 Data Handling and Management	32	
3.5.5 Data Tracking and Control	31	

Required QAPP Element(s) and Corresponding QAPP Section(s)	Optional QAPP Worksheet # in QAPP Workbook	Required Information
Assessment/Oversight		
4.1 Assessments and Response Actions		- Assessments and Response Actions
4.1.1 Planned Assessments	30	- Planned Project Assessments Table
4.1.2 Assessment Findings and Corrective Action Responses		- Audit Checklists
	31	- Assessment Findings and Corrective Action Responses Table
4.2 QA Management Reports	32 34	- QA Management Reports Table
4.2 QA Management Reports	32 34	- QA Management Reports Table
4.3 Final Project Report		

Required QAPP Element(s) and Corresponding QAPP Section(s)	Optional QAPP Worksheet # in QAPP Workbook	Required Information
Data Review		
5.1 Overview		
5.2 Data Review Steps	33	- Verification (Step I) Process Table
5.2.1 Step I: Verification	34	- Validation (Steps IIa and IIb) Process Table
5.2.2 Step II: Validation		- Validation (Steps IIa and IIb) Summary Table
5.2.2.1 Step IIa Validation Activities	35	- Usability Assessment
5.2.2.2 Step IIb Validation Activities	36	
5.2.3 Step III: Usability Assessment		
5.2.3.1 Data Limitations and Actions from Usability Assessment		
5.2.3.2 Activities		
5.3 Streamlining Data Review	33	
5.3.1 Data Review Steps To Be Streamlined	34	
5.3.2 Criteria for Streamlining Data Review	35	
5.3.3 Amounts and Types of Data Appropriate for Streamlining	35	

QAPP Worksheet #3 -- Distribution List

List those entities to which copies of the approved QAPP, subsequent QAPP revisions, addenda, and amendments will be distributed.

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Jane O'Connell	NYSDEC Project Coordinator	NYSDEC DER (R2)	718.482.4599		jhoconne@gw.dec.state.ny.us	
Shaun Bollers	NYSDEC Project Contact	NYSDEC DER (R2)	718.482.4096	718.482.6358	snboller@gw.dec.state.ny.us	
William Ryan	Lead Organizations Project Manager	National Grid	516.545.2586		william.ryan@nationalgrid.com	
Barry Giroux	Investigative Organizations Project Manager	GEI Consultants	860.368.5300	860.368.5307	bgiroux@geiconsultants.com	
David Terry	Investigative Organizations In-house Consultant	GEI Consultants	860.368.5300	860.368.5307	dterry@geiconsultants.com	
Brian Skelly	Investigative Organizations Project Quality Control Officer	GEI Consultants	860.368.5300	860.368.5307	bskelly@geiconsultants.com	
Lorie MacKinnon	Data Validator	GEI Consultants	603. 974.0939		lmackinnon@geiconsultants.com	
Kimberly Bradley	Field Team Leader/Site Safety Officer	GEI Consultants	860.368.5300	860.368.5307	kbradley@geiconsultants.com	

Electronic copies of the final QAPP and related project documents will also be available in the project directory and the project database for personnel named in the organization chart provided as Figure 1 and other personnel who will be assigned to work on the project. Those names will be responsible for distributing the QAPP and related documents to others in their organization.

Note: Per the requirements of DER-10 Chapter 2.4(a)2.ii, the current resumes for Barry Giroux (PM) and Lorie MacKinnon (Data Validator) are included in Attachment F.

QAPP Worksheet #4 -- Project Personnel Sign-Off Sheet

Have copies of this form signed by key project personnel from each organization to indicate that they have read the applicable QAPP sections and will perform the tasks as described. Ask each organization to forward signed sheets to the central project file.

Organization: GEI Consultants, Inc.

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Barry Giroux	Investigative Organizations Project Manager	860.368.5300		
David Terry	Investigative Organizations In-House Consultant	860.368.5300		
Roy Stoecker	Investigative Organizations Biological Senior Consultant	631.751.4600		
Brian Skelly	Investigative Organizations Project Quality Control Officer	860.368.5300		
Lorie MacKinnon	Data Validation/Data Reviewer	603.974.0939		
Mary Beth Billerman	Field Team	631.751.4600		
Kimberly Bradley	Field Team Leader/ Project Safety Officer	860.368.5300		

Have copies of this form signed by key project personnel from each organization to indicate that they have read the applicable QAPP sections and will perform the tasks as described. Ask each organization to forward signed sheets to the central project file.

QAPP Worksheet #4 -- Project Personnel Sign-Off Sheet (Continued)

Organization: New York Department of Environmental Conservation

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
Shaun Bollers	NYSDEC Project Contact	718.482.4096		

QAPP Worksheet #4 -- Project Personnel Sign-Off Sheet (Continued)

Have copies of this form signed by key project personnel from each organization to indicate that they have read the applicable QAPP sections and will perform the tasks as described. Ask each organization to forward signed sheets to the central project file.

Organization: National Grid

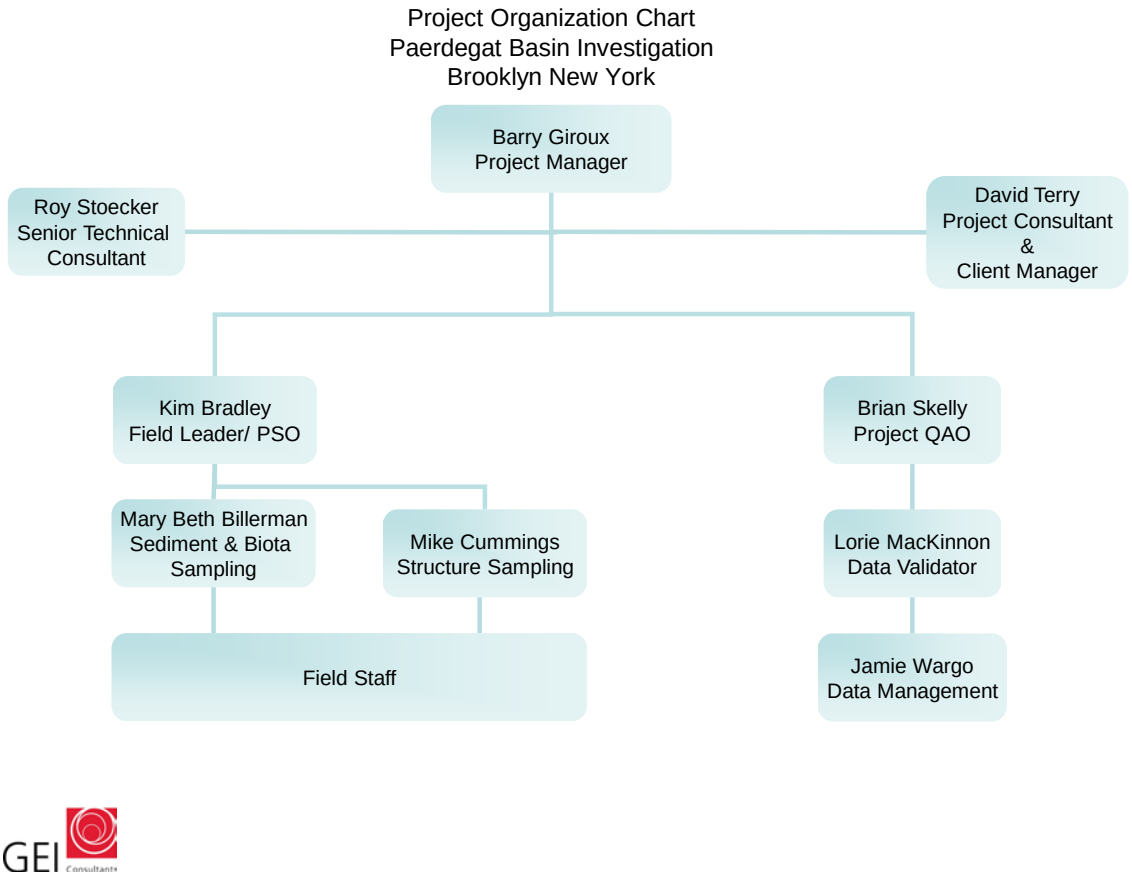
Project Personnel	Title	Telephone Number	Signature	Date QAPP Read Email Receipt
William Ryan	Lead Organizations Project Manager	516.545.2586		

QAPP Worksheet #5 – Project Organizational Chart

Project Organization

The Organization Chart, provided as Figure 1, the description of project organization, and the roles of the team members are summarized below:

Figure 1. Project Organization Chart



Project/Task Organization Overview

The project management team will consist of representatives from National Grid, NYSDEC, and GEI Consultants, Inc. (GEI). GEI will provide technical oversight to the project during the planning and investigation, serve as the primary contractor, bear responsibility for developing and implementing the investigation, and provide project management for the other subcontractors.

Investigation Team Members

This section contains a description of the project organizational structure. The National Grid Project Manager will have contract management with responsibility for the Paerdegat Basin Investigation. GEI, as the primary contractor, will be responsible for developing and implementing the investigation, and conduct project management for other subcontractors. Additional project team members from other companies may serve as subcontractors to GEI.

Project Manager (PM) – The PM is accountable to the PO throughout the duration of the project. The PM will be the primary point of contact with National Grid. The PM may delegate authority to expedite and facilitate the implementation of the project plan.

The PM is responsible for:

- Coordination with National Grid.
- Budget control.
- Subcontractor performance.
- Project coordination to implement Work Plans.
- Allocation of staffing and resources to implement the QA/QC program and the Health and Safety Plan (HASP).
- Review of investigation, engineering, and interim reports.

Corporate Health and Safety Manager (CHSM) – The Corporate Health and Safety Manager is responsible for development and implementation of GEI's Health and Safety program. The CHSM serves as the administrator of GEI's Corporate Health and Safety program. The CHSM bears responsibility for:

- Proper training for GEI field personnel.
- Medical clearance of GEI field personnel.
- Field personnel having adequate experience with personal protective equipment.
- Providing guidance on data interpretation.
- Determining levels of worker protection.
- Directing and assisting the Project Safety Officer (PSO).

Project Safety Officer (PSO) - The PSO is knowledgeable in safety and worker protection techniques as they relate to the project, as instructed and guided by the CHSM. Responsibilities include monitoring daily compliance of work to the HASP, having the ability and authority to make needed changes or additions to the HASP and providing technical assistance to the Project Manager on problems relating to work safety.

The PSO is responsible for the development and set-up of emergency procedures and personnel decontamination procedures. The PSO or designee will complete a daily diary of activities with health and safety relevance. If unsafe work conditions are encountered, the

PSO is authorized to stop work. Resolution of all health and safety problems will be coordinated through the Technical PM.

Project Quality Control Officer – The Project QC Officer is responsible for project specific supervision and monitoring of the QA program and reports to the Project Manager. Additional responsibilities include:

- Ensuring that field personnel are familiar with and adhere to proper sample identification, and chain-of-custody procedures.

- Coordinating with the analytical laboratory for the receipt of samples, the reporting of analytical results, and recommending corrective actions to correct deficiencies in the analytical protocol or sampling.

Field Team Leader – The Field Team Leader will serve as the contact person GEI for field investigations and activities. The Field Team Leader will be responsible for the logistics of the field activities. The Field Team Leader will:

- Ensure that proper sampling procedures and field measurement techniques are performed.
- Inspect and replace equipment.
- Prepare daily activity reports.
- Prepare samples (in coordination with the Sample Management Officer) for shipment.
- Coordinate field activities.
- Schedule sampling and other field activities.

QAPP Worksheet #6 -- QAPP Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Approval of Amendments to the QAPP	GEI Consultants, Inc.	Project Quality Control Officer) and Lead Organization's Project Manager	860.368.5300	Obtain initial approval from the Investigative Organization PM and submit documented amendments within 10 working days of initial approval
Document and Records Control	GEI Consultants, Inc.	Investigative Organization Project Manager	860.368.5300	Project Document Preparation and distribution. Document and records control posting procedure implemented within 5 working days of receipt by GEI Consultants, Inc.
Stop Work and Initiation of Corrective action	GEI Consultants, Inc.	Investigative Organization Project Manager	860.368.5300	The PM communicates within 24 hours of stop work to the project organization by phone, with confirming e-mail.
Real time modification, notifications and approval	GEI Consultants, Inc.	Field Team Leader	860.368.5300	Real time modification to the project will require the approval of the Project Quality Officer and PM (or designee) and will be documented using the Field Change Order Form in Attachment E within 5 working days.
Reporting of serious issues	GEI Consultants, Inc.	Project Managers	860.368.5300	Report any serious issues to National Grid and other concerned parties by e-mail or memo
Meeting Minutes	GEI Consultants, Inc.	Investigative Organization Project Manager	860.368.5300	Post approved meeting minutes or distribute by email within 5 working days of meeting.
Corrective action, assessment finding	GEI Consultants, Inc.	Project Safety Officer/Quality Control Officer	860.368.5300	Problems or negative assessment findings are reported to the PM by e-mail within 3 days.

QAPP Worksheet #7 -- Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Years of Professional Experience	Education and Experience Qualifications
William Ryan	Project Manager	National Grid	Lead Organization's Project Manager	20 +	MS Public Health-Environmental & Occupational Health Science
Barry Giroux	Project Manager	GEI Consultants, Inc.	Investigative Organization's Project Manager	20+	P.E., BS Civil Engineering
David Terry	Project Manager	GEI Consultants, Inc.	Investigative Organization's In House Consultant	20	PG, MS Geology
Roy Stoecker	Senior Consultant	GEI Consultants, Inc.	Investigative Organization's In House Consultant	20+	PhD Botany
Mary Beth Billerman	Project Manager/Scientist	GEI Consultants, Inc.	Field Team Coordination	9	BS Environmental Science
Kimberly Bradley	Project Scientist	GEI Consultants, Inc.	Field Team Leader/ Site Safety Officer	6+	MS Environmental Sciences
Brian Skelly	Project Manager	GEI Consultants, Inc.	Project Quality Officer	10	MS Environmental Sciences
Kirk Young	Project Manager	Test America	Laboratory Manager	20 +	MS Environmental Sciences

QAPP Worksheet #8 -- Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records/Certificates
Field Team	Safety and OSHA training and medical monitoring as specified in the HASP; Field Sampling training	GEI Consultants, Inc.	Training dates kept in company/ project training records	All field team members working on Project Properties.	All GEI Consultant and subcontractor personnel working on the Project Properties	GEI Consultant's Project Files; available upon request

QAPP Worksheet #9 -- Project Scoping Session Participants Sheets

Project Team Participants

Project Name: **Paerdegat Basin Spill** **Projected Date(s) of Sampling:** October 2012 **Project Managers:** W. Ryan, National Grid, B. Giroux, GEI Consultants	**Site Name:** Paerdegat Basin Site **Site Location:** Brooklyn, New York

Date of Session: October 15, 2012

Scoping Session Purpose: Scope
Investigation

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Jane O'Connell	NYSDEC Project Manager	NYSDEC DER (2)	(718) 482-4599	jhoconne@gw.dec.state.ny.us	Project Manager
William Ryan	Lead Organization Project Manager	National Grid	(516) 545-2586	william.ryan@nationalgrid.com	Project Manager
David Terry	Investigative Organization In House Consultant	GEI Consultants	860-368-5412	dterry@geiconsultants.com	In-House Consultant
Roy Stoecker	Investigative Senior Principal	GEI Consultants	860-368-5414	rstoecker@geiconsultants.com	Senior Scientist

Many of the members of the NYSDEC, National Grid and GEI Consultants investigative team participated on the October 15, 2012 call. Full participation is listed on a contact sheet sent out by Jane O'Connell on October 17, 2012 .

Comments/Decisions: The data quality objectives and data needs for the project were developed provided during communications with
Action Items: Complete project planning documents (HASP, Work Plan, QAPP)

Project Name: **Paerdegat Basin Spill**	
Projected Date(s) of Sampling: To Be February/March 2013	**Site Name:** Paerdegat Basin Site
Project Managers: W. Ryan, National Grid, B. Giroux, GEI Consultants	**Site Location:** Brooklyn, New York

Date of Session: February 4, 2013

Scoping Session Purpose: Scope
Investigation Comments

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Jane O'Connell	NYSDEC Project Manager	NYSDEC DER (2)	(718) 482-4599	jhoconne@gw.dec.state.ny.us	Project Manager
William Ryan	Lead Organization Project Manager	National Grid	(516) 545-2586	william.ryan@nationalgrid.com	Project Manager
Barry Giroux	Investigative Project Manager	GEI Consultants	860-368-5412	bgiroux@geiconsultants.com	In-House Consultant
Roy Stoecker	Investigative Senior Principal	GEI Consultants	860-368-5414	rstoecker@geiconsultants.com	Senior Scientist

Other members of the NYSDEC and associated agencies participated in the February 4, 2013 meeting. Full participation is listed on a contact sheet sent out by Roy Stoecker on February 5, 2013 .

Comments/Decisions: The data quality objectives and data needs for the project were developed provided during communications with
Action Items: Complete project planning documents (HASP, Work Plan, QAPP)

QAPP Worksheet #10 – Problem Definition

The problem to be addressed by the project:

During abandonment of a 24-inch diameter gas transmission pipeline there was a release of gas condensate from a temporary standpipe pit that was initially installed as part of the gas line abandonment project. The release flowed from the standpipe along a paved road to a nearby stormwater catch basin and then into Paerdegat Basin. The New York Fire Department reportedly also flushed the gas condensate liquids pooled on the ground surface and caused the liquids to flow into the catch basin.

The standpipe pit is located along the southeast side of Seaview Avenue near the intersection with Paerdegat Ave North. During gas line abandonment services on September 27, 2012, cement grout was pumped into the gas line from the west side of Paerdegat Basin near the Hudson River Yacht Club. The gas line runs beneath Paerdegat Basin. At the standpipe pit location, as a result of the cement grout filling operation, residual gas condensate within the gas line was inadvertently forced through a vent installed at the standpipe.

The environmental questions being asked:

Has the release of gas condensate impacted sediments, surface water, biota or structures in Paerdegat Basin?

Observations from any site reconnaissance reports:

An oil-like sheen was visible on the surface water of Paerdegat Basin following the release of gas condensate. Sheen transport was observed on surface water in most areas in the Basin including the area of fixed and free-standing structures in the water (i.e., boats, docks, piers, and bulkheads). Wind action caused the sheen extent to spread primarily toward the headwaters of the basin from the release point. During immediate response actions undertaken following the release, boat hulls were cleaned and wipe tested for PCBs. However, other structures contacting surface water in the Basin such as recreational boat docks, piers, and bulkheads have not been tested for potential impact from the release and it is not known whether or not sediment, surface water and biota have been impacted. Sampling of sediment, surface water, biota, and structures and analysis for PCBs will be undertaken to assess potential impact from the release of the gas condensate fluid.

A synopsis of secondary data or information from site reports:

Upon being notified of the release, National Grid notified the National Response Center (NRC) and the NYSDEC. Emergency response activities were conducted under the direct supervision of the United States Coast Guard (USCG), NYSDEC and NYCDEP. Extensive

emergency spill response efforts have been completed to recover the material released and work is ongoing to address residual impacts in upland areas.

The possible classes of contaminants and the affected matrices:

Based upon analytical results of the condensate oil collected from the standpipe, the condensate includes PCBs, volatile organic compounds and semi-volatile organic compounds.

The rationale for inclusion of chemical and nonchemical analyses:

The highest concentration contaminant is PCB Aroclor 1242. Given that this compound is present at the highest concentration, partitions strongly to sediments, is persistent in the environment and can bioaccumulate in biota, PCBs are the contaminants of concern for this Work Plan. Samples will be analyzed for PCB Aroclors. The PCB Aroclor analysis will be done on an expedited turn-around-time basis. If Aroclor 1242 is detected in a sample PCB congener analysis will be performed on that sample.

Project decision conditions:

QAPP Worksheet #11 -- Project Quality Objectives/Systematic Planning Process

Statements

Who will use the data?

National Grid, NYSDEC, and GEI will use this data.

What will the data be used for?

The data will be used to determine the presence of PCB Aroclor 1242 in the environment.

What type of data are needed (matrix, target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)?

Surface sediment at 42 sampling stations, surface water from five stations, 20 biological tissue (mussels) samples from five sampling stations, and 47 porous surface samples on docks and piers in Paerdegat Basin. Evaluate each sample for the presence of Aroclor 1242 at an offsite laboratory (Test America Burlington). Sampling techniques are documents in the GEI Field SOPs and Work Plan.

How "good" do the data need to be in order to support the environmental decision?

The data quality objectives (DQOs) for this project have been established in accordance with *Guidance for the Data Quality Objectives Process* (USEPA, 2000), NYSDEC Analytical Services Protocol (ASP), and NYSDEC DER-10, and will provide technically defensible data established for the project as indicators of environmental quality. The DQOs were developed to obtain the necessary data to sufficiently assess risks to human health and the environment. The type, number, and location of samples as well as the sample analysis methods have been prescribed per the Sampling Analysis Plan (2010); therefore, the Quantitation Limits (QLs) achievable by the prescribed analysis will meet the DQOs for this project.

Worksheet 15, Reference and Evaluation Table, summarizes the analytical parameters and the associated Project Action Levels (PALs) and QLs.

How much data are needed (number of samples for each analytical group, matrix, and concentration)?

Surface sediment will be collected at 40 sampling stations, surface water at five sampling stations, 20 biological tissue (mussels) samples at five sampling stations, and 47 porous surface samples on docks and piers in Paerdegat Basin are proposed.

Where, when, and how should the data be collected/generated?

Data will be collected as soon as possible (target of mid-to-late February 2013), using standard sampling approaches documented in the Work Plan.

Who will collect and generate the data?

GEI will collect environmental monitoring data and samples and tabulate and report field measurements. Test America will analyze samples for chemical analytical parameters and issue reports of analyses. GEI will conduct data validation and usability assessment.

How will the data be reported?

Test America, will submit reports of analyses to GEI, according to the requirements in Worksheet 29, including electronic data deliverables (EDD).

How will the data be archived?

GEI will maintain electronic and hard copies of the data. The data will be submitted to National Grid and NYSDEC. The availability of the data and the length of time the data is available will be at the discretion of the NYSDEC.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) - Measurement Performance Criteria Table

Matrix	Sediment
Analytical Group	TOC –Lloyd Kahn
Concentration Level	unknown

Sampling Procedure[2]	**Analytical Method/SOP**[3]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and / or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
PB-04	BR-WC-008	Sensitivity Accuracy/Bias Precision (lab) Accuracy/Bias	< RL %R (75-125) 50% RPD %R (75-125)	Method Blank (MB) Lab Control Sample (LCS) Sample Duplicate (DP) Matrix Spikes (MS)	A A A A

[2]Reference number from QAPP Worksheet #21 (see Section 3.1.2).

[3]Reference number from QAPP Worksheet #23 (see Section 3.2).

QAPP Worksheet #12 - Measurement Performance Criteria Table (cont.)

Matrix	Sediment
Analytical Group	Grain Size/ Bulk Density
Concentration Level	unknown

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PB-04	BR-GT-006 BR-GT-018	NA	NA	NA	NA

[1]If information varies within an analytical group, separate by individual analyte.

[2]Reference number from QAPP Worksheet #21 (see Section 3.1.2).

[3]Reference number from QAPP Worksheet #23 (see Section 3.2).

QAPP Worksheet #12 - Measurement Performance Criteria Table (cont.)

Matrix	Sediment/Solid
Analytical Group	PCB Aroclors
Concentration Level	

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PB-04 PB-09	BR-GC-005	Sensitivity and Accuracy	Less than CRQLs	Equipment Blank	S&A
		Precision	<RPD 50% for duplicate values greater than or equal to 5 times the CRQL	Field Duplicates	S&A
		Accuracy/Bias/ Precision	Per recovery and RPD% requirements of laboratory as listed in SOP	MS/MSD	A
		Accuracy/Bias	Per recovery requirements of laboratory as listed in SOP	LCS	A
		Sensitivity	MDLs	MDLs	A
		Sensitivity	Less than CRQLs	Method Blanks	A
		Completeness	> 90% sample collection, >90% laboratory analysis	Data Completeness Check	S&A

[2]Reference number from QAPP Worksheet #21 (see Section 3.1.2).

[3]Reference number from QAPP Worksheet #23 (see Section 3.2).

QAPP Worksheet #12 - Measurement Performance Criteria Table (cont.)

Matrix	Sediment/Solid
Analytical Group	Volatiles
Concentration Level	Low Level

Sampling Procedure[2]	**Analytical Method/SOP**[3]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
PB-04 PB-09	BR-MV-006	Sensitivity and Accuracy	Less than CRQLs	Equipment Blank and Trip Blank	S&A
		Precision	<RPD 50% for duplicate values greater than or equal to 5 times the CRQL	Field Duplicates	S&A
		Accuracy/Bias/ Precision	Per recovery and RPD% requirements of laboratory	MS/MSD	A
		Accuracy/Bias	Deuterated Monitoring Compound recoveries per requirements	Deuterated Monitoring Compounds	A
		Sensitivity	MDLs	MDLs	A
		Sensitivity	Less than CRQLs	Method Blanks	A
		Completeness	> 90% sample collection, >90% laboratory analysis	Data Completeness Check	S&A

[2]Reference number from QAPP Worksheet #21 (see Section 3.1.2).

[3]Reference number from QAPP Worksheet #23 (see Section 3.2).

QAPP Worksheet #12 - Measurement Performance Criteria Table (cont.)

Matrix	Sediment/Solid
Analytical Group	PCB Congeners by 1668A
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PB-04 PB-09 PB-12	002 - KNOX-ID-0013	Accuracy	50-150% for Toxics/LOCs	LCS	A
		Precision	0-50% RPD for Toxics/LOCs	Field Duplicate	S & A
		Bias/Contamination	No target analyte > EML	Method Blanks	A
		Completeness	90-100% valid data	Data Validation completeness check	S & A

[2]Reference number from QAPP Worksheet #21 (see Section 3.1.2).

[3]Reference number from QAPP Worksheet #23 (see Section 3.2).

QAPP Worksheet #12 - Measurement Performance Criteria Table (cont.)

Matrix	Aqueous
Analytical Group	PCB Aroclors
Concentration Level	

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PB-04	011-SW846 8082 / BR-GC-005	Sensitivity and Accuracy	Less than CRQLs	Equipment Blank	S&A
		Precision	<RPD 30% for duplicate values greater than or equal to 5 times the CRQL	Field Duplicates	S&A
		Accuracy/Bias/ Precision	Per recovery and RPD% requirements of laboratory as listed in SOP	MS/MSD	A
		Accuracy/Bias	Per recovery requirements of laboratory as listed in SOP	LCS	A
		Sensitivity	MDLs	MDLs	A
		Sensitivity	Less than CRQLs	Method Blanks	A
		Completeness	> 90% sample collection, >90% laboratory analysis	Data Completeness Check	S&A

[2]Reference number from QAPP Worksheet #21 (see Section 3.1.2).

[3]Reference number from QAPP Worksheet #23 (see Section 3.2).

QAPP Worksheet #12 - Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group	PCB Aroclors
Concentration Level	

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PB-08 PB-11	011-SW846 8082 / BR-GC-005	Sensitivity and Accuracy	Less than CRQLs	Equipment Blank	S&A
		Precision	<RPD 30% for duplicate values greater than or equal to 5 times the CRQL	Field Duplicates	S&A
		Accuracy/Bias/ Precision	Per recovery and RPD% requirements of laboratory as listed in SOP	MS/MSD	A
		Accuracy/Bias	Per recovery requirements of laboratory as listed in SOP	LCS	A
		Sensitivity	MDLs	MDLs	A
		Sensitivity	Less than CRQLs	Method Blanks	A
		Completeness	> 90% sample collection, >90% laboratory analysis	Data Completeness Check	S&A

[2]Reference number from QAPP Worksheet #21 (see Section 3.1.2).

[3]Reference number from QAPP Worksheet #23 (see Section 3.2).

QAPP Worksheet #12 - Measurement Performance Criteria Table (cont.)

Matrix	Solid
Analytical Group	SVOCs
Concentration Level	

Sampling Procedure[2]	**Analytical Method/SOP**[3]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
PB-04 PB-09	SW-846 8270D/BR-MS-001	Sensitivity and Accuracy	Less than CRQLs	Equipment Blank	S&A
		Precision	<RPD 30% for duplicate values greater than or equal to 5 times the CRQL	Field Duplicates	S&A
		Accuracy/Bias/ Precision	Per recovery and RPD% requirements of laboratory as listed in SOP	MS/MSD	A
		Accuracy/Bias	Per recovery requirements of laboratory as listed in SOP	LCS	A
		Sensitivity	MDLs	MDLs	A
		Sensitivity	Less than CRQLs	Method Blanks	A
		Completeness	> 90% sample collection, >90% laboratory analysis	Data Completeness Check	S&A

[2]Reference number from QAPP Worksheet #21 (see Section 3.1.2).

[3]Reference number from QAPP Worksheet #23 (see Section 3.2).

QAPP Worksheet #12 - Measurement Performance Criteria Table (cont.)

Matrix	Solid
Analytical Group	TPH - 8015
Concentration Level	

Sampling Procedure[2]	**Analytical Method/SOP**[3]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
PB-04 PB-09	SW-846 8015D/BR-GC-004_BR-GC-005	Sensitivity and Accuracy	Less than CRQLs	Equipment Blank	S&A
		Precision	<RPD 30% for duplicate values greater than or equal to 5 times the CRQL	Field Duplicates	S&A
		Accuracy/Bias/ Precision	Per recovery and RPD% requirements of laboratory as listed in SOP	MS/MSD	A
		Accuracy/Bias	Per recovery requirements of laboratory as listed in SOP	LCS	A
		Sensitivity	MDLs	MDLs	A
		Sensitivity	Less than CRQLs	Method Blanks	A
		Completeness	> 90% sample collection, >90% laboratory analysis	Data Completeness Check	S&A

[2]Reference number from QAPP Worksheet #21 (see Section 3.1.2).

[3]Reference number from QAPP Worksheet #23 (see Section 3.2).

QAPP Worksheet #13 – Secondary Data Criteria and Limitations

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation / collection dates)	How Data Will Be Used	Limitations on Data Use

QAPP Worksheet #14 – Summary of Project Tasks

Sampling Tasks:

Collect surface sediment at 42 sampling stations, surface water at five sampling stations, 20 biological tissue (mussels) samples at five sampling stations, and 47 porous surface samples on docks and piers in Paerdegat Basin. Evaluate each sample for soil, sediment, and tissue chemistry, specifically Aroclor 1242. All sample custody will be tracked through the use of Chains of Custody (Attachment D).

Work Plan Addendum 1 includes porous surface samples and wipe samples of tide gates, concrete bulkhead structures and sanitary manholes in and around Paerdegat Basin.

Determine if PCB Aroclor 1242 is present in soil, sediment, or biological tissue samples.

Analysis Tasks:

Analyze surficial soil and sediment samples from 42 sampling station plus field determined sampling locations for chemistry and characteristics:

- PCBs according to USEPA Method 8082A
- Target compound list volatile organic carbons (VOCs) at seven sample locations
- Total organic carbon (TOC) according to USEPA Method Lloyd Kahn
- Grain Size according to ASTM D422
- Samples will be archived with potential future analysis of PCB congeners according to USEPA Method 1668A
- Percent Moisture

Analyze surface water at five sampling stations for chemistry:

- PCBs according to USEPA Method 8082A
- Samples will be archived with potential future analysis of PCB congeners according to USEPA Method 1668A

Analyze 20 biological tissue (mussels) samples from five sampling stations for chemistry:

- PCBs according to USEPA Method 8082A
- Samples will be archived with potential future analysis of PCB congeners according to USEPA Method 1668A
- Percent moisture
- Percent lipids

Analyze semi-porous materials from 47 sampling stations with structures adjacent to the area of release for chemistry:

- PCBs according to USEPA Method 8082A
- Samples will be archived with potential future analysis of PCB congeners according to USEPA Method 1668A

Soils and semi-porous materials will be reported on a dry-weight basis, while surface water and mussel tissue will be reported on a wet-weight basis.

In addition, Work Plan Addendum 1 includes the following analysis:

Analyze semi-porous materials collected from tide gates, concrete bulkhead structures, and wipe tests from sanitary manholes associated with the NYCDEP CSO Facility for:

- PCBs according to USEPA Method 8082A
- Samples will be archived with potential future analysis of PCB congeners according to USEPA Method 1668A

A subset of two samples collected from tide gates and a reference tide gate sample will be analyzed for:

- VOCs according to USEPA Method 8260
- SVOC according to USEPA Method 8270
- Total Petroleum Hydrocarbons according to USEPA Method 8015

Quality Control Tasks:

The analytical and testing laboratories will be required to analyze QC samples. USEPA methods and the other documents and procedures are given in Worksheet 28. Quality control samples are shown by matrix and analytical group in Worksheet 20.

Secondary Data:

Information from previous investigations in the vicinity of Paerdegat Basin and Jamacia Bay.

Other Data:

Data Management Tasks:

All analytical data will be stored in a database on a server which will be maintained in the GEI office in Glastonbury, CT. All electronic data will be backed up. Hardcopies of data will also be stored in project files. See Worksheet 29 for discussion of data management.

Documentation and Records:

All hardcopy data (field notebooks, photos, hardcopies of Chain of Custody forms) will be stored at the GEI office in Glastonbury, CT and stored in the project files.

Assessment / Audit Tasks

The Work Plan and SOPs will be reviewed prior to the performance of tasks.

Data Review Tasks:

GEI will conduct verification of sampling and laboratory data. Chemical data that is generated will be validated by GEI data validators (see Worksheets 23, 28, 35, and 36).

QAPP Worksheet #15 -- Reference Limits and Evaluation Tables

Complete this worksheet for each matrix, analytical group, and concentration level. Identify the target analytes/contaminants of concern and project-required action limits. Next, determine the quantitation limits (QLs) that must be met to achieve the project quality objectives. Finally, list the published and achievable detection and quantitation limits for each analyte.

Matrix: Sediment
Analytical Group: PCBs - USEPA 8082A
Concentration Level: Low to moderate

Analyte	CAS Number	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit Goal[2] (mg/Kg)	Laboratory-specific	
					QLs (mg/Kg)	DLs (mg/Kg)
PCB-1016	12674-11-2	0.007	NE	0.017	0.017	0.0056
PCB-1221	11104-28-2	NE	NE	0.017	0.017	0.0043
PCB-1232	11141-16-5	NE	NE	0.017	0.017	0.0033
PCB-1242	53469-21-9	NE	NE	0.017	0.017	0.0067
PCB-1248	12672-29-6	0.03	NE	0.017	0.017	0.002
PCB-1254	11097-69-1	NE	NE	0.017	0.017	0.0028
PCB-1260	11096-82-5	0.005	NE	0.017	0.017	0.0024
PCB-1262	37324-23-5	NE	NE	0.017	0.017	0.0015
PCB-1268	11100-14-4	NE	NE	0.017	0.017	0.0014

Notes:
NE = Not established
NYDEC – New York Department of Environmental Conservation Sediment Screening Guidance
ER-L - Effects Range Low
ER-M - Effects Range Medium
ER-L and ER-M from "Sediments Classification Methods Compendium." Long and MacDonald 1992.

QAPP Worksheet #15 -- Reference Limits and Evaluation Tables (Continued)

Matrix: Tissue
Analytical Group: PCBs - USEPA 8082A
Concentration Level: Low to moderate

Analyte	CAS Number			Project Quantitation Limit Goal[2] (ug/Kg)	Laboratory-specific	
					QLs (ug/Kg)	DLs (ug/Kg)
PCB-1016	12674-11-2			34	34	4.6
PCB-1221	11104-28-2			34	34	2.4
PCB-1232	11141-16-5			34	34	4.2
PCB-1242	53469-21-9			34	34	2.8
PCB-1248	12672-29-6			34	34	1.4
PCB-1254	11097-69-1			34	34	6.6
PCB-1260	11096-82-5			34	34	4.4
PCB-1262	37324-23-5			34	34	2.4
PCB-1268	11100-14-4			34	34	0.96

QAPP Worksheet #15 -- Reference Limits and Evaluation Tables (Continued)

Matrix: Aqueous
Analytical Group: PCBs - USEPA 8082A
Concentration Level: Low to moderate

Analyte	CAS Number	6 NYCRRs Part 703 SW(AA) (ug/L)	6 NYCRRs Part 703 SW(AC) (ug/L)	6 NYCRRs Part 703 SW(FC) (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific	
						QLs (ug/L)	DLs (ug/L)
PCB-1016	12674-11-2	NE	NE	NE	0.5	0.5	0.031
PCB-1221	11104-28-2	NE	NE	NE	0.5	0.5	0.041
PCB-1232	11141-16-5	NE	NE	NE	0.5	0.5	0.065
PCB-1242	53469-21-9	NE	NE	NE	0.5	0.5	0.037
PCB-1248	12672-29-6	NE	NE	NE	0.5	0.5	0.034
PCB-1254	11097-69-1	NE	NE	NE	0.5	0.5	0.044
PCB-1260	11096-82-5	NE	NE	NE	0.5	0.5	0.03
PCB-1262	37324-23-5	NE	NE	NE	0.5	0.5	0.044
PCB-1268	11100-14-4	NE	NE	NE	0.5	0.5	0.02

QAPP Worksheet #15 -- Reference Limits and Evaluation Tables (Continued)

Matrix: Sediment
Analytical Group: Volatiles - USEPA 8260B
Concentration Level: Low to moderate

Analyte	CAS Number	NYSDEC ER-L (mg/kg)	NYSDEC ER-M (mg/kg)	Project Quantitation Limit Goal2 (ug/Kg)	MDLs (ug/Kg)	Laboratory-specific QLs (ug/Kg)
1,1,1,2-Tetrachloroethane	630-20-6	NE	NE	5	0.13	5
1,1,1-Trichloroethane	71-55-6	NE	NE	5	0.7	5
1,1,2,2-Tetrachloroethane	79-34-5	NE	NE	5	0.26	5
Freon TF	76-13-1	NE	NE	5	0.33	5
1,1,2-Trichloroethane	79-00-5	NE	NE	5	0.34	5
1,1-Dichloroethane	75-34-3	NE	NE	5	0.41	5
1,1-Dichloroethene	75-35-4	NE	NE	5	0.37	5
1,1-Dichloropropene	563-58-6	NE	NE	5	0.93	5
1,2,3-Trichlorobenzene	87-61-6	NE	NE	5	0.15	5
1,2,3-Trichloropropane	96-18-4	NE	NE	5	0.3	5
1,2,4-Trichlorobenzene	120-82-1	NE	0.0048	5	0.2	5
1,2,4-Trimethylbenzene	95-63-6	NE	NE	5	0.18	5
1,2-Dibromo-3-Chloropropane	96-12-8	NE	NE	5	0.91	5
1,2-Dibromoethane	106-93-4	NE	NE	5	0.15	5
1,2-Dichlorobenzene	95-50-1	NE	0.013	5	0.22	5
1,2-Dichloroethane	107-06-2	NE	NE	5	0.62	5
1,2-Dichloropropane	78-87-5	NE	NE	5	0.29	5
1,3,5-Trimethylbenzene	108-67-8	NE	NE	5	0.18	5
1,3-Dichlorobenzene	541-73-1	NE	NE	5	0.15	5
1,3-Dichloropropane	142-28-9	NE	NE	5	0.19	5
1,4-Dioxane	123-91-1	NE	NE	250	23	250
1,4-Dichlorobenzene	106-46-7	NE	0.11	5	0.23	5
2,2-Dichloropropane	594-20-7	NE	NE	5	0.43	5
2-Butanone	78-93-3	NE	NE	5	1.5	5

Analyte	CAS Number	NYSDEC ER-L (mg/kg)	NYSDEC ER-M (mg/kg)	Project Quantitation Limit Goal2 (ug/Kg)	MDLs (ug/Kg)	Laboratory-specific QLs (ug/Kg)
2-Chloroethyl vinyl ether	110-75-8	NE	NE	5	0.53	5
2-Chlorotoluene	95-49-8	NE	NE	5	0.14	5
2-Hexanone	591-78-6	NE	NE	5	0.49	5
4-Chlorotoluene	106-43-4	NE	NE	5	0.35	5
4-Isopropyltoluene	99-87-6	NE	NE	5	0.12	5
4-Methyl-2-pentanone	108-10-1	NE	NE	5	0.6	5
Acetone	67-64-1	NE	NE	5	1	5
Benzene	71-43-2	0.34	NE	5	0.71	5
Bromobenzene	108-86-1	NE	NE	5	0.087	5
Bromoform	75-25-2	NE	NE	5	0.2	5
Bromomethane	74-83-9	NE	NE	5	0.74	5
Carbon tetrachloride	56-23-5	NE	NE	5	0.76	5
Chlorobenzene	108-90-7	NE	NE	5	0.076	5
Dibromochloromethane	124-48-1	NE	NE	5	0.11	5
Chloroethane	75-00-3	NE	NE	5	0.38	5
Chloromethane	74-87-3	NE	NE	5	0.26	5
Chloroform	67-66-3	NE	NE	5	0.32	5
cis-1,2-Dichloroethene	156-59-2	NE	NE	5	0.42	5
cis-1,3-Dichloropropene	10061-01-5	NE	NE	5	0.35	5
Cyclohexane	110-82-7	NE	NE	5	0.85	5
Dibromomethane	74-95-3	NE	NE	5	0.27	5
Bromochloromethane	74-97-5	NE	NE	5	0.37	5
Bromodichloromethane	75-27-4	NE	NE	5	0.21	5
Dichlorodifluoromethane	75-71-8	NE	NE	5	0.23	5
Methylene Chloride	75-09-2	NE	NE	5	0.55	5
Ethylbenzene	100-41-4	1.4	NE	5	0.056	5
Hexachlorobutadiene	87-68-3	NE	NE	5	0.17	5
Methyl iodide	74-88-4	NE	NE	5	0.31	5
Isobutyl alcohol	78-83-1	NE	NE	250	49	250
Isopropylbenzene	98-82-8	NE	NE	5	0.077	5
Methyl acetate	79-20-9	NE	NE	5	0.63	5

Analyte	CAS Number	NYSDEC ER-L (mg/kg)	NYSDEC ER-M (mg/kg)	Project Quantitation Limit Goal2 (ug/Kg)	MDLs (ug/Kg)	Laboratory-specific QLs (ug/Kg)
Methyl t-butyl ether	1634-04-4	NE	NE	5	0.3	5
m&p-Xylene	179601-23-1	NE	NE	5	0.7	5
Naphthalene	91-20-3	NE	NE	5	0.26	5
n-Butylbenzene	104-51-8	NE	NE	5	0.19	5
n-Propylbenzene	103-65-1	NE	NE	5	0.11	5
o-Xylene	95-47-6	NE	NE	5	0.061	5
sec-Butylbenzene	135-98-8	NE	NE	5	0.089	5
Styrene	100-42-5	NE	NE	5	0.1	5
tert-Butylbenzene	98-06-6	NE	NE	5	0.1	5
Tetrachloroethene	127-18-4	0.45	NE	5	0.11	5
Tetrahydrofuran	109-99-9	2.5	NE	50	6.1	50
Toluene	108-88-3	NE	NE	5	0.1	5
trans-1,2-Dichloroethene	156-60-5	NE	NE	5	0.37	5
trans-1,3-Dichloropropene	10061-02-6	NE	NE	5	0.13	5
Trichloroethene	79-01-6	1.6	NE	5	0.48	5
Trichlorofluoromethane	75-69-4	NE	NE	5	0.33	5
Vinyl acetate	108-05-4	NE	NE	5	0.7	5
Vinyl chloride	75-01-4	NE	NE	5	0.3	5
Xylenes, Total	1330-20-7	0.12	NE	5	0.73	5
Carbon disulfide	75-15-0	NE	NE	5	0.31	5
Methylcyclohexane	108-87-2	NE	NE	5	0.17	5

Notes:
NE = Not established
NYDEC - New York Department of Environmental Protection; Sediment Screening Guidance
ER-L - Effects Range Low
ER-M - Effects Range Medium
ER-L and ER-M from "Sediments Classification Methods Compendium." Long and MacDonald 1992.

QAPP Worksheet #15 -- Reference Limits and Evaluation Tables (Continued)

Matrix: Sediment
Analytical Group: PCB Congeners - USEPA 1668A
Concentration Level: Low

Sediment / PCB Congeners Analyte	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
2-Chlorobiphenyl	2051-60-7	NE	NE	0.00001	0.000008	0.00001
3-Chlorobiphenyl	2051-61-8	NE	NE	0.00001	4E-07	0.00001
4-Chlorobiphenyl	2051-62-9	NE	NE	0.00001	0.000009	0.00001
2,2'-Dichlorobiphenyl	13029-08-8	NE	NE	0.00002	0.000017	0.00002
2,3-Dichlorobiphenyl	16605-91-7	NE	NE	0.00001	0.000001	0.00001
2,3'-Dichlorobiphenyl	25569-80-6	NE	NE	0.00001	0.000001	0.00001
2,4-Dichlorobiphenyl	33284-50-3	NE	NE	0.00001	0.000002	0.00001
2,4'-Dichlorbiphenyl	34883-43-7	NE	NE	0.00002	0.000012	0.00002
2,5-Dichlorobiphenyl	34883-39-1	NE	NE	0.00001	0.000002	0.00001
2,6-Dichlorobiphenyl	33146-45-1	NE	NE	0.00001	0.000002	0.00001
3,3'-Dichlorobiphenyl	2050-67-1	NE	NE	0.00002	0.00001	0.00002
3,4-Dichlorobiphenyl	2974-92-7	NE	NE	0.00001	0.000003	0.00001
3,4'-Dichlorobiphenyl	2974-90-5	NE	NE	0.00001	0.000003	0.00001
3,5-Dichlorobiphenyl	34883-41-5	NE	NE	0.00001	0.000003	0.00001
4,4'-Dichlorobiphenyl	2050-68-2	NE	NE	0.00001	0.000018	0.00001
2,2',3-Trichlorobiphenyl	38444-78-9	NE	NE	0.00001	0.000004	0.00001
2,2',4-Trichlorobiphenyl	37680-66-3	NE	NE	0.00001	0.000009	0.00001
2,2',5-Trichlorobiphenyl	37680-65-2	NE	NE	0.00002	0.000017	0.00002
2,2',6-Trichlorobiphenyl	38444-73-4	NE	NE	0.00001	0.000004	0.00001
2,3,3'-Trichlorobiphenyl	38444-84-7	NE	NE	0.00002	0.000019	0.00002
2,3,4-Trichlorobiphenyl	55702-46-0	NE	NE	0.00001	0.000005	0.00001

Sediment / PCB Congeners Analyte	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
2,3,4'-Trichlorobiphenyl	38444-85-8	NE	NE	0.00001	0.000009	0.00001
2,3,5-Trichlorobiphenyl	55720-44-0	NE	NE	0.00001	0.000005	0.00001
2,3,6-Trichlorobiphenyl	55702-45-9	NE	NE	0.00001	0.000005	0.00001
2,3',4-Trichlorobiphenyl	55712-37-3	NE	NE	0.00001	0.000005	0.00001
2,3',5-Trichlorobiphenyl	38444-81-4	NE	NE	0.00001	0.000008	0.00001
2,3',6-Trichlorobiphenyl	38444-76-7	NE	NE	0.00001	0.000006	0.00001
2,4,4'-Trichlorobiphenyl	7012-37-5	NE	NE	0.00002	0.000019	0.00002
2,4,5-Trichlorobiphenyl	15862-07-4	NE	NE	0.00001	0.000008	0.00001
2,4,6-Trichlorobiphenyl	35693-92-6	NE	NE	0.00002	0.000017	0.00002
2,4',5-Trichlorobiphenyl	16606-02-3	NE	NE	0.00002	0.000015	0.00002
2,4',6-Trichlorobiphenyl	38444-77-8	NE	NE	0.00001	0.000008	0.00001
2',3,4-Trichlorobiphenyl	38444-86-9	NE	NE	0.00001	0.000005	0.00001
2',3,5-Trichlorobiphenyl	37680-68-5	NE	NE	0.00001	0.000007	0.00001
3,3',4-Trichlorobiphenyl	37680-69-6	NE	NE	0.00001	0.000008	0.00001
3,3',5-Trichlorobiphenyl	38444-87-0	NE	NE	0.00001	0.000008	0.00001
3,4,4'-Trichlorobiphenyl	38444-90-5	NE	NE	0.00001	0.000013	0.00001
3,4,5-Trichlorobiphenyl	53555-66-1	NE	NE	0.00001	0.000008	0.00001
3,4',5-Trichlorobiphenyl	38444-88-1	NE	NE	0.00001	0.000009	0.00001
2,2',3,3'-Tetrachlorobiphenyl	38444-93-8	NE	NE	0.00001	0.000012	0.00001
2,2',3,4-Tetrachlorobiphenyl	52663-59-9	NE	NE	0.00001	0.000012	0.00001
2,2',3,4'-Tetrachlorobiphenyl	36559-22-5	NE	NE	0.00001	0.000006	0.00001
2,2',3,5-Tetrachlorobiphenyl	70362-46-8	NE	NE	0.00001	0.000009	0.00001
2,2',3,5'-Tetrachlorobiphenyl	41464-39-5	NE	NE	0.00001	0.000019	0.00001
2,2',3,6-Tetrachlorobiphenyl	70362-45-7	NE	NE	0.00001	0.000005	0.00001
2,2',3,6'-Tetrachlorobiphenyl	41464-47-5	NE	NE	0.00001	0.00001	0.00001
2,2',4,4'-Tetrachlorobiphenyl	2437-79-8	NE	NE	0.00001	0.000019	0.00001

Sediment / PCB Congeners Analyte	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
2,2',4,5-Tetrachlorobiphenyl	70362-47-9	NE	NE	0.00001	0.000008	0.00001
2,2',4,5'-Tetrachlorobiphenyl	41464-40-8	NE	NE	0.00001	0.000011	0.00001
2,2',4,6-Tetrachlorobiphenyl	62796-65-0	NE	NE	0.00001	0.000006	0.00001
2,2',4,6'-Tetrachlorobiphenyl	68194-04-7	NE	NE	0.00001	0.000005	0.00001
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	NE	NE	0.00001	0.000019	0.00001
2,2',5,6'-Tetrachlorobiphenyl	41464-41-9	NE	NE	0.00001	0.000006	0.00001
2,2',6,6'-Tetrachlorobiphenyl	15968-05-5	NE	NE	0.00001	0.000012	0.00001
2,3,3',4-Tetrachlorobiphenyl	74338-24-2	NE	NE	0.00001	0.000012	0.00001
2,3,3',4'-Tetrachlorobiphenyl	41464-43-1	NE	NE	0.00001	0.00001	0.00001
2,3,3',5-Tetrachlorobiphenyl	70424-67-8	NE	NE	0.00001	0.000012	0.00001
2,3,3',5'-Tetrachlorobiphenyl	41464-49-7	NE	NE	0.00001	0.000013	0.00001
2,3,3',6-Tetrachlorobiphenyl	74472-33-6	NE	NE	0.00001	0.000006	0.00001
2,3,4,4'-Tetrachlorobiphenyl	33025-41-1	NE	NE	0.00001	0.000013	0.00001
2,3,4,5-Tetrachlorobiphenyl	33284-53-6	NE	NE	0.00002	0.000017	0.00002
2,3,4,6-Tetrachlorobiphenyl	54230-22-7	NE	NE	0.00001	0.000006	0.00001
2,3,4',5-Tetrachlorobiphenyl	74472-34-7	NE	NE	0.00001	0.000014	0.00001
2,3,4',6-Tetrachlorobiphenyl	52663-58-8	NE	NE	0.00001	0.000007	0.00001
2,3,5,6-Tetrachlorobiphenyl	33284-54-7	NE	NE	0.00001	0.000019	0.00001
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	NE	NE	0.00001	0.000016	0.00001
2,3',4,5-Tetrachlorobiphenyl	73575-53-8	NE	NE	0.00001	0.000015	0.00001
2,3',4,5'-Tetrachlorobiphenyl	73575-52-7	NE	NE	0.00001	0.000015	0.00001
2,3',4,6-Tetrachlorobiphenyl	60233-24-1	NE	NE	0.00001	0.000011	0.00001
2,3',4',5-Tetrachlorobiphenyl	32598-11-1	NE	NE	0.00002	0.000017	0.00002
2,3',4',6-Tetrachlorobiphenyl	41464-46-4	NE	NE	0.00001	0.000012	0.00001
2,3',5,5'-Tetrachlorobiphenyl	41464-42-0	NE	NE	0.00001	0.000016	0.00001
2,3',5',6-Tetrachlorobiphenyl	74338-23-1	NE	NE	0.00001	0.000016	0.00001

Sediment / PCB Congeners Analyte	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
2,4,4',5-Tetrachlorobiphenyl	32690-93-0	NE	NE	0.00002	0.000017	0.00002
2,4,4',6-Tetrachlorobiphenyl	32598-12-2	NE	NE	0.00001	0.000006	0.00001
2',3,4,5-Tetrachlorobiphenyl	70362-48-0	NE	NE	0.00001	0.000017	0.00001
3,3',4,4'-Tetrachlorobiphenyl	32598-13-3	NE	NE	0.00001	0.000017	0.00001
3,3',4,5-Tetrachlorobiphenyl	70362-49-1	NE	NE	0.00001	0.000017	0.00001
3,3',4,5'-Tetrachlorobiphenyl	41464-48-6	NE	NE	0.00001	0.000017	0.00001
3,3',5,5'-Tetrachlorobiphenyl	33284-52-5	NE	NE	0.00001	0.000018	0.00001
3,4,4',5-Tetrachlorobiphenyl	70362-50-4	NE	NE	0.00001	0.000018	0.00001
2,2',3,3',4-Pentachlorobiphenyl	52663-62-4	NE	NE	0.00001	0.000013	0.00001
2,2',3,3',5-Pentachlorobiphenyl	60145-20-2	NE	NE	0.00001	0.000022	0.00001
2,2',3,3',6-Pentachlorobiphenyl	52663-60-2	NE	NE	0.00001	0.000012	0.00001
2,2',3,4,4'-Pentachlorobiphenyl	65510-45-4	NE	NE	0.00001	0.00001	0.00001
2,2',3,4,5-Pentachlorobiphenyl	55312-69-1	NE	NE	0.00001	0.000015	0.00001
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	NE	NE	0.00001	0.000015	0.00001
2,2',3,4,6-Pentachlorobiphenyl	55215-17-3	NE	NE	0.00001	0.000012	0.00001
2,2',3,4,6'-Pentachlorobiphenyl	73575-57-2	NE	NE	0.00001	0.000019	0.00001
2,2',3,4',5-Pentachlorobiphenyl	68194-07-0	NE	NE	0.00001	0.000024	0.00001
2,2',3,4',6-Pentachlorobiphenyl	68194-05-8	NE	NE	0.00001	0.000012	0.00001
2,2',3,5,5'-Pentachlorobiphenyl	52663-61-3	NE	NE	0.00001	0.000012	0.00001
2,2',3,5,6-Pentachlorobiphenyl	73575-56-1	NE	NE	0.00001	0.000022	0.00001
2,2',3,5,6'-Pentachlorobiphenyl	73575-55-0	NE	NE	0.00001	0.000012	0.00001
2,2',3,5',6-Pentachlorobiphenyl	38379-99-6	NE	NE	0.00001	0.000022	0.00001
2,2',3,6,6'-Pentachlorobiphenyl	73575-54-9	NE	NE	0.00001	0.000021	0.00001
2,2',3',4,5-Pentachlorobiphenyl	41464-51-1	NE	NE	0.00001	0.000015	0.00001
2,2',3',4,6-Pentachlorobiphenyl	60233-25-2	NE	NE	0.00001	0.000022	0.00001
2,2',4,4',5-Pentachlorobiphenyl	38380-01-7	NE	NE	0.00001	0.000022	0.00001

Sediment / PCB Congeners Analyte	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
2,2',4,4',6-Pentachlorobiphenyl	39485-83-1	NE	NE	0.00001	0.000022	0.00001
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	NE	NE	0.00001	0.000024	0.00001
2,2',4,5,6'-Pentachlorobiphenyl	68194-06-9	NE	NE	0.00001	0.000022	0.00001
2,2',4,5',6-Pentachlorobiphenyl	60145-21-3	NE	NE	0.00001	0.000023	0.00001
2,2',4,6,6'-Pentachlorobiphenyl	56558-16-8	NE	NE	0.00001	0.000023	0.00001
2,3,3',4,4'-Pentachlorobiphenyl	32598-14-4	NE	NE	0.00001	0.000011	0.00001
2,3,3',4,5-Pentachlorobiphenyl	70424-69-0	NE	NE	0.00001	0.000014	0.00001
2,3,3',4',5-Pentachlorobiphenyl	70424-68-9	NE	NE	0.00001	0.000027	0.00001
2,3,3',4,5'-Pentachlorobiphenyl	70362-41-3	NE	NE	0.00001	0.000015	0.00001
2,3,3',4,6-Pentachlorobiphenyl	74472-35-8	NE	NE	0.00001	0.00001	0.00001
2,3,3',4',6-Pentachlorobiphenyl	38380-03-9	NE	NE	0.00001	0.000024	0.00001
2,3,3',5,5'-Pentachlorobiphenyl	39635-32-0	NE	NE	0.00001	0.000024	0.00001
2,3,3',5,6-Pentachlorobiphenyl	74472-36-9	NE	NE	0.00001	0.000025	0.00001
2,3,3',5',6-Pentachlorobiphenyl	68194-10-5	NE	NE	0.00001	0.000024	0.00001
2,3,4,4',5-Pentachlorobiphenyl	74472-37-0	NE	NE	0.00001	0.000012	0.00001
2,3,4,4',6-Pentachlorobiphenyl	74472-38-1	NE	NE	0.00001	0.000024	0.00001
2,3,4,5,6-Pentachlorobiphenyl	18259-05-7	NE	NE	0.00001	0.00001	0.00001
2,3,4',5,6-Pentachlorobiphenyl	68194-11-6	NE	NE	0.00001	0.00001	0.00001
2,3',4,4',5-Pentachlorobiphenyl	31508-00-6	NE	NE	0.00001	0.000019	0.00001
2,3',4,4',6-Pentachlorobiphenyl	56558-17-9	NE	NE	0.00001	0.000015	0.00001
2,3',4,5,5'-Pentachlorobiphenyl	68194-12-7	NE	NE	0.00001	0.000015	0.00001
2,3',4,5',6-Pentachlorobiphenyl	56558-18-0	NE	NE	0.00001	0.000021	0.00001
2',3,3',4,5-Pentachlorobiphenyl	76842-07-4	NE	NE	0.00001	0.000012	0.00001
2',3,4,4',5-Pentachlorobiphenyl	65510-44-3	NE	NE	0.00001	0.000015	0.00001
2',3,4,5,5'-Pentachlorobiphenyl	70424-70-3	NE	NE	0.00001	0.000027	0.00001
2',3,4,5,6'-Pentachlorobiphenyl	74472-39-2	NE	NE	0.00001	0.000015	0.00001

Sediment / PCB Congeners Analyte	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
3,3',4,4',5-Pentachlorobiphenyl	57465-28-8	NE	NE	0.00001	0.000014	0.00001
3,3',4,5,5'-Pentachlorobiphenyl	39635-33-1	NE	NE	0.00001	0.000028	0.00001
2,2',3,3',4,4'-Hexachlorobiphenyl	38380-07-3	NE	NE	0.00001	0.000012	0.00001
2,2',3,3',4,5-Hexachlorobiphenyl	55215-18-4	NE	NE	0.00001	0.000021	0.00001
2,2',3,3',4,5'-Hexachlorobiphenyl	52663-66-8	NE	NE	0.00001	0.000014	0.00001
2,2',3,3',4,6-Hexachlorobiphenyl	61798-70-7	NE	NE	0.00001	0.000012	0.00001
2,2',3,3',4,6'-Hexachlorobiphenyl	38380-05-1	NE	NE	0.00001	0.000012	0.00001
2,2',3,3',5,5'-Hexachlorobiphenyl	35694-04-3	NE	NE	0.00001	0.000017	0.00001
2,2',3,3',5,6-Hexachlorobiphenyl	52704-70-8	NE	NE	0.00001	0.000013	0.00001
2,2',3,3',5,6'-Hexachlorobiphenyl	52744-13-5	NE	NE	0.00001	0.000011	0.00001
2,2',3,3',6,6'-Hexachlorobiphenyl	38411-22-2	NE	NE	0.00001	0.000009	0.00001
2,2',3,4,4',5-Hexachlorobiphenyl	35694-06-5	NE	NE	0.00001	0.00003	0.00001
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	NE	NE	0.00001	0.000021	0.00001
2,2',3,4,4',6-Hexachlorobiphenyl	56030-56-9	NE	NE	0.00001	0.00002	0.00001
2,2',3,4,4',6'-Hexachlorobiphenyl	59291-64-4	NE	NE	0.00001	0.00002	0.00001
2,2',3,4,5,5'-Hexachlorobiphenyl	52712-04-6	NE	NE	0.00001	0.000009	0.00001
2,2',3,4,5,6-Hexachlorobiphenyl	41411-61-4	NE	NE	0.00001	0.000031	0.00001
2,2',3,4,5,6'-Hexachlorobiphenyl	68194-15-0	NE	NE	0.00001	0.000013	0.00001
2,2',3,4,5',6-Hexachlorobiphenyl	68194-14-9	NE	NE	0.00001	0.000017	0.00001
2,2',3,4,6,6'-Hexachlorobiphenyl	74472-40-5	NE	NE	0.00001	0.000032	0.00001
2,2',3,4',5,5'-Hexachlorobiphenyl	51908-16-8	NE	NE	0.00001	0.000018	0.00001
2,2',3,4',5,6-Hexachlorobiphenyl	68194-13-8	NE	NE	0.00001	0.000018	0.00001
2,2',3,4',5,6'-Hexachlorobiphenyl	74472-41-6	NE	NE	0.00001	0.000032	0.00001
2,2',3,4',5',6-Hexachlorobiphenyl	38380-04-0	NE	NE	0.00001	0.000018	0.00001
2,2',3,4',6,6'-Hexachlorobiphenyl	68194-08-1	NE	NE	0.00001	0.000033	0.00001
2,2',3,5,5',6-Hexachlorobiphenyl	52663-63-5	NE	NE	0.00001	0.000011	0.00001

Sediment / PCB Congeners Analyte	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
2,2',3,5,6,6'-Hexachlorobiphenyl	68194-09-2	NE	NE	0.00001	0.000024	0.00001
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	NE	NE	0.00001	0.000013	0.00001
2,2',4,4',5,6'-Hexachlorobiphenyl	60145-22-4	NE	NE	0.00001	0.000011	0.00001
2,2',4,4',6,6'-Hexachlorobiphenyl	33979-03-2	NE	NE	0.00001	0.000034	0.00001
2,3,3',4,4',5-Hexachlorobiphenyl	38380-08-4	NE	NE	0.00001	0.000013	0.00001
2,3,3',4,4',5'-Hexachlorobiphenyl	69782-90-7	NE	NE	0.00001	0.000013	0.00001
2,3,3',4,4',6-Hexachlorobiphenyl	74472-42-7	NE	NE	0.00001	0.00001	0.00001
2,3,3',4,5,5'-Hexachlorobiphenyl	39635-35-3	NE	NE	0.00001	0.000035	0.00001
2,3,3',4,5,6-Hexachlorobiphenyl	41411-62-5	NE	NE	0.00001	0.000021	0.00001
2,3,3',4,5',6-Hexachlorobiphenyl	74472-43-8	NE	NE	0.00001	0.000035	0.00001
2,3,3',4',5,5'-Hexachlorobiphenyl	39635-34-2	NE	NE	0.00001	0.000035	0.00001
2,3,3',4',5,6-Hexachlorobiphenyl	74472-44-9	NE	NE	0.00001	0.000021	0.00001
2,3,3',4',5',6-Hexachlorobiphenyl	74472-45-0	NE	NE	0.00001	0.000014	0.00001
2,3,3',5,5',6-Hexachlorobiphenyl	74472-46-1	NE	NE	0.00001	0.000036	0.00001
2,3,4,4',5,6-Hexachlorobiphenyl	41411-63-6	NE	NE	0.00001	0.000012	0.00001
2,3',4,4',5,5'-Hexachlorobiphenyl	52663-72-6	NE	NE	0.00001	0.000011	0.00001
2,3',4,4',5',6-Hexachlorobiphenyl	59291-65-5	NE	NE	0.00001	0.000013	0.00001
3,3',4,4',5,5'-Hexachlorobiphenyl	32774-16-6	NE	NE	0.00001	0.000016	0.00001
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	NE	NE	0.00001	0.000016	0.00001
2,2',3,3',4,4',6-Heptachlorobiphenyl	52663-71-5	NE	NE	0.00001	0.000037	0.00001
2,2',3,3',4,5,5'-Heptachlorobiphenyl	52663-74-8	NE	NE	0.00001	0.000038	0.00001
2,2',3,3',4,5,6-Heptachlorobiphenyl	68194-16-1	NE	NE	0.00001	0.000037	0.00001
2,2',3,3',4,5,6'-Heptachlorobiphenyl	38411-25-5	NE	NE	0.00001	0.000019	0.00001
2,2',3,3',4,5',6-Heptachlorobiphenyl	40186-70-7	NE	NE	0.00001	0.000038	0.00001
2,2',3,3',4,6,6'-Heptachlorobiphenyl	52663-65-7	NE	NE	0.00001	0.000039	0.00001
2,2',3,3',4',5,6-Heptachlorobiphenyl	52663-70-4	NE	NE	0.00001	0.000014	0.00001

Sediment / PCB Congeners Analyte	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
2,2',3,3',5,5',6-Heptachlorobiphenyl	52663-67-9	NE	NE	0.00001	0.000022	0.00001
2,2',3,3',5,6,6'-Heptachlorobiphenyl	52663-64-6	NE	NE	0.00001	0.000023	0.00001
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	NE	NE	0.00001	0.000014	0.00001
2,2',3,4,4',5,6-Heptachlorobiphenyl	74472-47-2	NE	NE	0.00001	0.00004	0.00001
2,2',3,4,4',5,6'-Heptachlorobiphenyl	60145-23-5	NE	NE	0.00001	0.00004	0.00001
2,2',3,4,4',5',6-Heptachlorobiphenyl	52663-69-1	NE	NE	0.00001	0.00004	0.00001
2,2',3,4,4',6,6'-Heptachlorobiphenyl	74472-48-3	NE	NE	0.00001	0.00004	0.00001
2,2',3,4,5,5',6-Heptachlorobiphenyl	52712-05-7	NE	NE	0.00001	0.00004	0.00001
2,2',3,4,5,6,6'-Heptachlorobiphenyl	74472-49-4	NE	NE	0.00001	0.000041	0.00001
2,2',3,4',5,5',6-Heptachlorobiphenyl	52663-68-0	NE	NE	0.00001	0.000019	0.00001
2,2',3,4',5,6,6'-Heptachlorobiphenyl	74487-85-7	NE	NE	0.00001	0.000023	0.00001
2,3,3',4,4',5,5'-Heptachlorobiphenyl	39635-31-9	NE	NE	0.00001	0.000018	0.00001
2,3,3',4,4',5,6-Heptachlorobiphenyl	41411-64-7	NE	NE	0.00001	0.000023	0.00001
2,3,3',4,4',5',6-Heptachlorobiphenyl	74472-50-7	NE	NE	0.00001	0.000042	0.00001
2,3,3',4,5,5',6-Heptachlorobiphenyl	74472-51-8	NE	NE	0.00001	0.000042	0.00001
2,3,3',4',5,5',6-Heptachlorobiphenyl	69782-91-8	NE	NE	0.00001	0.000014	0.00001
2,2',3,3',4,4',5,5'-Octachlorobiphenyl	35694-08-7	NE	NE	0.00001	0.000017	0.00001
2,2',3,3',4,4',5,6-Octachlorobiphenyl	52663-78-2	NE	NE	0.00001	0.000043	0.00001
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	42740-50-1	NE	NE	0.00001	0.000043	0.00001
2,2',3,3',4,4',6,6'-Octachlorobiphenyl	33091-17-7	NE	NE	0.00001	0.000025	0.00001
2,2',3,3',4,5,5',6-Octachlorobiphenyl	68194-17-2	NE	NE	0.00001	0.00002	0.00001
2,2',3,3',4,5,6,6'-Octachlorobiphenyl	52663-73-7	NE	NE	0.00001	0.00002	0.00001
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	NE	NE	0.00001	0.000025	0.00001
2,2',3,3',4,5,5',6'-Octachlorobiphenyl	52663-75-9	NE	NE	0.00001	0.000044	0.00001
2,2',3,3',5,5',6,6'-Octachlorobiphenyl	2136-99-4	NE	NE	0.00001	0.000044	0.00001
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	NE	NE	0.00001	0.000044	0.00001

Sediment / PCB Congeners Analyte	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
2,2',3,4,4',5,6,6'-Octachlorobiphenyl	74472-52-9	NE	NE	0.00001	0.000045	0.00001
2,3,3',4,4',5,5',6-Octachlorobiphenyl	74472-53-0	NE	NE	0.00001	0.000045	0.00001
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	40186-72-9	NE	NE	0.00001	0.000045	0.00001
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	52663-79-3	NE	NE	0.00001	0.000045	0.00001
2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl	52663-77-1	NE	NE	0.00001	0.000046	0.00001
Decachlorobiphenyl	2051-24-3	NE	NE	0.00001	0.000015	0.00001

Notes:
NE = Not established
NYDEC - New York Department of Environmental Conservation; Technical Guidance for Screening Contaminated Sediment
ER-L - Effects Range Low
ER-M - Effects Range Medium
ER-L and ER-M from "Sediments Classification Methods Compendium." Long and MacDonald 1992.

QAPP Worksheet #15 -- Reference Limits and Evaluation Tables (Continued)

Matrix: Sediment
Analytical Group: TOC Lloyd Kahn and Black Carbon
Concentration Level: Unknown

Sediment / Analyte	TOC	CAS	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit (mg/kg)	MDL (mg/kg)	QL (mg/kg)
TOC		7440-44-0	NE	NE	1000	220	1000

Notes:
NE = Not established
NYDEC - New York Department of Environmental Conservation; Technical Guidance for Screening Contaminated Sediment
ER-L - Effects Range Low
ER-M - Effects Range Medium
ER-L and ER-M from "Sediments Classification Methods Compendium." Long and MacDonald 1992.

QAPP Worksheet #15 -- Reference Limits and Evaluation Tables (Continued)

Matrix: Solid/Sediment
Analytical Group: Semivolatile Organic Compounds

Analyte	CAS Number	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit Goal2 (ug/Kg)	Laboratory-specific		
					QLs (ug/Kg)	LODs (ug/Kg)	DLs (ug/Kg)
1,1'-Biphenyl	92-52-4	NE	NE	330	330	330	15
1,2,4,5-Tetrachlorobenzene	95-94-3	NE	NE	330	330	330	40
2,2'-oxybis[1-chloropropane]	108-60-1	NE	NE	330	330	330	16
2,3,4,6-Tetrachlorophenol	58-90-2	NE	NE	330	330	330	37
2,4,5-Trichlorophenol	95-95-4	NE	NE	830	830	830	34
2,4,6-Trichlorophenol	88-06-2	NE	0.003	330	330	330	34
2,4-Dichlorophenol	120-83-2	NE	0.006	330	330	330	33
2,4-Dimethylphenol	105-67-9	NE	0.005	330	330	330	52
2,4-Dinitrophenol	51-28-5	NE	NE	830	830	830	140
2,4-Dinitrotoluene	121-14-2	NE	NE	330	330	330	24
2,6-Dinitrotoluene	606-20-2	NE	NE	330	330	330	30
2-Chloronaphthalene	91-58-7	NE	NE	330	330	330	43
2-Chlorophenol	95-57-8	NE	NE	330	330	330	34
2-Methylnaphthalene	91-57-6	NE	0.008	330	330	330	15
2-Methylphenol	95-48-7	0.07	0.67	330	330	330	40
2-Nitroaniline	88-74-4	NE	NE	830	830	830	37
2-Nitrophenol	88-75-5	NE	NE	330	330	330	37
3 & 4 Methylphenol	15831-10-4	NE	NE	670	670	670	74
3,3'-Dichlorobenzidine	91-94-1	NE	NE	330	330	330	48
3-Nitroaniline	99-09-2	NE	NE	830	830	830	38
4,6-Dinitro-2-methylphenol	534-52-1	NE	NE	830	830	830	97
4-Bromophenyl phenyl ether	101-55-3	NE	NE	330	330	330	18
4-Chloro-3-methylphenol	59-50-7	NE	NE	330	330	330	40
4-Chloroaniline	106-47-8	NE	NE	330	330	330	32
4-Chlorophenyl phenyl ether	7005-72-3	NE	NE	330	330	330	15
4-Nitroaniline	100-01-6	NE	NE	830	830	830	32

Analyte	CAS Number	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit Goal2 (ug/Kg)	Laboratory-specific		
					QLs (ug/Kg)	LODs (ug/Kg)	DLs (ug/Kg)
4-Nitrophenol	100-02-7	NE	NE	830	830	830	84
Acenaphthene	83-32-9	0.016	0.5	330	330	330	13
Acenaphthylene	208-96-8	0.044	0.64	330	330	330	15
Acetophenone	98-86-2	NE	NE	330	330	330	16
Anthracene	120-12-7	0.085	1.1	330	330	330	14
Atrazine	1912-24-9	NE	NE	330	330	330	16
Benzaldehyde	100-52-7	NE	NE	330	330	330	16
Benzo[a]anthracene	56-55-3	0.261	1.6	330	330	330	13
Benzo[a]pyrene	50-32-8	0.43	1.6	330	330	330	12
Benzo[b]fluoranthene	205-99-2	NE	1.8	330	330	330	23
Benzo[g,h,i]perylene	191-24-2	0.17	NE	330	330	330	13
Benzo[k]fluoranthene	207-08-9	0.24	NE	330	330	330	30
Bis(2-chloroethoxy)methane	111-91-1	NE	NE	330	330	330	15
Bis(2-chloroethyl)ether	111-44-4	NE	NE	330	330	330	15
Bis(2-ethylhexyl) phthalate	117-81-7	0.18216	2.64651	330	330	330	21
Butyl benzyl phthalate	85-68-7	NE	0.063	330	330	330	20
Caprolactam	105-60-2	NE	NE	330	330	330	35
Carbazole	86-74-8	0.384	2.8	330	330	330	15
Chrysene	218-01-9	0.063	0.26	330	330	330	18
Dibenz(a,h)anthracene	53-70-3	NE	NE	330	330	330	11
Dibenzofuran	132-64-9	NE	0.006	330	330	330	16
Diethyl phthalate	84-66-2	NE	NE	330	330	330	15
Dimethyl phthalate	131-11-3	NE	0.058	330	330	330	15
Di-n-butyl phthalate	84-74-2	NE	NE	330	330	330	15
Di-n-octyl phthalate	117-84-0	0.6	5.1	330	330	330	23
Fluoranthene	206-44-0	0.019	0.54	330	330	330	12
Fluorene	86-73-7	0.02	NE	330	330	330	15
Hexachlorobenzene	118-74-1	NE	0.0013	330	330	330	46
Hexachlorobutadiene	87-68-3	NE	NE	330	330	330	35
Hexachlorocyclopentadiene	77-47-4	NE	0.073	330	330	330	65
Hexachloroethane	67-72-1	0.2	NE	330	330	330	34

Analyte	CAS Number	NYDEC ER-L	NYDEC ER-M	Project Quantitation Limit Goal2 (ug/Kg)	Laboratory-specific		
					QLs (ug/Kg)	LODs (ug/Kg)	DLs (ug/Kg)
Indeno[1,2,3-cd]pyrene	193-39-5	NE	NE	330	330	330	14
Isophorone	78-59-1	0.16	2.1	330	330	330	42
Naphthalene	91-20-3	NE	NE	330	330	330	15
Nitrobenzene	98-95-3	NE	NE	330	330	330	41
N-Nitrosodi-n-propylamine	621-64-7	NE	NE	330	330	330	46
N-Nitrosodiphenylamine	86-30-6	NE	0.017	387	387	387	16
Pentachlorophenol	87-86-5	0.24	1.5	830	830	830	68
Phenanthrene	85-01-8	NE	0.13	330	330	330	12
Phenol	108-95-2	0.665	2.6	330	330	330	40
Pyrene	129-00-0	0.016	0.5	330	330	330	14
2,4,6-Tribromophenol (Surrogate)	118-79-6						
2-Fluorobiphenyl (Surrogate)	321-60-8						
2-Fluorophenol (Surrogate)	367-12-4						
Nitrobenzene-d5 (Surrogate)	4165-60-0						
Phenol-d5 (Surrogate)	4165-62-2						
Terphenyl-d14 (Surrogate)	1718-51-0						

Notes:
NE = Not established
NYDEC - New York Department of Environmental Conservation; Technical Guidance for Screening Contaminated Sediment
ER-L - Effects Range Low
ER-M - Effects Range Medium
ER-L and ER-M from "Sediments Classification Methods Compendium." Long and MacDonald 1992.

QAPP Worksheet #15 -- Reference Limits and Evaluation Tables (Continued)

Matrix: Sediment
Analytical Group: TPH

Analyte	CAS Number	NYSDEC ER-L	NYSDEC ER-M	Project Quantitation Limit Goal2 (ug/Kg)	Laboratory-specific		
					QLs (ug/Kg)	LODs (ug/Kg)	DLs (ug/Kg)
Gasoline Range Organics (C6-C10)	8006-61-9	NE	NE	1250	1250	330	330
Diesel Range Organics (C10-C28)	STL00143	NE	NE	6700	6700	340	340
a,a,a-Trifluorotoluene (Surrogate)	98-08-8						

Notes:
NE = Not established
NYDEC – New York Department of Environmental Conservation Sediment Screening Guidance
ER-L - Effects Range Low
ER-M - Effects Range Medium
ER-L and ER-M from "Sediments Classification Methods Compendium." Long and MacDonald 1992.

QAPP Worksheet #16 – Project Schedule/ Timeline Table

Activities	Organization	Anticipated Time Frame of Initiation	Anticipated Time Frame of Completion	Deliverable	Deliverable Due Date
Development Sampling Plan, Investigation Scope of Work, and QAPP	GEI	October 2012, Revised March 2013	March/April 2013	Final WP, QAPP	March/April 2013
Sampling Event	GEI	March -April 2013	April 2013	Interim Data Report	May 2013
Laboratory Analyses – All Events	Laboratories	Upon sample receipt	Dependent on Individual Laboratory Schedules	Laboratory Deliverable	Approximately 1 month after sample receipt
Work Plan Addendum 1	GEI	April 2014	July 2014	WP Addendum, QAPP Rev.,	July 2014
Work Plan Addendum 1 Sampling Activities	GEI	August 2014	September 2014	Data report	October 2014

QAPP Worksheet #17 -- QAPP Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach:

This Work Plan was prepared by GEI Consultants, Inc. (GEI) for National Grid and outlines the scope of work for an investigation to determine if a release of gas condensate has impacted sediments, surface water, biota or structures in Paerdegat Basin. Paerdegat Basin is located in Brooklyn, New York as indicated Figure 1 in the current Work Plan.

This plan is based upon a field inspection conducted by GEI on October 16, 2012 and is also responsive to the NYSDEC comments of October 15, 2012, amendments from the GEI conference call of October 17, 2012, and review letter from NYSDEC received January 14, 2013 and follow up meeting held February 4, 2013. The scope of work includes the following:

- Intertidal sediment sampling.
- Subtidal sediment and surface water sampling from shoreline structures including the CSO wall and the mouth of the Basin.
- Subtidal sediment and surface water sampling from the survey boat; weather and ice permitting.
- Biota sampling (mussels only).
- Structure sampling (piles, docks, and bulkheads).

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations):

The proposed field investigations include the collection of sediment at 42 sampling stations, 20 biological tissue (mussels) samples from five stations, surface water from five stations, and 47 porous structure samples on docks, piers and bulkheads in Paerdegat Basin. All samples will be analyzed for PCBs. Proposed sample locations are indicated on Figure 2 in the Work Plan. Actual sample locations may have to be adjusted based on field conditions at the time the field work is done. GEI will conduct the sampling activities for all media on behalf of National Grid.

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Shoreline Survey and Contingent Sediment Sampling

The NYSDEC requested that a detailed shoreline survey be performed to document the potential presence of oily residues that may remain following the response action. Where possible, that survey will be performed by GEI staff walking the shoreline. This will likely be possible in areas such as the marinas and other easily accessible areas. However, because much of the shoreline consists of wetlands and mud-flat areas (including constructed wetlands currently being developed), large sections of the shoreline may not be accessible on foot. Therefore, GEI will also conduct a visual shoreline survey by boat of the entire shoreline of the Basin. The objective will be to document presence/absence of visible product or oily residues, primarily by sheen or possibly by staining of the *Spartina* shoots in the restoration areas. The survey will be conducted around low tide. We will notify staff at NYSDEC's Division of Fish, Wildlife and Marine Resources so that they can participate in the survey if they are available.

GEI will document the shoreline conditions and observations of any sheen or oily residues using video photographs and field notes. GPS coordinates of any observed oily residues will be recorded. It is likely that other petroleum-related releases un-related to the gas condensate liquid release have caused oily residue or sheen impacts in the intertidal zone of the basin. Therefore, regardless of potential source, GEI will adjust its proposed sample locations to include the collection of soil/sediment samples for laboratory analyses from any accessible area of oily residue or sheen to evaluate the potential for the observed impact to be related to the gas condensate release. The documented observations will be included in GEI's sampling report.

Sediment, Surface Water and Biota Sampling

The sampling plan will be implemented over an approximate one week period. The scope of work for field investigation includes the following:

- Intertidal surface sediment sampling: this effort will involve 14 stations along the *Spartina* restoration side and other areas accessible on foot.

- Subtidal surface sediment sampling from shoreline structures: this will include 12 subtidal stations. This includes four from the CSO wall and floating docks, seven from marina docks and one at the mouth of the basin. A surface water sample will also be collected from the station located near the outfall.

- Subtidal surface sediment sampling from the survey boat (weather and ice permitting): this will consist of 14 stations using the research vessel including three reference stations to be taken in Jamaica Bay. Surface water samples will be collected from three of these stations within the basin and one from Jamaica Bay.

- Biota sampling for mussels: up to 20 samples from five stations, however, the actual number of stations will depend upon availability of mussels.

Intertidal Sample Locations

The objective of this sampling task is to characterize the extent and concentrations of PCBs in the intertidal zone. The study zone will range from the mean low water (MLW) to the mean high water line with stations as shown in Figure 2 in the Work Plan. Surficial sediment will be collected from eighteen stations with stainless steel trowels cleaned between stations as described in the QAPP. Single use, disposable sampling equipment may also be used to collect sample aliquots. Locations will be recorded utilizing GPS. Sediment samples will be photographically recorded. Complete chain of custody records will be maintained.

Subtidal Sediment and Surface Water Sampling From Shoreline Structures

The objective of this element is to characterize the extent and concentrations of PCBs in the subtidal zones. Sediment samples will be collected from the 12 stations using a petite PONAR sampling device. Three surface water samples will be collected at locations shown on Figure 2 in the Work Plan. Limited surface water sampling is proposed due to the time that has elapsed since the initial release, the low solubility of PCBs, and because the analysis of samples conducted immediately after the release did not detect any PCBs. This particular protocol is for nearshore collections under and around hard structures such as floating docks and bulkheads. The exact sample locations may be modified in the field should obstructions be encountered. The PONAR sampler will be deployed manually at the sampling station until sufficient sediment sample volume is obtained for the desired analytical requirements (see below). Based on input from NYSDEC the primary focus is to characterize the upper 1-inch of the sediment surface. As a result efforts will be made to obtain sediment material from the top fraction of material in each retrieved PONAR sampler. The PONAR and all re-usable sampling equipment will be decontaminated between sample locations. Single use, disposable sampling equipment may also be used to collect sample aliquots from the PONAR device and transfer the sediments to the laboratory sample containers. The sediment sampling locations will be recorded with a GPS and the sediment samples will be photographically recorded. Complete chain of custody records will be maintained.

Subtidal Sediment and Surface Sampling Utilizing the Survey Vessel

Sediment samples will be collected from 15 stations using a petite PONAR sampling device and four direct surface water samples will be collected as shown on Figure 2 (within basin) and Figure 3 (within Jamacia Bay) in the Work Plan. GEI's sampling vessel, the RV Kingfisher will be used to access the offshore stations for sample collections (weather and ice conditions permitting). The exact sample locations may be modified in the field should obstructions be encountered. The PONAR sampler will be deployed at the sampling station until sufficient sediment sample volume is obtained for the desired analytical requirements (see below). Collection strategy will again be focused on characterizing the upper 1-inch of the sediment surface. Efforts will be made to obtain sediment material from the top fraction of material in each retrieved PONAR sampler. The PONAR and all re-usable sampling equipment will be decontaminated between sample locations. Single use, disposable sampling equipment may also be used to collect sample aliquots from the PONAR device and transfer the sediments to the laboratory sample containers. Surface water samples will be directly sampled. The sampling locations will be recorded with an on-board GPS and the sediment samples will be photographically recorded. Complete chain of custody records will be maintained.

Biota Tissue Sampling for Mussels

Mussels are non-mobile, therefore good indicators for bioaccumulation of metals and/or persistent organics in the water column or sediment. Mussels will be collected if they are encountered in the intertidal zones (e.g., attached to *Spartina* stubs), from the floating docks and piers at the marinas in Paerdegat Basin, and on hard surfaces at the head or mouth of the basin. Priority will be given to attempt and locate up to four target stations in intertidal regions upstream and/or downstream of the outfall. The initial shoreline survey will provide a better understanding of the feasibility of these sample locations; however, it is important to note the exact locations of biota sampling stations will be highly dependent on field conditions and the availability of mussels. At least one target station will be located at one of the marinas on the east side of the basin near the outfall. If mussels are not available in intertidal regions, another potential target station will be located at marina on the west side of the basin.

The total weights of mussels collected per station will be recorded. All biota samples will be wrapped in aluminum foil, packed in plastic bags and immediately placed on ice in coolers for same day shipment to the analytical laboratory. All samples will be processed in the analytical laboratory. The mussels will be shucked and the soft tissue retained for analysis. The sampling locations will be recorded with a GPS and photographically recorded. Complete chain of custody records will be maintained. If sufficient weight of samples are collected (e.g., >20 grams for each sample type) for all 20 samples prior to the last day, the

sampling for that effort may be discontinued. If sample mass from each station is insufficient for laboratory requirements, samples will be composited and submitted on an area basis as opposed to individual stations.

Structure Sampling

Sample Locations and Rationale

The objective of this element is to determine if PCBs are present at or above the USEPA cleanup criteria of 1 mg/kg in structures that could have been impacted by the spill. Proposed sample locations are indicated on Figure 4 in the Work Plan. Floating docks, piers and bulkheads in the area of investigation in the Basin will be inspected for oil-like staining where access is permitted by the owner. Proposed sample locations will be adjusted to locations where oil-staining is observed with suspected impact from the gas condensate release. If no oil-staining is observed or not suspected to be related to the recent release of gas condensate, samples of the outer surface of the structures in contact with the surface water will be collected at the scum line as indicated in Figure 3 in the Work Plan. It may not be possible to collect samples from some locations for safety reasons or due to accessibility.

A summary of the proposed structure sample locations is presented in the following table:

Location	Number of Samples	Sample Media
Docks and Piers		
Hudson River Yacht Club	10	Wood and Styrofoam
Midget Squadron Marina	18	Wood and Styrofoam
Kayak Club	3	Wood and Styrofoam
Diamond Point Club	6	Wood and Styrofoam
Paerdegat Squadron	4	Wood and Styrofoam
Canarsie Athletic Club	4	Wood and Styrofoam
Bulkheads		
CSO Outfall Structure Bulkhead	2	Concrete

Sampling Methods

Samples of wood and Styrofoam materials will be collected from the surface using USEPA sampling protocols for collection of porous materials for PCB analysis (USEPA, May 2011). Wood chisels or handheld rotary drill with a corer attachment will be used to collect surface samples from the porous material. The depth of sampling will not exceed 1/2 inch into the surface sampled. Samples of wooden and Styrofoam dock materials will be collected and analyzed as discrete samples. Samples collected from wooden piers which are exposed to daily tidal fluctuations, will be comprised of a composite of three subsamples collected during low tide from three locations representative of depth approximate heights of the low tide, mid tide and high tide. Samples of dock material will be collected from the side wall of the dock while kneeling on the dock surface.

The concrete bulkhead at the CSO outfall is considered porous materials and samples of it will be collected using a vibratory hammer drill and core as described in USEPA sampling protocols (May, 2011).

Some samples may require the use of a boat for added safety during sample collection. All samples will be placed in laboratory provided sampling jars for PCB analysis.

Proposed Sample Analysis

Based upon analytical results of the condensate oil collected from the standpipe , the condensate included PCBs, volatile organic compounds (VOCs) and semivolatile organic compounds. The highest concentration contaminant is PCB Aroclor 1242. Given that this compound is present at the highest concentration, partitions strongly to sediments, is persistent in the environment and can bioaccumulate in biota, PCBs are the primary contaminants of concern for this Work Plan. All samples will be analyzed for PCB Aroclors and 20% of the sediment samples will also be analyzed for VOCs. The analyses will be done on an expedited turn-around-time basis.

Sediment samples will be analyzed for the following parameters:

- PCBs according to USEPA Method 8082A.
- Target compound list VOCs according to USEPA Method 8260B at seven of the sample locations.
- Total organic carbon (TOC) according to USEPA Method Lloyd Kahn.
- Grain Size according to ASTM D422.

- Samples will be archived with the potential for future analysis of PCB congeners according to USEPA Method 1668A for forensic evaluations.
- Percent Moisture.

Surface water, biological tissue and porous structural material samples will be analyzed for the following parameter:

- PCBs according to USEPA Method 8082A.
- Samples will be archived with potential future analysis of PCB congeners according to USEPA Method 1668A for forensic evaluations.
- Percent moisture.
- Percent lipid (for biological tissue samples only).

Soils and semi-porous materials will be reported on a dry-weight basis, while surface water and mussel tissue will be reported on a wet-weight basis.

QAPP Worksheet #18 -- Sampling Locations and Methods/SOP Requirements Table

Locations	Sample ID	Matrix	Depth (inch)	Analytical Group	Concentration Level	Number of Samples[1]	Sampling SOP Reference[2]	Rationale for Sampling Location
Stations SD-001 through SD-042	NG-PB-SD-001 through NG-PB-042	Sediment	0-1	PCBs Aroclors*, TOC, Grain size, percent moisture, VOCs (subset of 7 samples)	Unknown	42	PB-04	See Work Plan
Stations T-001 through T-005	NG-PB-T-001 through PB-T-020	Tissue (mussels)	NA	Tissue PCB Aroclors*, percent moisture, percent lipid	Unknown	20	PB-10	See Work Plan
Stations SW-001 through SW-005	NG-PB-SW-001 through PB-SW-005	Surface Water	0-5	PCBs Aroclors*	Unknown	5	PB-08	See Work Plan
Stations PS-001 through PS-047	NG-PB-PS-001 through PB-PS-047	Porous solid	0-0.5	PCBs Aroclors*	Unknown	47	PB-09	See Work Plan
Stations PS-048 through PS-075	NG-PB-PS-048 through PB-PS-075	Porous solid	0-0.5	PCBs Aroclors*, VOCs, SVOCs, TPH (subset of 3 samples)	Unknown	28	PB-09	See Work Plan Addendum 1
Stations MH-001 through MH-004	NG-PB-MH-001 through PB-MH-004	Man hole wipe test	Surface	PCBs Aroclors*	Unknown	4	PB-12	See Work Plan Addendum 1

Notes:

1. Does not include quality assurance/ quality control samples. Quality assurance/ quality control samples will include blind duplicate samples, matrix spike/ matrix spike duplicate samples, and equipment rinsate blank samples. These samples will be completed on a frequency of 1 per 20 samples per matrix or once per week of sampling per matrix.
2. Appropriate letter or number from the Project Sampling SOP References table (Worksheet #21).

* Samples will be archived with potential future analysis of PCB congeners according to USEPA Method 1668A

QAPP Worksheet #19 – Analytical SOP Requirements Table

For each matrix, analytical group and concentration level, list the analytical and preparation method/SOP and associated sample volume, container specifications, preservation requirements, and maximum holding time.

Matrix	**Analytical Group**	**Concentration Level**	**Analytical and Preparation Method / SOP Reference[1]**	**Sample Volume**	**Containers** (number, size, and type)	**Preservation Requirements** (chemical, temperature, light protected)	**Maximum Holding Time** (preparation / analysis)
Solid/Sediment	PCBs Aroclors	unknown	Method SW846 8082A BR-GC-005(A), BR-EX-027(P)	50 g	4 oz. glass jar	Cool to 4 ± 2 C	14 days for extraction and 40 days for analysis.
Sediment	TOC Lloyd Kahn	unknown	Lloyd Khan / 006	10 g	Taken from 32 oz glass jar	4 C	14 days
Sediment	Grain Size	unknown	ASTM D422 / 007	500 g	Taken 32 oz glass jar	4 C	NA
Sediment	PCB Congeners	Low	1668A / 002	4 oz	8 oz. amber glass jar	<6 °C in transit to lab. Lab storage at < -10 °C	Up to 1 year when stored frozen and in the dark
Sediment/Solids	VOCs	Low	Method 8260B BR-MV-006(A), BR-MV-007(P)	(2) 40 mL glass vials	2 x 5 grams	To Lab: Cool 4±2°C At lab: Freeze -20 ± 10°C 5 mL of VOA Free water	48Hours to Freeze 14 days to analysis
				(1) 40 mL glass vial	1 x 5 grams	Cool 4±2°C 10 mL of Methanol	14 days to analysis

Matrix	**Analytical Group**	**Concentration Level**	**Analytical and Preparation Method / SOP Reference[1]**	**Sample Volume**	**Containers** (number, size, and type)	**Preservation Requirements** (chemical, temperature, light protected)	**Maximum Holding Time** (preparation / analysis)
Tissue	PCBs Aroclors	unknown	Method SW846 8082A BR-GC-005(A), BR-EX-009(P)	20 g	Foil and ziplock bag	Cool to 4 ± 2 C	14 days for extraction and 40 days for analysis.
Tissue	PCB Congeners	Low	1668A / 002	20 g	Foil and ziplock bag/ transfer in lab	<6 °C in transit to lab. Lab storage at < -10 °C	Up to 1 year when stored frozen and in the dark
Water	PCBs Aroclors	Low	Method SW846 8082A BR-GC-005(A), BR-EX-005(P)	1 L	(1) 1 L amber glass bottle	Cool to 4 ± 2 C	7 days for extraction and 40 days for analysis.
Solids	SVOCs	Low	Method 8270D BR-MS-001(A), BR-EX-008(P)	(1) 4 oz Amber Glass	50 grams	Cool 4±2°C	14 days to extraction 40 days to analysis
Solids	TPH GRO	Low	Laboratory Defined BR-GC-004(A), BR-EX-008(P)	(1) 4 oz glass jar	50 g	Cool to 4 ± 2 C	14 days for extraction and 40 days for analysis.
Solids	TPH DRO	Low	Method 8015D BF-GV-005, BF-MV-012	(1) Soil 4oz wide-mouth jar	3 grams	Cool 4±2°C	14 days to analysis

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

QAPP Worksheet #20 -- Field Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSD[1]	No. of Rinsate Blanks[1]	No. of Trip Blanks[2]	Total No. of Samples to Lab
Sediment	PCBs	Unknown	EPA Method 8082A	42	1 (1 per 20)	1 (1 per 20)	1 (1 per 20)	0	48
Sediment	PCB Congeners	Unknown	EPA Method 1668A	42	1 (1 per 20)	1 (1 per 20)	1 (1 per 20)	0	48
Sediment	TOC	Unknown	EPA Method Lloyd Kahn	42	1 (1 per 20)	1 (1 per 20)	1 (1 per 20)	0	48
Sediment	Grain Size	Unknown	ASTM D422	42	1 (1 per 20)	1 (1 per 20)	0	0	46
Surface Water	PCBs	Unknown	EPA Method 8082A	5	1 (1 per 20)	1 (1 per 20)	1 (1 per 20)	0	8
Tissue	PCBs	Unknown	EPA Method 8082A	20	0 (1 per 20)	1 (1 per 20)	0 (1 per 20)	0	21
Solids	SVOCs	Unknown	EPA Method 8270	8	1 (1 per 20)	1 (1 per 20)	0 (1 per 20)	0	10
Solids	TPH	Unknown	EPA Method 8015	8	1 (1 per 20)	1 (1 per 20)	0 (1 per 20)	0	10

Notes:

[1] Quality assurance/ quality control samples will include field duplicate samples, matrix spike/ matrix spike duplicate samples, and equipment rinsate blank samples. These samples will be completed on a frequency of 1 per 20 samples or once per week of sampling.

[2] Trip blanks are only required for volatile organic carbon samples. These samples will be completed on a frequency of 1 per 20 samples or once per week of sampling.

QAPP Worksheet #21 – Project Sampling SOP Reference Table

The following is a list of all SOPs associated with project sampling including, but not limited to sample collection, sample preservation, equipment cleaning and decontamination, equipment testing, inspection and maintenance, supply inspection and acceptance, and sample handling and custody.

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
PB-01	Field Notebook	GEI Consultants	NA	No	Attachment B
PB-02	Equipment Decontamination	GEI Consultants	Various – see SOP	No	Attachment B
PB-03	Water Safety	GEI Consultants	Various – see SOP	No	Attachment B
PB-04	Sediment Sampling- Ponar or Shipex Grab Sampler	GEI Consultants	Ponar	No	Attachment B
PB-05	Sample Handling and Chain of Custody	GEI Consultants	NA	No	Attachment B
PB-06	Sample Handling	GEI Consultants	NA	No	Attachment B
PB-07	YSI Quick Card	GEI Consultants	YSI	No	Attachment B
PB-08	Biological Tissue Sampling	GEI Consultants	Various – see SOP	Yes	Attachment B
PB-09	Semi-porous Surface Sampling	GEI Consultants	Various – see SOP	Yes	Attachment B
PB-10	Surface Water Sampling	GEI Consultants	Various – see SOP	No	Attachment B
PB-11	Mussel Tissue Extraction	GEI Consultants	Various – see SOP	Yes	Attachment B
PB-12	Sediment Sampling Using Vibracore Equipment	GEI Consultants	Various – see SOP	No	Attachment B
PB-13	Wipe Sampling	GEI Consultants	Various – see SOP	No	Attachment B

Procedural modifications to these documents may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification will be approved in advance by the GEI Project QA Coordinator and GEI Manager and communicated to the Respondents and to the USEPA. Deviations will be documented in the field records.

QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing and Inspection Table

Identify all field equipment and instruments (other than analytical instrumentation) that require calibration, maintenance, testing, or inspection and provide the SOP reference number for each type of equipment. In addition, document the frequency of activity, acceptance criteria, and corrective action requirements on the worksheet.

Field Equipment	Calibration Activity	Maint. Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference[1]
Multi-parameter water quality sonde	PB-07 provided in Attachment B	PB-07 provided in Attachment B	PB-07 provided in Attachment B	PB-07 provided in Attachment B	PB-07 provided in Attachment B	PB-07 provided in Attachment B	PB-07 provided in Attachment B	Field Team Leader*	PB-07 provided in Attachment B

Notes:

[1]Specify the appropriate reference letter or number from the Project Sampling SOP References table (Worksheet #21).

*Calibration will be performed by field team leader and field personnel trained through GEI SOPs for Multi-parameter water quality sonde calibration.

Field Instrumentation: The Field Team Leader will be responsible for insuring that these instruments are calibrated before each field sampling event. Field equipment must be inspected and calibrated before use according to the criteria given in the Field Sampling Plan. If problems occur with field instruments or equipment which cannot be resolved by the field team personnel they should contact the Field Team Leader. If field equipment fails inspection it is the Field Team Leader's responsibility to investigate and resolve the problem. The GEI Field Team Leader can coordinate with equipment vendors assist in resolution of problems with field equipment and supply or obtain any spare or replacement parts or equipment.

QAPP Worksheet #23 -- Analytical SOP References Table

All referenced analytical SOP's can be found in Attachment C.

Analytical SOP References Table						
Lab SOP Number	**Title, Revision Date, and/or Number**	**Definitive or Screening Data**	**Matrix and Analytical Group**	**Instrument**	**Organization Performing Analysis**	**Modified for Project Work (Y/N)**
BR-EX-002r11_EXcleanup	Extract Clean Up Procedures	Definitive	Solid/Sediment PCBs	GC	TestAmerica-Burlington	N
BR-GC-005	PCBs by Gas Chromatography (GC) SOP No. BR-GC-005, Rev 11, 04/01/11	Definitive	Solid/Sediment PCBs	GC	TestAmerica-Burlington	N
BR-GC-005	PCBs by Gas Chromatography (GC) SOP No. BR-GC-005, Rev 11, 04/01/11	Definitive	Aqueous PCBs	GC	TestAmerica-Burlington	N
BR-GC-005	PCBs by Gas Chromatography (GC) SOP No. BR-GC-005, Rev 11, 04/01/11	Definitive	Tissue PCBs	GC	TestAmerica-Burlington	N
BR-EX-027	Automated Soxhlet Extraction (SW846 3541) SOP No. BR-EX-027, Rev 0, 11/10/10	Definitive	Solid/Sediment PCBs	NA Preparation	TestAmerica-Burlington	N
BR-EX-005	Separatory Funnel Extraction (SW-846 3510C) SOP No. BR-EX-005, Rev 9, 12/08/11	Definitive	Aqueous PCBs	NA Preparation	TestAmerica-Burlington	N
BR-EX-009	Homogenization of Biota & Tissue SOP No. BR-EX-009, Rev 7, 08/01/12	Definitive	Tissue PCBs	NA Preparation	TestAmerica-Burlington	N
BR-WC-008 Current Version	TOC Lloyd Kahn/	Definitive	Solid/Sediment	Carlo Erba Elemental Analyzer	TestAmerica-Burlington	N
BR-GT-006 BR-GT-018	Grain Size	Definitive	Solid/Sediment	NA	TestAmerica-Burlington	N
BR-MV-006	Volatile Organic Compounds by GC/MS (SW-846 8260B) SOP No. BR-MV-006, Rev 8, 05/28/10	Definitive	Solid/Sediment Volatiles	GC/MS	TestAmerica-Burlington	N

Analytical SOP References Table						
Lab SOP Number	**Title, Revision Date, and/or Number**	**Definitive or Screening Data**	**Matrix and Analytical Group**	**Instrument**	**Organization Performing Analysis**	**Modified for Project Work (Y/N)**
BR-MV-007	VOA Sample Preservation & Screen Analysis Procedure (SW-846 5030A, 5035 and 5035A) SOP No. BR-MV- 007, Rev 5, 12/05/08	Definitive	Solid/Sediment Volatiles	NA Preparation	TestAmerica-Burlington	N
BR-GC-004	Diesel Range Organics by GC/FID SOP No. BR-GC-004, Rev 14, 03/18/10	Definitive	Solid/Sediment Organotins	GC	TestAmerica-Burlington	N
BR-EX-008	Ultrasonic Extraction (SW846 3550C) SOP No. BR-EX-008, Rev 10.1, 12/31/13	Definitive	Solid/Sediment Organotins	NA Preparation	TestAmerica-Burlington	N
BF-GV-005	Volatile Organic Compounds by GC (SW-846 8015D) SOP No. BF-GV-005, Rev 2, 8/30/2013	Definitive	Solid/Sediment Volatiles	GC	TestAmerica-Buffalo	N
BF-MV-012	Purge and Trap (SW-846 5030C) SOP No. BF-MV- 012, Rev 0, 07/30/13	Definitive	Solid/Sediment Volatiles	NA Preparation	TestAmerica-Buffalo	N
BR-MS-001	Semivolatile Organic Compounds by GC/MS (SW-846 8270D) SOP No. BR-MS-001, Rev 7, 04/01/11	Definitive	Solid/Sediment Semivolatiles	GC/MS	TestAmerica-Burlington	N

QAPP Worksheet #24 -- Analytical Instrument Calibration Table

Analytical Instrument Calibration Table						
Instrument	**Calibration Procedure**	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
GC	Five-point calibration	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	Option 1: Mean relative standard deviation (RSD) for all analytes ≤ 20% Option2: Linear Regression: r > 0.995	Correct problem, reanalyze, and repeat calibration.	Laboratory Analyst	SOP BR-GC-005
GC	Initial Calibration Verification	Immediately after each initial calibration	%R ± 20% of true value	Correct problem and verify second source standard. If that fails repeat calibration.	Laboratory Analyst	SOP BR-GC-005
GC	Continuing Calibration Verification	Daily before sample analysis, every 10 samples and at the end of the analytical sequence	% Difference or Drift ±20%	See Laboratory SOP	Laboratory Analyst	SOP BR-GC-005

QAPP Worksheet #24 - Analytical Instrument Calibration Table (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRMS	Mass Resolution Check	Before ICAL	- Document acceptable mass resolution check prior to analysis of ICAL per method.	Inspect system; adjust source tune parameters to achieve required mass resolution.	Analyst	002-KNOX-ID-0013
HRMS	Initial Calibration (ICAL)	Prior to sample analysis; after major instrument changes/maintenance or when continuing calibration criteria are no longer met.	- Analyte peaks and labeled IS peaks must have a S/N ratio of 10 or more in the CS0.5 standard - Percent valley between PCB 34 and 23 must be <= 40% - Percent valley between PCB 187 and 182 must be <= 40% - %RSD for analytes calculated using isotope dilution <= 20% - % RSD for all other analytes and internal standards <= 35%	Inspect analytical system; correct problem; repeat ICAL	Analyst	002-KNOX-ID-0013
HRMS	Initial Calibration Verification (ICV)	After ICAL and prior to sample analysis	%D cannot exceed 35% for more than 4 analytes or labeled standards. %D must not exceed 50% any one analyte or labeled standard. Note: the RFs from the CS3 level of the ICAL are used to quantitate the ICV.	Inspect system; correct problem. Reanalyze ICV. Repeat ICAL if necessary.	Analyst	002-KNOX-ID-0013
HRMS	Continuing Calibration	At the beginning of each 12 hour	- Document acceptable mass resolution checks at the start and end of each 12	Inspect system;	Analyst	002-KNOX-ID-

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
	Verification (CCV)	analytical shift	hour analytical shift - The CS3 solution is used to verify RFs. The CS3 CCAL check is analyzed at the start of each 12 hour analytical shift. - S/N ratio for each analyte and labeled Is must be 10 or greater - CCV %D for Toxics/LOCs <= 30% - CCV %D for non-toxic/LOC analyte must be within 40-160% - Absolute RTs for all labeled IS must be within 15 seconds of the RTs established during the ICAL.	correct problem; reanalyze CCV. Repeat ICAL if necessary.		0013
LRMS	Initial Calibration (ICAL)	Prior to sample analysis; after major instrument changes/maintenance or when continuing calibration criteria are no longer met.	- %RSD for all parent PAHs must be <=30% - For each parent PAH linearity must be documented by obtaining a r^2 of 0.990 or greater	Inspect analytical system; correct problem; repeat ICAL.	Analyst	003-KNOX-ID-0018
LRMS	Initial Calibration Verification (ICV)	After ICAL and prior to sample analysis	%D cannot exceed 35%	Inspect system; correct problem. Reanalyze ICV. Repeat ICAL if necessary.	Analyst	KNOX-ID-0018
LRMS	Continuing Calibration Verification (CCV)	At the beginning of each 24 hour analytical shift	- Two CCVs are analyzed at the start of each 24 hour analytical sequence - The %D for each parent PAH should be <=30% - In the event a parent PAH CCV %D is	Inspect system; correct problem; reanalyze CCV.	Analyst	003-KNOX-ID-0018

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
			greater than 30%, calculate the mean RF CCV %D using both CCV runs. If this mean is <=30%D an acceptable CCAL has been obtained	Repeat ICAL if necessary.		
5310C - TOC	Initial Calibration	The instrument is calibrated at the beginning of each day or if the CCV/CCB fails to meet acceptance criteria.	The calibration correlation coefficient is ≥0.995.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/Supervisor	029-PT-WC-017
	Initial Calibration Verification (ICV)	Analyze a standard at the beginning after calibration	The acceptance criterion for the initial calibration verification standard is 90 to 110% recovery of true value.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/Supervisor	
	Initial Calibration Blank (ICB)	Before beginning a sample sequence, following ICV.	The result must be < RL.	Terminate analysis; Correct the problem; Recalibrate.	Analyst/Supervisor	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
	CCV	Analyze a standard at the beginning and end of the sequence and after every 10 environmental samples.	The acceptance criterion for the continuing calibration standard ± 10% of the initial curve.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standard. Reanalyze the affected data.	Analyst/Supervisor	
	CCB	Immediately following CCV and at the end of the sequence.	The result must be < RL.	Correct the problem, then prepare and reanalyze calibration blank and previous 10 samples.	Analyst/Supervisor	
GC/MS SW-846 8260B	Tune Standard	Prior to initial calibration and every 12 hours	See Laboratory SOP	Reanalyze, retune mass spectrometer; no samples may be analyzed without a valid tune.	Laboratory Analyst	SOP BR-MV-006

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS SW-846 8260B	Five-point calibration	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	Option 1: Mean relative standard deviation (RSD) for all analytes ≤ 20% Option2: Linear Regression: r > 0.995	Instrument maintenance, standard, inspection, recalibration	Laboratory Analyst	SOP BR-MV-006
GC/MS SW-846 8260B	Initial Calibration Verification	Immediately after each initial calibration	%R ± 25% of true value	Correct problem and verify second source standard. If that fails repeat calibration.	Laboratory Analyst	SOP BR-MV-006
GC/MS SW-846 8260B	Continuing Calibration Verification	Beginning of each 12-hour window after the tune standard	See Laboratory SOP	See Laboratory SOP	Laboratory Analyst	SOP BR-MV-006
Incubators	Temperatures checked daily during weekdays	Thermometers calibrated biannually	Must match temperature range in log book	Report/discontinue use/Repair	QA officer	034-039
Scales	Checked monthly	Vendor calibrator annually	Must match range in QC packet	Report/discontinue use/Repair	QA officer	034-039
Microscopes	Micrometer checked	Vendor calibration and maintenance annually	Must be uniform with analyst verification	Report/discontinue use/Repair	QA officer	034
Pipettors	Checked quarterly	Vendor calibrator annually	Must match range in QC packet	Report/clean/Repair	QA officer	034-039

QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Identify all analytical instrumentation that requires maintenance, testing, or inspection and provide the SOP reference number for each. In addition, document the frequency, acceptance criteria, and corrective action requirements on the worksheet.

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
5310C - TOC	Check Oxygen supply Persulfate supply Acid supply Carrier gas flow rate (~ 150 cc/min) IR millivolts for stability (after 30 min. warm-up) Reagent reservoirs	TOC	Check injection port septum after 50-200 runs. Tube end-fitting connections after 100 hours or use. Indicating drying tube. NDIR zero, after 100 hours of use. Sample pump, after 2000 hours for use. Digestion vessel/condensation chamber, after 2000 hours of use. Permeation tube, after 2000 hours of use. NDIR cell, after 2000 hours of use	As needed	CCV +/- 10%	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data	Analyst/ Supervisor	029- PT-WC-017

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC	Replace Septa, Clean and replace Injection Port Liner, Replace or clip Guard Column Replace or clip Analytical Column Bake, Re-foil, Refurbish Detector		Check Septa, Injection Port Liner, Guard Column and Analytical Column	As required	Passing calibration	Perform maintenance, check standards, recalibrate	Laboratory Analyst	SOP BR-QAM
GC/MS (VOA)	Clean Injection Port and Liner, Change Septa, Cut 2-3 inches from GC Column, Fill Auto sampler rinse vials, Clean Purge and Trap mount and purge vessel		Check Injection Port and GC columns, Check autosampler rinse vials, check purge and trap mount and purge vessel, check Purge Flow	As required	Passing calibration	Perform maintenance, check standards, recalibrate	Laboratory Analyst	SOP BR-QAM

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Carlo Erba Elemental Analyzer	Oven maintenance	Lloyd Kahn	Pass calibration and blank checks	Daily	Linear Regression r $\geq$ 0.995 ICB < RL CCV 85-115 %	Perform Maintenance, Check Standards, Recalibrate, Reanalyze	Assigned Lab personnel	006
Costech Elemental Combustion System	Oven maintenance	Lloyd Kahn	Pass calibration and blank checks	Daily	Linear Regression r $\geq$ 0.995 ICB < RL CCV 85-115 %	Perform Maintenance, Check Standards, Recalibrate, Reanalyze	Assigned Lab personnel	006
HRMS	Injection port maintenance, clean ion volume, clean source, replace filament	Refer to Worksheet #24	Refer to Worksheet #24	As needed	Refer to Worksheet #24	Refer to Worksheet #24	Analyst	002- KNOX-ID-0013
HRMS	Tune instrument to maximize sensitivity and mass resolution	Refer to Worksheet #24	Refer to Worksheet #24	Daily	Refer to Worksheet #24	Refer to Worksheet #24	Analyst	002- KNOX-ID-0013
HRMS	Change carrier gas filters	Refer to Worksheet #24	Refer to Worksheet #24	Yearly	Refer to Worksheet #24	Refer to Worksheet #24	Analyst	002- KNOX-ID-0013
HRMS	Change mechanical pump fluid	Refer to Worksheet #24	Refer to Worksheet #24	Yearly	Refer to Worksheet #24	Refer to Worksheet #24	Analyst	002- KNOX-ID-0013

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
LRMS	Injection port maintenance, clean source, replace filament	Refer to Worksheet #24	Refer to Worksheet #24	As needed	Refer to Worksheet #24	Refer to Worksheet #24	Analyst	003- KNOX-ID-0018
LRMS	Tune to maximize sensitivity and mass resolution	Refer to Worksheet #24	Refer to Worksheet #24	As needed	Refer to Worksheet #24	Refer to Worksheet #24	Analyst	003- KNOX-ID-0018
Scales	Clean, calibrate	Vendor tests yearly	As needed and yearly	Monthly	As documented in log books	Report/repair	QA Officer	036, 037,038,039, 040
Microscopes	Clean	Vendor tests yearly	As needed and yearly	As needed and yearly	As documented in log books	Report/repair	QA Officer	036
Pipettors	Clean, change o-ring	Vendor tests yearly	As needed and yearly	As needed and quarterly	As documented in log books	Report/repair	QA Officer	036, 037,038,039, 040

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

QAPP Worksheet #26 – Sample Handling System

Use this worksheet to identify components of the project-specific sample handling system. Record personnel, and their organizational affiliations, who are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection, to laboratory delivery, to final sample disposal. Indicate the number of days field samples and their extracts/ digestates will be archived prior to disposal.

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): GEI Consultants Field Team supervised by the Field Team Leader will collect samples.
Sample Packaging (Personnel/Organization): GEI Consultants Field Team
Coordination of Shipment (Personnel/Organization): GEI Consultants Field Team
Type of Shipment/Carrier: Federal Express for Overnight Delivery or courier to the laboratory
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Assigned laboratory personnel
Sample Custody and Storage (Personnel/Organization): Assigned laboratory personnel
Sample Preparation (Personnel/Organization): Assigned laboratory personnel
Sample Determinative Analysis (Personnel/Organization): Assigned laboratory personnel
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples will not be stored in the field, but will be kept in cooler at 4 degree C and shipped within 24 hours of collection. If due to an emergency they are stored in the field, they will be kept in a cooler or transferred to a refrigerator kept at 4 degrees C.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Sample extraction and digestion will be conducted according to the SOPs and the requirements given in Worksheet 19.
Biological Sample Storage (No. of days from sample collection): NA
SAMPLE DISPOSAL
Personnel/Organization: Test America Laboratories Sample Custodians
Number of Days from Analysis: At least 60 days

QAPP Worksheet #26 – Sample Handling System (continued)

Sample Handling System

Sample handling and custody procedures ensure the timely, correct, and complete analysis of each sample for all parameters requested. A sample is considered to be in a person's custody if it is in:

- his/her possession;
- his/her view, after being in his/her possession;
- his/her possession and has been placed in a secure location; or
- a designated secure area.

Sample custody documentation provides a written record of sample collection and analysis. The sample custody procedures provide for specific identification of samples associated with an exact location, the recording of pertinent information associated with the sample, including time of sample collection and any preservation techniques, and a Chain of Custody (COC) record which serves as physical evidence of sample custody. Custody procedures will be similar to the procedures outlined in the USEPA's Contract Laboratory Program Guidance for Field Samplers (USEPA, 2007). The COC documentation system provides the means to individually identify, track, and monitor each sample from the time of collection through final data reporting. Sample custody procedures are developed in three areas: sample collection, laboratory analysis, and final evidence files, which are described below.

Field Sample Handling and Custody

Field records provide a means of recording information for each field activity performed at the Site. COC procedures document pertinent sampling data and all transfers of custody until the samples reach the analytical laboratory. The sample packaging and shipment procedures summarized below will ensure that the samples arrive at the laboratory with the COC intact. Worksheet 19 lists the specific sample preservation requirements for each test method.

QAPP Worksheet #26 – Sample Handling System Field Procedures (cont.)

The general responsibilities of the field team are listed below:

- The field sampler is personally responsible for the care and custody of the samples until they are transferred to the Sample Management Officer (SMO) or until they are properly dispatched. As few people as possible should handle the samples.

- The Field Team Leader, or designee, is responsible for entering the proper information in the field logbook, including all pertinent information such as sample identification number, date and time of sample collection, type of analysis, and description of sample location. The information entered into the field log book will be used to generate a COC.

- All sample containers will be labeled with the project identification, sample identification, matrix, type of analysis required, and preservation requirements.

- The samples will be properly preserved, bagged, and packed into coolers. The original COC form will be placed into the lead cooler and will be shipped to the laboratory.

- The SMO or designee will review all field activities to determine whether proper custody procedures were followed during the field work and if additional samples are required.

Field Records

The field log book will provide the means of recording data collection activities. Entries will be described in as much detail as possible, so that persons going to the Project Properties can reconstruct a particular situation without reliance on memory. At the beginning of each field day, the date, start time, weather, and names of all sampling team members present will be entered. The names of visitors to the Project Properties and the purpose of their visit will also be recorded. All field measurements, as well as the instrument(s), will be noted.

Samples will be collected following the sampling procedures documented in the work plan. Observations such as sampling conditions or any problems will also be recorded. Sample identification numbers will be assigned at the time the data are entered in the logbook. Field duplicate samples, which will receive a unique sample identification number, are “blind” to the laboratory and will be identified under the sample description so that they can be associated with their respective samples by project staff.

QAPP Worksheet #26 – Sample Handling System (cont.)

Sample Identification System

All samples collected from the Project Properties must be identified with a sample label in addition to an entry on a COC record. Indelible ink will be used to complete sample labels and handwritten COC records. Each sample will be identified by a unique sample number assigned by the field team as described in the work plan. The unique sample identification will include a sequential sample number, the well location identification (ID), and the type of sample and the depth of the sample, if applicable.

Sample Labels/Tags

Sample labels will require the field team to complete the following information for each sample container:

1. Sample Number;
2. Sample Matrix;
3. Parameters to be analyzed;
4. Date of Collection;
5. Time of Collection;
6. Preservation Method(s); and
7. Sampler's Name.

QAPP Worksheet #27 -- Sample Custody Requirements

Describe the procedures that will be used to maintain sample custody and integrity. Include examples of chain-of-custody forms, traffic reports, sample identification, custody seals, laboratory sample receipt forms, and laboratory sample transfer forms.

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Samples will be collected per the procedures described in the work plan. The field sample custody procedures including sample packing, shipment, and delivery requirements are discussed in the text in Worksheets 17 and 26.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

Each laboratory will have a sample custodian who accepts custody of the samples and verifies that the information on the sample labels matches the information on the COC. The sample custodian will document any discrepancies and will sign and date all appropriate receiving documents. The sample custodian will also document the condition of the samples upon receipt at the laboratory. The laboratory sample custody procedures were discussed further in the following text.

Sample Identification Procedures:

The sample identification scheme that will be employed is described in the Surface Sediment Investigation Work Plan. Sample labeling procedures are discussed in the text in Worksheet 26.

Chain-of-Custody Procedures:

A COC record will accompany the samples from the time of sampling through all transfers of custody. The COC procedures are detailed in the following text.

QAPP Worksheet #27 -- Sample Custody Requirements (continued)

Sample Custody Requirements:

Chain of Custody Procedure

The following information should be recorded on COC forms. All COC forms must be signed in ink:

- Project name and/or project number;
- Signature of SMO or designee;
- Sampling station number;
- Date and time of collection;
- Grab or composite sample designation;
- Sample matrix;
- Sampling location description;
- Field identification number;
- Analyses required;
- Preservation technique;
- Signatures and dates for transfers of custody; and
- (if applicable) Air express/shipper's bill of lading identification numbers.

The COC form serves as an official communication to the laboratory detailing the particular analyses required for each sample. The COC record will accompany the samples from the time of sampling through all transfers of custody. It will be kept on file at the laboratory where samples are analyzed and archived. Three copies of the COC form are created; one copy is retained by the Field Team Leader and two are sent to the laboratory. An electronic copy of each COC should be also made and kept in the project directory. The SMO or designee completes a COC record to accompany each shipment from the field to the laboratory.

The completed COC is put in a zip-lock bag and taped to the inside cover of the sample shipping container. If there is more than one container in a shipment, copies of the COC form will be placed in each container. Each container is then sealed with custody seals and custody is transferred to the laboratory.

QAPP Worksheet #27 -- Sample Custody Requirements (continued)

Transfer of Custody and Shipment

The custody of samples must be maintained from the time of sampling through shipment and relinquishment to the laboratory. Instructions for transferring custody are given below:

- All samples are accompanied by a COC. When transferring custody of samples, the individuals relinquishing and receiving will sign, date, and note the time on the COC. This form documents sample custody transfer from the SMO or designee, through the shipper, to the analytical laboratory. Since a common carrier will usually not accept responsibility for handling COC forms, the name of the carrier is entered under "Received by," the bill-of-lading number is recorded in the comments section, and the COC form is placed in a zip-lock plastic bag and taped to the inside lid of the lead shipping cooler. Copies of the COC form will be placed in each additional cooler in a shipment.

- Samples will be packaged for shipment and either picked up at a pre-arranged location by the laboratory or dispatched to the appropriate laboratory via overnight delivery service. A separate COC record must accompany each shipment. Shipping containers will be sealed for shipment to the laboratory. Two custody seals will be applied to each cooler to document that the container was properly sealed and to determine if the container was tampered with during shipment. The custody seals will be placed on the coolers in such a manner that the custody seal would be broken if the cooler were opened (*i.e.*, diagonally opposite corners of the cooler lid).

- The original COC will accompany the shipment. A copy will be retained by the Field Team Leader.

- If the samples are sent by common carrier or air freight, proper documentation must be maintained. For example, the bill of lading must be retained by the Field Team Leader.

Laboratory Custody Procedures

The laboratory custody procedures will be equivalent to those described in the latest edition of the SOW. The following will be addressed in the laboratory custody SOPs:

- A designated sample custodian accepts custody of the samples and verifies that the information on the sample labels matches the information on the COC. The sample custodian will document any discrepancies and will sign and date all appropriate receiving documents. The sample custodian will also document the condition of the samples upon receipt at the laboratory.

QAPP Worksheet #27 -- Sample Custody Requirements (continued)

- Once the samples have been accepted by the laboratory, checked and logged in, they must be maintained in accordance with laboratory custody and security requirements.
- To ensure traceability of samples while in the possession of the laboratory, a method for sample identification that has been documented in a laboratory SOP will be used to assign sample numbers.
- The following stages of analysis must be documented by the laboratory:
  - Sample Extraction/Preparation.
  - Sample Analysis.
  - Data Reduction.
  - Data Reporting.
- Laboratory personnel are responsible for the custody of samples until they are returned to the sample custodian.

When sample analyses and QA checks have been completed in the laboratory, the used portion of the sample must be stored or disposed of in accordance with the protocols specified in the SOW or the subcontract agreement. Identifying labels, data sheets, COCs, and laboratory records will be retained until analyses and QA checks are completed in accordance with the protocols specified in the subcontract agreement.

Final Evidence Files

This is the final phase of sample custody. The COC records and sample analysis request form copies are archived in their respective project files. Laboratory custody forms, sample preparation and analysis logbooks, and data packages will become part of the laboratory final evidence file. Other relevant documentation including records, reports, and correspondence, logs, pictures, and data review reports will be archived by GEI Consultants.

Sample Holding Times

Information on sample holding times and required preservation for each test method are provided in Worksheet 19.

Sample Packaging and Shipping Requirements

Custody of samples must be maintained through the shipment of samples to the selected laboratory. All samples will be packaged and shipped at the end of each day unless other arrangements are made with the laboratory.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table

Matrix	Aqueous / Solid / Sediment / Tissue
Analytical Group	PCBs
Analytical Method/ SOP Reference	BR-GC-005

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per extraction batch of 20 or fewer samples	< LOQ	See laboratory SOP	TestAmerica Laboratory	Contamination	See worksheet 15 for lab CRQL
Surrogates	Each sample, standard, blank	See worksheet 15	See laboratory SOP	TestAmerica Laboratory	Accuracy/Bias	Per Laboratory SOP
Laboratory Control Sample	One per extraction batch of 20 or fewer samples	See worksheet 15	See laboratory SOP	TestAmerica Laboratory	Accuracy	Per Laboratory SOP
Matrix Spike/Matrix Spike Duplicates	Per client Request	See worksheet 15	See laboratory SOP	TestAmerica Laboratory	Accuracy/Bias and Precision	Per laboratory SOP
Method Detection Limits	Annual	Per Laboratory SOP	Reanalyze MDL	TestAmerica Laboratory	Sensitivity	Low enough to support CRQLs

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table (continued)

Matrix	Sediment
Analytical Group	Total Organic Carbon
Concentration Level	Low
Sampling SOP	See Worksheet 20
Analytical Method / SOP Reference	Lloyd Kahn, 006
Analytical Organization	Test America, Inc. Burlington VT
Number of Sample Locations	See Worksheet 18

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Equip blank	One per day per type of sampling equipment	Per laboratory SOP	Investigate source of contamination	Assigned Lab personnel	Accuracy/Bias	Per laboratory SOP
Matrix Spike/Matrix Spike Duplicates (MS/MSD)	Per client submission	Per laboratory SOP	None if blank spike passes	Assigned Lab personnel	Accuracy/Bias	Per laboratory SOP
Field Duplicate	1 per 20 field samples	QAPP	If the limits exceed limits for the field duplicate, this will be addressed by the GEI Data Reviewer	GEI Field Team Leader	Precision	RPD < 30% for duplicate for values greater than or equal to five times the CRQL
LFB Method Blank (MB)	Once per batch	QAPP	Re-prep Batch	Assigned Lab personnel	Sensitivity	Per laboratory SOP

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table (continued)

Matrix	Aqueous / Solid / Sediment
Analytical Group	Volatile Organics
Analytical Method/ SOP Reference	BR-MV-006

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	Once every 12 hours	< LOQ	Reanalyze Batch	TestAmerica Laboratory	Contamination	See worksheet 15 for lab CRQL
Surrogates	Each sample, standard, blank	See worksheet 15	Reanalyze sample	TestAmerica Laboratory	Accuracy/Bias	Per Laboratory SOP
Laboratory Control Sample	Once every 12 hours	Per Worksheet 15	Reanalyze Batch	TestAmerica Laboratory	Accuracy	Per Laboratory SOP
Matrix Spike/Matrix Spike Duplicates (MS/MSD)	Each group of field samples in an SDG or each SDG, whichever is most frequent	See worksheet 15	None if laboratory control sample passes	TestAmerica Laboratory	Accuracy/Bias and Precision	Per laboratory SOP
Internal Standard	Each sample, standard, Blank	Area between 50-100% of area of daily calibration internal standard area	Reanalyze Sample	TestAmerica Laboratory	Instrument Performance	Per Laboratory SOP
Method Detection Limits	Annual	Per Laboratory SOP	Reanalyze MDL	TestAmerica Laboratory	Sensitivity	Low enough to support CRQLs

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table (continued)

Matrix	Sediment
Analytical Group	PCB Congeners
Concentration Level	Low
Sampling SOP	See Worksheet 20
Analytical Method / SOP Reference	002
Analytical Organization	TestAmerica Knoxville, TN
Number of Sample Locations	See Worksheet 18

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch (20 or fewer client samples)	No Target Analytes > EML	Reanalyze Method Blank (MB) and samples if instrument performance is believed to have contributed to MB failure. If sample results >20x blank or ND, report results. If analyte result in MB > RL and sufficient sample is available, re-prepare and reanalyze batch if project data quality objectives are not met or flag data in consultation with client.	Analyst/Section Supervisor/PM	Accuracy/Bias-Contamination	No Target Analytes > EML
Laboratory Control Sample	1 per batch (20 or fewer client samples)	Toxic/LOC Analytes percent recovery between 50% and 150%	Verify calculations. Reanalyze extract if instrument performance is believed to have contributed to LCS failure. If LCS recovery is high and the analyte is not detected, document excursion in narrative. If sufficient sample is available, re-prepare and reanalyze batch or flag data in consultation with client.	Analyst/Section Supervisor/PM	Accuracy/Bias	Laboratory SOP % Recovery Control Limits
Internal Standards	Every client sample field QC and lab QC sample	Percent recovery between 30% and 140%	Verify calculations. For low recovery calculate S/N ratio. If S/N is >= 10 and EDL <= EML report data as is and narrate.	Analyst/Section Supervisor/PM	Accuracy/Bias	Laboratory SOP % Recovery Control Limits

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table (continued)

Matrix	Aqueous / Solid / Sediment
Analytical Group	Semivolatile Organics
Analytical Method/ SOP Reference	BR-MS-001

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	Once every 12 hours	< LOQ	Reanalyze Batch	TestAmerica Laboratory	Contamination	See worksheet 15 for lab CRQL
Surrogates	Each sample, standard, blank	See worksheet 15	Reanalyze sample	TestAmerica Laboratory	Accuracy/Bias	Per Laboratory SOP
Laboratory Control Sample	Once every 12 hours	Per Worksheet 15	Reanalyze Batch	TestAmerica Laboratory	Accuracy	Per Laboratory SOP
Matrix Spike/Matrix Spike Duplicates (MS/MSD)	Each group of field samples in an SDG or each SDG, whichever is most frequent	See worksheet 15	None if laboratory control sample passes	TestAmerica Laboratory	Accuracy/Bias and Precision	Per laboratory SOP
Internal Standard	Each sample, standard, Blank	Area between 50-100% of area of daily calibration internal standard area	Reanalyze Sample	TestAmerica Laboratory	Instrument Performance	Per Laboratory SOP
Method Detection Limits	Annual	Per Laboratory SOP	Reanalyze MDL	TestAmerica Laboratory	Sensitivity	Low enough to support CRQLs

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) -- QC Samples Table (continued)

Matrix	Solid
Analytical Group	Total Petroleum Hydrocarbons
Analytical Method/ SOP Reference	BF-MS-004/BF-MV-005

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	Once every 12 hours	< LOQ	Reanalyze Batch	TestAmerica Laboratory	Contamination	See worksheet 15 for lab CRQL
Surrogates	Each sample, standard, blank	See worksheet 15	Reanalyze sample	TestAmerica Laboratory	Accuracy/Bias	Per Laboratory SOP
Laboratory Control Sample	Once every 12 hours	Per Worksheet 15	Reanalyze Batch	TestAmerica Laboratory	Accuracy	Per Laboratory SOP
Matrix Spike/Matrix Spike Duplicates (MS/MSD)	Each group of field samples in an SDG or each SDG, whichever is most frequent	See worksheet 15	None if laboratory control sample passes	TestAmerica Laboratory	Accuracy/Bias and Precision	Per laboratory SOP
Internal Standard	Each sample, standard, Blank	Area between 50-100% of area of daily calibration internal standard area	Reanalyze Sample	TestAmerica Laboratory	Instrument Performance	Per Laboratory SOP
Method Detection Limits	Annual	Per Laboratory SOP	Reanalyze MDL	TestAmerica Laboratory	Sensitivity	Low enough to support CRQLs

QAPP Worksheet #29 -- Project Documents and Records Table

This section identifies the documents and records that will be generated for all aspects of the project including, but not limited to, sample collection and field measurement, on- and off-site analysis, and data assessment.

Project Documents and Records Table

Sample Collection Documents and Records (as applicable):

- Field Notes and or data sheets
- Chain of Custody Forms
- Air bills
- Analytical and Testing Sample Data Packages
- Data Validation Reports

On-Site Activities Documents and Records:

- Sample collection and processing record and custody records.
- Sample custody records
- Air bills (if applicable)
- Custody records
- Copies of field notes

Off-Site Analysis Documents and Records

- Chain of Custody (COC) records will be made and stored in the project files
- Copies of air bills (if applicable) will be kept in project files

- Copies of all Analytical Data Deliverables stored in Lab and transferred to Project files, instrument calibration records, lab, raw data stored in electronically or in hardcopy. Laboratory electronic data deliverables (EDD) will be obtained in a NYS DEC EDD ("EqUIS") format.

Data Assessment Documents and Records

- Project Records: Copies of all field notes must be sent to GEI Consultants, Inc.
- Project Records: Copies of COC must be kept by GEI Consultants, Inc.
- Field and/or lab inspection reports/checklists.
- Corrective action documentation.
- Data validation narratives.
- QA Review sheet.
- Copies of Form 1.
- Final Report.

This section describes the project data management process, tracing the path of the data from their generation to their final use or storage. All project data and information must be documented in a format useable to the project personnel.

Project Document Control System

Project documents will be controlled by the GEI Consultants, Inc. Project Manager who will maintain and distribute the hardcopies and electronic copies of the project documents, including any amendments. Electronic copies of project information will be maintained in the project directory on the server at GEI Consultants, Glastonbury, CT office, which is backed up at least once per day.

Data Recording

Data for this project will be collected by handwritten entries and will be recorded into field logbooks or on forms. Software may be the used to generate COC records and sample labels, or COCs and labels may be created manually. Computer-generated data associated with laboratory analyses will be managed under the control of the laboratory's laboratory information management system (LIMS).

Laboratory Data Transmittal

Laboratory data are managed by the laboratory's LIMS system, beginning with sample check-in on the sample receiving data terminal. Full laboratory data reports will be delivered to GEI Consultants, Inc. and will include electronic data deliverables (EDDs).

Data Storage and Retrieval

Paper copies of the forms, electronic copies of files, and the photographic log will be transmitted regularly to the GEI PM or designee. The completed forms and notebooks will be stored in the custody of the PM for the duration of the project. The full laboratory data reports submitted to GEI Consultants, Inc. will be stored in the custody of the Project Quality Officer or designee.

The Laboratory will maintain copies of documents and backups of all data associated with the analyses of samples. Raw data and electronic media of all field samples, including QC samples and blanks, will be archived from the date of generation and will be kept by the laboratory. Hard copies of project files will be archived at a secure facility and retained until the end of the contract. Data will be transferred to National Grid upon completion of the project. Retrieval of data by others will be at the discretion of National Grid and the NYSDEC. The length of time that records will be archived will be at the discretion of the National Grid and NYSDEC.

Each laboratory will archive, electronically, the sample analyses and submit the electronic data files along with the data deliverable package. Laboratory electronic data deliverables (EDD) will be obtained in a NYS DEC EDD ("EqUIS") format.

QAPP Worksheet #30 – Analytical Services Table

Identify all laboratories or organizations that will provide analytical services for the project, including on-site screening, on-site definitive, and off-site laboratory analytical work. Group by matrix, analytical group, concentration, and sample location or ID number. If applicable, identify the subcontractor laboratories and backup laboratory or organization that will be used if the primary laboratory or organization cannot be used.

Matrix	Analytical Group	Concentration Level	Sample Locations/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/ Organization	Backup Laboratory/Organization
Sediment Samples							
Sediment/Solids	PCBs USEPA Method 8082A	Low	See Worksheet 18	001	Validation Level Data Package: Fifteen Business Days	TestAmerica-Burlington, VT	A backup lab has not been assigned at this time
Sediment/Solids	PCB Congeners USEPA Method 1668A	Low	See Worksheet 18	002	Validation Level Data Package: Fifteen Business Days	TestAmerica-Knoxville, TN	A backup lab has not been assigned at this time
Sediment	Total Organic Carbon USEPA Method Lloyd Kahn	Low	See Worksheet 18	003	Validation Level Data Package: Fifteen Business Days	TestAmerica-Burlington, VT	A backup lab has not been assigned at this time
Sediment	Grain Size ASTM D422	Standard	See Worksheet 18	004	Validation Level Data Package: Ten Business Days	TestAmerica-Burlington, VT	A backup lab has not been assigned at this time
Solids	SVOCs	Low	See Worksheet 18	004	Validation Level Data Package: Ten Business Days	TestAmerica-Burlington, VT	A backup lab has not been assigned at this time
Solids	TPH	Low	See Worksheet 18	004	Validation Level Data Package: Ten Business Days	TestAmerica-Buffalo, NY	A backup lab has not been assigned at this time

Note: Environmental data suppliers (labs) will provide accredited information by the NYSDOH ELAP in appropriate analytical categories.

QAPP Worksheet #31 – Planned Project Assessment Table

Identify the type, frequency, and responsible parties of planned assessment activities that will be performed for the project.

Assessment Type	**Frequency**	**Internal or External**	**Organization Performing Assessment**	**Person(s) Responsible for Performing Assessment** (title and organizational affiliation)	**Person(s) Responsible for Responding to Assessment Findings** (title and organizational affiliation)	**Person(s) Responsible for Identifying and Implementing Corrective Actions (CA)** (title and organizational affiliation)	**Person(s) Responsible for Monitoring Effectiveness of CA** (title and organizational affiliation)
Field Safety Audit	Discretionary	Internal	GEI	GEI Corporate Health and Safety Officer	GEI PMs	GEI PMs	GEI PMs
Contractor Performance Evaluation	Monthly or as warranted	External	National Grid	National Grid delegate	GEI PMs	GEI PMs	GEI PMs

QAPP Worksheet #32 – Assessment Findings and Response Actions

For each type of assessment describe procedures for handling QAPP and project deviations encountered during the planned project assessments.

PROJECT ASSESSMENT TABLE						
Assessment Type	**Frequency**	**Internal or External**	**Organization Performing Assessment**	**Party responsible for performing assessment**	**Person(s) responsible for responding to assessment findings**	**Person(s) responsible for identifying and implementing corrective actions**
Field Sampling Assessment	Project commencement and as needed.	Internal	GEI	Field Team Leader/Project Safety Officer, GEI, Inc.	Project Manager, GEI	Project Manager, GEI
Fixed Laboratory Technical Systems Audit	As needed.	External	GEI	Project QA/QC Officer, GEI, Inc.	Project Manager, Project Laboratory	Project Manager, Project Laboratory

Field Oversight

Field oversight of the project will be conducted by the Task Manager/Field Leader on a daily basis. The Task Manager/Field Leader will oversee the field samplers and subcontractors to see that the work goes smoothly and according to the site-specific plans. Corrective actions will be addressed immediately in the field and any issues that might possibly impact the data will be documented in the field notes.

Field Sampling Assessment

An assessment of field sampling procedures would take place on-Site early in the field program so that necessary corrective action measures can be implemented, if required. The assessment would consist of an evaluation by the Field Team Leader and Project Safety Officer of sampling techniques, field parameter measurements, record keeping including log books and COCs, sample collection and handling sample design, subcontractor oversight and health and safety.

QAPP Worksheet #32 – Assessment Findings and Response Actions (continued)

Fixed Laboratory Technical Systems Audit

A laboratory technical systems audit would consist of a review of any, but not necessarily all, of the following: sample handling procedures, equipment condition and operation, analytical methods and procedures and overall conformance with SOPs provided in this QAPP. The audit may span a period of one or more days, so that the audit team can view various types of analytical procedures that will be used on the project.

Assessment Findings and Corrective Action Responses

Deficiencies that are found as a result of the audits will be communicated both verbally to the responsible party upon discovery and will also be documented in a written audit report. A formal corrective action response in writing will be requested from the responsible party. The response will document the reason for the deficiency and the actions that will be put in place to correct the deficiency. Corrective action responses will be filed in the project files.

Additional QAPP Non-Conformances

The corrective action procedures discussed in this section will also be applied to significant deviations from procedures outlined in this QAPP. Project personnel who determine that a deviation has occurred will document the deviation and notify the GEI project manager. The project manager will evaluate the severity of the deviation, document deviations, and implement corrective action procedures as appropriate.

QAPP Worksheet #33 – Planned Project Assessment Table

Identify the frequency and type of planned QA Management Reports, the project delivery dates, the personnel responsible for report preparation, and the report recipients.

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Data Validation Report	After laboratory data are received	Within 30 days after receiving the full deliverable	Data Validator	Project QC Officer and Project Manager

The National Grid PM will receive various types of management reports, such as the results of the data validation reports. In addition, monthly progress report, provided to National Grid and USEPA, may contain a section on quality control issues. Problems or issues that arise between regular reporting periods may be identified to program management. The progress report will include an assessment of problems with the measurement data, including accuracy, precision, completeness, representativeness, and comparability.

QAPP Worksheet #34 – Sampling and Analysis Verification (Step 1) Process Table

Describe the processes that will be followed to verify project data. Describe how each item will be verified, when the activity will occur, and what documentation is necessary, and identify the person responsible. *Internal* or *external* is in relation to the data generator.

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Chain of custody (COC)	Form will be internally reviewed upon completion and verified against field logs and laboratory reports. Review will occur with the completion of each report.	I	GEI Consultants, Inc.
Field report	Field reports will be verified with the field logbooks.	I	GEI Consultants, Inc.
Laboratory data packages	Laboratory data packages will be used to verify the reported results in the project report and against QAPP criteria.	I	GEI Consultants, Inc.

Data Verification

- The Field Team Leader or designee is required to review the logbook entries for errors or omissions. This information is transmitted to the Project QC Officer or designee for correction.

- In addition, the Project QC Officer or designee is responsible for reviewing field data for completeness and to verify that the field crew followed the QC requirements detailed in this QAPP (*e.g.*, the collection of QC samples at the required frequency, response checking the field instruments). If any problems with the information are found, the Project QC Officer or designee will document the problems.

The Project QC Officer or designee reviews the field data.

QAPP Worksheet #35 – Sampling and Analysis Validation (Steps IIa and IIb) Process Table

Describe the processes that will be followed to validate project data. Validation inputs include items such as those listed in Table of the UFP-QAPP Manual (Section 5.1). Describe how each item will be validated, when the activity will occur, and what documentation is necessary and identify the person responsible. Differentiate between steps IIa and IIb of validation.

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	Methods	Records support implementation of SOP in QAPP.	GEI Consultants, Inc.
IIa	Chain of Custody	Examine traceability of data from sample collection to generation of project report	GEI Consultants, Inc.
IIb	Deviations from SOP and project documents.	Determine impacts of any deviation from methods and the project plan.	GEI Consultants, Inc.

QAPP Worksheet #36 – Sampling and Analysis Validation (Steps IIa and IIb) Summary Table

Identify the matrices, analytical groups, and concentration levels that each entity performing validation will be responsible for, as well as criteria that will be used to validate those data.

Step IIa/ IIb	Matrix	Analytical Group1	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa/ IIb	Sediment/solid and Tissue	Chemical Parameters	Low to High	NYSDEC Validation Criteria*	Lorie MacKinnon, GEI Consultants, Data Validator
IIa/ IIb	Sediment/solid and tissue	Chemical/Geotechnical Parameters	Low to High	NYSDEC Validation Guidance* and Laboratory SOP Criteria	Lorie MacKinnon, GEI Consultants, Data Validator

[1]. Analytical data on chemical parameters produced by subcontract laboratories will be reviewed by a qualified data validator assigned by GEI.

*Validation will be performed in accordance with the NYSDEC DER-10 based on a Category B NYSDEC ASP Category B Data Deliverable, followed by validation per *USEPA Region II Functional Guidelines for Evaluating Organic Analyses* (September 2006b).

QAPP Worksheet #37 – Data Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used: The GEI Consultants' data validator will validate chemical data in accordance with the protocols outlined on Worksheet 35. Data validation alone does not insure usability of the data. Other factors will be considered, including comparison of actual reporting limits achieved by the lab on the samples collected to the project action levels and data needs.

Describe the evaluative procedures used to assess overall measurement error associated with the project: As part of the data validation process, the validator identifies any qualifications, the bias (if known) of the data, applies qualifiers and comments on the usability of the data. Once the validation package is received from the validator it is reviewed by the Project Quality Officer or a designee. Any QA/QC problems with the validation will be discussed with the validator and laboratories. Data will be compared to appropriate reference limits provided in Worksheet No. 15.

Identify the personnel responsible for performing the usability assessment: The usability of the data is the responsibility of the project team. The PMs will reconvene the project team after all data has been validated and reviewed. The data users performing the remediation design will participate in a usability assessment to determine if the data is sufficient to meet the data needs and the project DQOs, and will recommend if additional data is required. A data assessment report will be issued by the PM or his designee documenting the results of the usability assessment review performed by the project team. The report will be submitted to the USEPA and National Grid for their approval and regulatory review.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies: The Data Validation Report will present the findings of the data evaluation processes. Resulting data quality and conformance with evaluation guidelines will be presented.

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Attachment A

Regulations and Guidance Documents (Electronic)



New York State
Department of Environmental Conservation

Division of Fish, Wildlife and Marine Resources

Technical Guidance for Screening Contaminated Sediments



GEORGE E. PATAKI, *Governor*

JOHN P. CAHILL, *Commissioner*

New York State Department of Environmental Conservation
Division of Fish, Wildlife and Marine Resources

Technical Guidance for Screening Contaminated Sediments

Change Sheet for January 25, 1999

This document is a reprint of the original "Technical Guidance for Screening Contaminated Sediments" that was first printed in November 1993, and subsequently reprinted in July 1994 and March 1998, with the following changes noted:

- Additional sediment screening values have been added to Table 1 for benzene, toluene, ethylbenzene, xylene, and nine polycyclic aromatic hydrcarbon compounds. The 13 new substances have not been integrated alphabetically into table 1. They are listed separately as an aditional page (page 25).

In all other respects, this edition is an exact reprint of the editions dated November 1993, July 1994, and March 1998 w/changes

New York State Department of Environmental Conservation
Division of Fish, Wildlife and Marine Resources

Technical Guidance for Screening Contaminated Sediments

Change Sheet for March 2, 1998

This document is a reprint of the original "Technical Guidance for Screening Contaminated Sediments" that was first printed in November 1993, and reprinted in July 1994, with the following changes noted:

- The Division of Fish and Wildlife and the Division of Marine Resources were merged into a single entity, the Division of Fish, Wildlife and Marine Resources

- New tables have been added for screening marine and estuarine sediments only. The new tables have been taken from Long et al (1995), and are included as appendix 4. These tables have been distributed with earlier editions of this document as an addendum since April 25, 1996. Wherever the current text makes reference to Table 2 for screening sediments for metals contamination, Table 3 in Appendix 4 should be used instead if the sediments are in marine or estuarine water bodies.

In all other respects, this edition is an exact reprint of the November 1993 and July 1994 document.

New York State Department of Environmental Conservation
Division of Fish and Wildlife
Division of Marine Resources

Technical Guidance for Screening Contaminated Sediment

22 November 1993

(reprinted July 1994, March 1998, January 1999)

This document describes the methodology used by the Division of Fish and Wildlife and the Division of Marine Resources for establishing sediment criteria for the purposes of identifying contaminated sediments. Sediments with contaminant concentrations that exceed the criteria listed in this document are considered to be contaminated, and potentially causing harmful impacts to marine and aquatic ecosystems. These criteria do not necessarily represent the final concentrations that must be achieved through sediment remediation. Comprehensive sediment testing and risk management are necessary to establish when remediation is appropriate and what final contaminant concentrations the sediment remediation efforts should achieve.

- ORIGINAL SIGNED -
Kenneth F. Wich
Director
Division of Fish and Wildlife

- ORIGINAL SIGNED -
Gordon Colvin
Director
Division of Marine Resources

Table of Contents

I. Executive Summary vi

II. Background and Objectives 1

Ill. Need, Basis, and Concept of Sediment Criteria 2

IV. Derivation of Sediment Criteria for Non-Polar Organic Contaminants Using Equilibrium Partitioning 5

V. Polar Organics - Application of Water Quality Criteria to Pore Water via Direct Measurement of Pore Water 11

VI. Derivation of Sediment Criteria for Metals 11

VII. Use of Sediment Criteria in Risk Management Decision 15

VIll. Implementation of Sediment Criteria for Screening 17

Table 1 . Sediment Criteria for Non-Polar Organic Contaminants 20

Table 2. Sediment Criteria for Metals 26

Appendix 1. Derivation of Water Quality Criteria Used to Derive Sediment Criteria for the Protection of Piscivorous Wildlife 27

Appendix 2. Data Tables Used to Derive Sediment Criteria for Metals 32

Appendix 3. Literature Cited 34

Appendix 4. Data tables for screening marine and estuarine sediments 38

1. Executive Summary

The Department of Environmental Conservation originally proposed sediment criteria in 1989, as an appendix of a Cleanup Standards Task Force Report. These criteria were controversial because the proposed methodology, equilibrium partitioning, had not yet been endorsed by the U.S. Environmental Protection Agency (EPA) Science Advisory Board, and because the criteria themselves were perceived as remediation target concentrations. This revised sediment criteria document was prepared to incorporate scientific literature published since 1989, and to establish the purpose of sediment criteria for screening; that is, to identify areas of sediment contamination and to make a preliminary assessment of the risk posed by the contamination to human health and the environment. Criteria are developed for two classes of contaminants - non-polar organic contaminants and metals. Non-polar organic contaminant criteria are derived using the equilibrium partitioning approach, which has now been endorsed by the EPA Science Advisory Board. This approach estimates the biological impacts that a contaminant may cause based on it's affinity to sorb to organic carbon in the sediment. The concentration of biologically available contaminant is predicted and related to potential toxicity and bioaccumulation by using existing criteria established for the water column. New York State water quality standards and guidance values are used to derive sediment criteria. EPA water quality criteria are used only when New York State has not published a standard or guidance value for a particular compound. Water quality criteria for bioaccumulation proposed by the Divisions of Fish and Wildlife and Marine Resources are used when no New York State water quality standard or guidance value for bioaccumulation has been developed.

Metals criteria are derived from Ministry of Ontario guidelines and NOAA data that make use of the screening level approach. This methodology measures the concentration of contaminants present in areas where ecological impacts have been noted, and correlates the contaminant concentration with the severity of the impact. Toxicity mitigating conditions such as acid volatile sulfides are not considered because with the screening level approach, the metal concentrations present are correlated directly to a measurable ecological impact. Finally, this document discusses risk management for contaminated sediment, and makes recommendations for implementing sediment criteria. Table 1 lists sediment criteria for 64 non-polar organic compounds or classes of compounds, and Table 2 lists sediment criteria for 12 metals.

II. Background and Objectives

The Department of Environmental Conservation originally proposed draft sediment criteria in December 1989 as Appendix D to the Draft Clean Up Standards Task Force Report (DEC 1991). These criteria were based on the EPA equilibrium partitioning (EP) model, which had at that time just been submitted to the EPA Science Advisory Board for review. Two problems developed relative to these criteria. The first was that the equilibrium partitioning model did not receive a complete endorsement by the EPA Science Advisory Board (EPA SAB 1990). The SAB raised questions about the degree of uncertainty, sources of variability, and applicability of EP-based sediment criteria. Secondly, the New York State sediment criteria were published in the context of a clean-up standards report for contaminated sediment remediation. The perception of the reviewers and potential users was that the criteria represented mandatory clean-up levels that must be achieved by remediation methodologies. Appendix D of the Draft Clean-up Standards Task Force Report did state that risk management decisions were necessary and appropriate in the application of the sediment criteria, but the perception remained that the low concentrations described therein were in fact the primary target levels for sediment remediation. This issue was further clouded by real-world environmental problems such as dioxin in the New York-New Jersey Harbor area. Dredging and dredge spoil disposal is necessary for continued harbor operation, but attainment of the dioxin sediment criterion described in Appendix D could be economically unachievable.

There were three objectives for revising the sediment criteria document. The first objective was simply to clarify the document, make it easier to read, and provide greater scientific documentation to support the information presented.

The second objective was to incorporate scientific literature that has been published since 1989. This revision will be based primarily upon an EPA Proposed Technical Support Document (TSD) for the Development of Sediment Quality Criteria (EPA 1991). The EPA TSD was also published verbatim in peer-reviewed scientific literature (DiToro et al., 1991). The revised sediment criteria document will also incorporate a new EPA Science Advisory Board Report that endorses the equilibrium partitioning methodology and commends the EPA for satisfactorily addressing many of the concerns noted in the original SAB review (EPA SAB 1992). Also, this revision incorporates the 1992 Ministry of Ontario Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, for metals concentrations in sediment (Persaud et al., 1992). These guidelines were only draft in 1989, when the first sediment criteria document was produced.

The final objective of the revised document was to establish the role of EP-based sediment criteria as screening criteria; that is, for identifying areas of sediment contamination, and providing an initial assessment of potential adverse

impacts. While attainment of the EP-based sediment criteria will provide the maximum assurance of environmental protection, it is not necessary in all cases and at all times to achieve these criteria through remediation efforts. Risk assessment, risk management, and the results of further biological and chemical tests and analyses are vital tools for managing sediment contamination. To view sediment criteria in a one-dimensional, go/no go context is to miss potential opportunities for resource utilization through appropriately identified and managed risk.

Ill. Need, Basis, and Concept of Sediment Criteria

Sediments can be loosely defined as a collection of fine-, medium-, and course- grain minerals and organic particles that are found at the bottom of lakes [and ponds], rivers [and streams], bays, estuaries, and oceans (Adams et al., 1992). Sediments are essential components of aquatic [and marine] ecosystems. They provide habitat for a wide variety of benthic organisms as well as juvenile forms of pelagic organisms. The organisms in sediments are in constant contact with the sediments, and therefore, constant contact with any contaminants that may be adsorbed to the sediment particles. Potential impacts to benthic organisms include both acute and chronic toxicity with individual-, population-, and community- level affects, bioaccumulation of contaminants, and the potential to pass contaminants along to predators of benthic species (Adams, et al, 1992; Marcus, 1991; Milleman and Kinney, 1992).

Potential to harm benthic organisms is not the only adverse impact of contaminated sediments. They serve as diffuse sources of contamination to the overlying water body; slowly releasing the contaminant back into the water column (Marcus, 1991; DEC, 1989).

Contamination is a concept that is not always clearly defined relative to sediments. The mere presence of a foreign substance in a sediment could be construed as contamination. However, the presence of a foreign substance does not necessarily mean it is harmful. Metals can be present in naturally occurring concentrations (background levels) in species, or forms, that are not harmful to aquatic life. While there are no naturally occurring background concentrations for synthetic organic compounds, the presence of a synthetic organic compound does not necessarily imply harm. Some evaluation must be made to estimate the potential risk to aquatic life or human health that the compound will have.

The EPA has defined a contaminant as: "Any solid, liquid, semisolid, dissolved solid, gaseous material, or disease-causing agent which upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, may . . . pose a risk of or cause death, disease, behavioral abnormalities, cancer, genetic mutations,

physiological malfunctions ... or physical deformations, in the organism or their offspring" (EPA, 1992). This definition clearly explains that a contaminant is not simply the presence of a foreign substance, but an element of harm to some organism, species, population, or community must be involved.

The EPA defines sediment criteria in the following manner: A sediment criterion is a specific level of protection from the adverse effects of sediment associated pollutants, for beneficial uses of the environment, for biota, or for human health ... (EPA, 1992). A sediment criterion, then, must relate to the element of harm that the contaminant possesses by specifying an appropriate level of protection. To develop sediment criteria, it is necessary to identify the potential elements of harm to the various organisms, populations, and communities that could be affected. The criterion must then specify the level of protection necessary to balance each identified element of harm.

A corollary of the EPA definition is that if the specified level of protection is not attained, then a certain level of risk exists. The concentration of a contaminant in sediment can be compared to a number of criteria and their associated levels of protection, to determine the overall potential risk posed by that particular contaminant concentration to various exposed organisms. Only if the contaminant concentration is less than all of the available criteria can exposure to the sediment, or to organisms that inhabit the sediment, be considered to be without significant risk from those contaminants (risk could still result from other sources, such as contaminants for which criteria have not yet been derived). This is the concept of screening criteria. By comparing the contaminant concentration to various criteria and their associated levels of protection, the resource manager can begin to identify the appropriate tests, studies, and procedures to quantify and refine the level of risk; set remediation goals; prioritize remediation actions; and select risk management and communications options.

EP-based sediment criteria are tied to water quality standards, guidance values, (DEC, 1991) and criteria (EPA, 1991)[1]. Within the framework of New York State water quality regulations, five primary levels of protection are identified (6NYCRR, 1991) from which sediment criteria can be derived. These are:

---

[1]Water quality standards and guidance values are New York State regulatory terms that are essentially synonymous with the EPA term criterion. A standard is a water quality criterion that has been adopted into regulation. A guidance value is a water quality criterion that has been derived in the same manner as a standard, but has not yet been adopted into regulation, or subjected to public review and comment. When referring to water quality in this document, the use of the general term criteria will mean either a New York standard or guidance value.

A. Protection of human health from acute or chronic toxicity;

B. Protection of human health from toxic effects of bioaccumulation;

C. Protection of aquatic life from acute toxicity;

D. Protection of aquatic life from chronic toxicity;

E. Protection of wildlife from toxic effects of bioaccumulation.

Other levels of protection include fish flesh tainting, and aesthetics (taste, odor, or appearance). Human health-based criteria can be further subdivided into oncogenic (cancer causing) effects and non-oncogenic effects (6NYCRR, 1991). Unfortunately, water quality standards or guidance values do not usually exist for all five levels of protection simultaneously.

This document will identify a series of screening criteria concentrations for a number of contaminants that can be used to identify areas of sediment contamination, and evaluate the potential risk that the contaminated sediment may pose to human health or the environment. A contaminated sediment can be identified as one in which the concentration of a contaminant in the sediment exceeds any of the sediment criteria for that contaminant. Once a sediment has been identified as contaminated, a site-specific evaluation procedure must be employed to quantify the level of risk, establish remediation goals, and determine the appropriate risk management actions. The site-specific evaluation might include for example: additional chemical testing; sediment toxicity testing; or sediment bioaccumulation tests.

Sediment contaminants. primarily consist of heavy metals and persistent organic compounds (EPA, 1990). Sediment criteria for non-polar organic compounds are derived using equilibrium partitioning methodology (EPA, 1991, DiToro, et al., 1991). This document will derive sediment criteria for non-polar organic contaminants listed in the TOGS 1.1.1. (DoW, 1991), using the water quality standards and guidance values listed there. If a water quality criterion for a particular contaminant is not identified in TOGS 1.1.1., an EPA water quality criterion is used. These criteria are annotated with the suffix (E). Proposed water quality criteria for the protection of human health and piscivorous wildlife from bioaccumulative affects are derived using procedures identified in Appendix 1; Newell et a[. (1987); and 6NYCRR Parts 702.8 and 702.13. These criteria are annotated with the suffix (P). With the exception of PCBs, these water quality guidance values are not yet listed in TOGS 1.1.1.

Sediment criteria for metals are based upon procedures and data developed by the Ministry of Ontario (Persaud et al., 1992), and the National Oceanic and

Atmospheric Agency (NOAA) (Long and Morgan, 1990). Sediment criteria for polar organic compounds are not derived. Instead, contaminant concentrations in pore water should be compared directly to surface water quality criteria; see section V. Some polar organics such as phenolic compounds behave as non-polar compounds under conditions of neutral pH. For these compounds, EP-based sediment criteria can be derived. Both the equilibrium partitioning methodology and the Ministry of Ontario procedures are discussed below.

IV. Derivation of Sediment Quality Criteria for Non-polar Organic Compounds using Equilibrium Partitioning.

A. Characteristics of Non-polar Organics

Non-polar organic compounds are substances that contain carbon, and do not exhibit a net electrical (ionic) charge (Nebergall, et al. 1968). Non-polar organic contaminants tend to be of low solubility in water. Otherwise they would dissolve and not accumulate in sediments (Manahan, 1991). Many non-polar contaminants are highly soluble in lipids, and thus can be bioaccumulated. They are persistent, meaning they do not break down or degrade rapidly, and can remain in sediments for long periods of time. The International Joint Commission defines persistent compounds as compounds with a half life greater than 56 days (IJC, 1978). Some contaminants such as pesticides can cause direct, acute toxicity to exposed benthic organisms in low concentrations. Others such as DDT, PCB, and dioxin are more insidious and bioaccumulate over time to cause chronic toxicity effects such as reproductive failure, either in populations exposed directly to the contaminated sediment or to organisms further up the food chain (Rand and Petrocelli, 1985).

B. Fundamentals of Equilibrium Partitioning (EP)

The basis for the EP methodology for deriving sediment criteria is that the toxicity of a contaminant in a sediment is attributable to the fraction of the contaminant that dissolves in the interstitial pore water, and is considered to be freely biologically available. The EP methodology predicts the concentration of contaminant that will dissolve in the interstitial pore water from three factors: 1) the concentration of contaminant in the sediment; 2) the concentration of organic carbon in the sediment; and 3) the affinity of the contaminant for organic carbon in the sediment.

The affinity of a contaminant for sediment organic carbon can be directly measured. The sediment/water partition coefficient or K_P is a measure of the concentration of a contaminant sorbed to the sediment divided by the concentration dissolved in water (measured in l/kg), after mixing. The K_P is only useful as a site specific measure because the K_P will vary with different sediment

samples. The EPA (1991) reported that the organic carbon content of a sediment accounts for most of the variation in the uptake of the contaminant by the sediment. The K_{OC}, or sediment organic carbon/water partition coefficient is a measure of the concentration of contaminant that adsorbs to the organic carbon content of the sediment divided by the concentration dissolved in water, after mixing (measured in l/kg). When normalized for organic carbon, concentrations of a contaminant in different sediment samples are comparable. Another partition coefficient that is closely correlated with K_{OC} and is useful for predicting soil adsorption is the octanol/water partition coefficient, or K_{OW} (Kenaga, 1980). Voice, et al. (1983) citing Karickhoff (1979), reports that the relationship between the three coefficients can be described in two equations:

$$K_{OC} = K_P/f_{OC}$$

and

$$\log_{10}K_{OC} = \log_{10}K_{OW} - 0.21 \quad \text{(also in Kenaga, 1980)}$$

where f_{OC} is the fraction of solids by weight that is comprised of organic carbon.

The EPA (1991) refers to DiToro (1985) to define the relationship between K_{OC} and K_{OW} as:

$$\text{Log}_{10}K_{OC} = 0.00028 + 0.983\log_{10} K_{OW}$$

Using the DiToro (1 985) relationship, the Koc very nearly equals the K_{OW}. Using either relationship, it can be readily seen that the Koc and Kow for a given non-polar organic compound are very similar, and vary in direct proportion. In their initial review of the equilibrium partitioning methodology, the EPA SAB considered the equating of K_{OC} and K_{OW} to be a source of uncertainty (EPA SAB 1990). In their 1992 review, the EPA SAB states that uncertainties have diminished largely as a result of more accurate determination's of K_{OW}s, and that occasionally the Kow may not be a good predictor of the Koc (EPA SAB 1992).

When a non-polar organic contaminant enters the sediment, it will partition between the sediment and pore water in three compartments: a fraction will adsorb to the organic carbon in the sediment; another fraction will adsorb to dissolved organic carbon in the interstitial pore water; and a third fraction will dissolve in the pore water. An equilibrium will be established so that any change in the contaminant concentration in one compartment will result in a corresponding change in the contaminant concentration in other compartments. For example, if some of the contaminant dissolved in the pore water is removed, some of the contaminant adsorbed to the sediments will desorb to balance the loss from the pore water. If dissolved contaminant is added to the pore water, it will not all

remain in the pore water, but some will adsorb to dissolved organic carbon and sediment organic carbon, re-establishing the equilibrium. Interestingly, the EPA (1991) noted that an increase in the volume of dissolved organic carbon in the pore water causes contaminant sorbed to the sediment to desorb and in turn sorb to the dissolved organic carbon. The freely dissolved fraction of the contaminant remains practically unchanged.

Equilibrium partitioning methodology contends that sediment toxicity is attributable to the concentration of contaminant dissolved in the interstitial pore water and considered to be biologically available (EPA 1989, EPA 1991). It can be inferred, then, that a water quality criterion developed to protect aquatic life from contaminants dissolved in the water column should also protect benthic aquatic life from contaminant concentrations dissolved in pore water. The EPA (1991) compared the sensitivity of benthic organisms to the sensitivity of water column organisms to toxicity from the same chemicals, and found that they were very similar. Therefore the prediction that exceeding a water column-based criterion in sediment pore water would harm benthic organisms was considered valid.

C. Derivation of Sediment Criteria using Equilibrium Partitioning

To derive an organic carbon normalized sediment criterion, two items of information are required:

A. An ambient water quality criterion for a particular contaminant;

B. the K_{OW} partition coefficient for the contaminant;

For example, the PCB water quality criterion (see footnote 1 on page 4) for the protection of piscivorous wildlife from bioaccumulation is 0.001 ug/l. The K_{OW} for PCB is $10^{6.14}$, or 1,380,384.3 l/kg. The organic carbon normalized PCB sediment criterion (SCoc) would be:

$$SC_{OC} = WQC * K_{OW}$$

$$PCB\ SC_{OC} = 0.001\ /ug/l * 1{,}380{,}384.3\ l/kg * 1\ kg/1{,}000\ gOC$$

$$1.38\ (\approx 1.4)\ \mu g/gOC$$

1 kg/1,000 gOC is a conversion factor.

The meaning of the criterion is: based on the equilibrium partitioning characteristic of PCBs, in order not to exceed the water quality criterion of 0.001 ug/l in the pore water, the concentration of PCB in the sediment must not exceed 1.4 μg for each gram of organic carbon in the sediment.

To apply this SC_{OC} on a site specific basis, the concentration of organic carbon in the sediment at the site must be known. If a sediment sample was known to contain 3% organic carbon, the site specific sediment criterion (SC) for PCB could be derived:

$$SC = SC_{OC} * f_{OC}$$

f_{OC} = 3% OC/kg sediment = 30 gOC/kg

PCB SC = 1.4 μg/gOC * 30 gOC/kg = 42 μg PCB/kg sediment

This criterion states that: if there are less than 42 ug PCB/kg of sediment in a sediment containing > 3% organic carbon, there is no appreciable risk to piscivorous wildlife from consuming fish or other aquatic life from the water body over the contaminated sediment.

D. Limitations of Equilibrium Partitioning Derived Sediment Criteria

There are several limitations to the application of EP-based criteria:

1. EP-based criteria are only applicable to non-polar organic compounds, or other substances that behave as non-polar organic compounds in the sediment and prevailing environmental conditions, such as pH.

2. EP-based criteria apply only to the specific level of protection identified in the criterion. In the example above, the 42 μg/kg PCB concentration in the 3% sediment sample does not pose appreciable risk to wildlife, however, it may or may not pose a risk to human beings. A sediment criterion derived from a human health-based water quality criterion must be compared to make that determination.

3. EP-based criteria should only be derived for sediments with organic carbon fractions between approximately 0.2 - 12% (EPA SAB, 1992). Outside of this range, other factors that the EP methodology does not account for may influence contaminant partitioning.

4. The equilibrium partitioning method should not be applied to broad classes of compounds or mixtures if one K_{OW} value is used to represent the entire class or the mixture (EPA SAB, 1992). In this respect, PCB congeners would not be considered a broad class of compounds; they are a narrow class of quite similar compounds.

5. For compounds with a K_{OW} less than 100 ($\log_{10}K_{OW} \leq 2$), the water quality criterion can be greater than the site specific sediment quality

criterion. This implies that virtually all of the contaminant is biologically available. Since the water quality criterion delineates the concentration that is harmful to aquatic life, it is not reasonable that a smaller concentration in the sediments would be harmful to benthic organisms, especially considering that some fraction of the contaminant will be sorbed to the sediment and not biologically available. For these compounds, the organic carbon normalized sediment criterion should be derived in the manner described above. However, when determining the site specific criterion, compare the product of the SC_{OC} * f_{OC} with the water quality criterion, converted from a volumetric to mass units (μg/l * 1/kg = μg/kg). If the water criterion is greater than the site specific sediment quality criterion, use the water quality criterion as the sediment criterion. For example, the $\log_{10}K_{OW}$ of benzidine is 1.4. The SC_{OC} for the protection of benthic life (chronic toxicity), based on a TOGS 1.1.1. water quality criterion of 0.1 μg/l is 0.003 μg/gOC. If the sediment contained 3% organic carbon, the site specific SC would be 0.09 μg/kg. The water quality criterion (converted from a volumetric measure to a mass measure) of 0.1 μg/kg is greater, so the site specific sediment criterion should be 0.1 μg/kg. If the site contained 5% organic carbon the site specific sediment criterion would be 0.15 μg/kg, which is greater than the water quality criterion of 0.1 μg/I. In this instance, the 0.15 μg/kg would be the appropriate criterion to use.

6. Derivation of EP-based criteria assumes that an equilibrium between the sediment/pore water compartments has been achieved. Rand and Petrocelli (1985) indicate that the sorption-desorption equilibria are achieved rapidly, usually in a few minutes to several hours. Voice et al. (1983) found that in laboratory studies, equilibria were generally achieved in about 4 hours. In investigating contamination of stable sediments with long term exposure to a contaminant, it is likely that equilibrium has been achieved. However for spill sites, and areas with unstable sediments, attainment of the equilibrium condition may be questionable. The EPA SAB (1992) recommends that EP-based criteria not be used in areas of rapid deposition or erosion (e.g.>10 cm/yr), such as active dredge disposal areas, areas of heavy boat and barge traffic, and some river channels.

7. The EP methodology is not a highly accurate procedure in and of itself. Several related sampling and analysis procedures could introduce additional variation and uncertainty into the results. Some of these factors include: the value of the K_{OW} used and how it was derived; how the sediment sample was taken and analyzed for contaminant content; and how the organic content of the sediment sample (f_{OC}) was determined. For consistent application of sediment criteria, these factors must be considered systematically and consistently. ASTM (1993) recommendations should be followed for the proper collection, storage, and analysis techniques when

applying EP-based sediment criteria. The analysis method is particularly important for determination of sediment total organic carbon, because there are several methods available that may give variable results. The authors and EPA (1992b) recommend the use of catalytic combustion with nondispersive infrared carbon dioxide detection (Leonard, 1991) when developing total organic carbon-normalized criteria for non-polar organic compounds. However, unless the "true" K_{OW} differs by a factor of 10, or the 'true' f_{OC} differs by 50 - 100% from the K_{OW} and f_{OC} values used to derive the sediment criteria, the level of imprecision introduced into the criteria calculation will be minor. An EP-based criterion applies to a single sediment sample. Results obtained from composite samples may be misleading in that the contaminant concentration at a single point or depth might be diluted with uncontaminated samples. Conversely, a contaminated sample mixed with uncontaminated samples from other points or depths might cause a greater area appear to be contaminated than actually is.

8. There are still a number of uncertainties related to equilibrium partitioning-derived sediment criteria. These include such factors as particle size, particle density, organic carbon content, K_{OW}/K_{OC} relationship, route of exposure, the impact of dissolved organic carbon, and the uncertainty of extrapolating laboratory data to field conditions (EPA, 1991; EPA SAB, 1992). Despite these uncertainties, the EPA has found that sediment toxicity from laboratory experiments generally falls within a factor of 5 of the toxicity predicted by equilibrium partitioning. EP-based criteria are considered to be valid for screening and assessment. These preliminary assessments can be followed up with further testing if necessary to more accurately quantify risk.

Table 1 lists 52 non-polar organic compounds or classes of compounds for which sediment criteria have been derived using the equilibrium partitioning methodology. The derivation procedure is the same as that recommended by the EPA (1991). The only difference is that New York State water quality standards and guidance values are used instead of EPA ambient water quality criteria. EPA criteria have been used to derive a sediment quality criterion only when a New York standard or guidance value is not available. Four criteria, corresponding to four of the five levels of protection, are listed for each contaminant whenever possible. Sediment criteria are not derived for the protection of human health from toxicity, because that type of exposure would constitute human consumption of the interstitial pore water within the contaminated area, which is an unreasonable assumption. A sediment is considered to be contaminated if the contaminant concentration exceeds any of the criteria listed. The table also identifies the K_{OW} and the water quality criterion used to derive the sediment criterion. Water quality criteria are from DoW TOGS 1.1.1., unless suffixed with an (E), which indicates an EPA water quality criterion. Proposed water quality criteria for the protection of human health and piscivorous wildlife from bioaccumulative effects are used when

no TOGS 1.1.1. criterion for bioaccumulation has been developed. These criterion are annotated with the suffix (P), and are derived according to the method described in Appendix 1 and Newell et al. (1987).

V. Polar Organics - Application of Water Quality Criteria to Pore Water via Direct Measurement of Pore Water

For polar organics (except for phenols) no algorithms have been developed yet for sediment criteria that account for sediment characteristics which may affect substance toxicity. However, in order to screen sediments for potential impacts from polar organic compounds, interstitial (pore) water from sediment samples should not exceed existing water quality standards and guidance values for polar organics in TOGS 1. 1. 1.

The application of these criteria to pore water is complicated by dissolved organic carbon (DOC) in pore water that is generally much higher than DOC in the water column. DOC tends to reduce toxicity and bioaccumulation of chemicals by reducing their availability for uptake by the organism. However, even though water column DOC is usually low, water quality criteria are not modified to account for the effects of DOC. If the partitioning coefficient between DOC and water for a contaminant is known, that coefficient could be used to account for the effect of DOC on toxicity or bioaccumulation in the application of water quality criteria to pore water. The bioaccumulation of contaminants with low K_{OW} is generally not suppressed by water column DOC, indicating that the effects of DOC can probably be ignored. In any case, a conservative risk assessment is assured if the effects of DOC in pore water are ignored during a preliminary screening. In follow-on assessments, DOC affects should be evaluated. As a consequence, the water quality criteria becomes the pore water criteria, and sediment criteria per se are not derived for these compounds.

VI. Derivation of Sediment Quality Criteria for Metals

A. Characteristics of Metals as Sediment Contaminants

A wide variety of metals in a wide variety of forms can be found in marine and aquatic sediments. Some concentrations occur naturally, while others have been introduced through man's activities. Very low concentrations of most metals are required nutrients for living organisms, but in excess concentrations, metals can be harmful (Rand and Petrocelli, 1985). The properties that metals exhibit in water depend largely on the form in which the metal occurs (Manahan, 1991). In waterbodies, metals are typically found (Demayo et. a[, 1978):

1. Dissolved as free ions and complexes;

2. As particulates:

a. inorganic precipitates such as hydroxides, sulfide, carbonates, and sulfates;

b. sorbed onto or complexed with high molecular weight organic compounds or clay particles;

3. Mixed or sorbed to bottom sediments;

4. Incorporated into the tissues of biota.

The toxicity and bioavailability of metals in water [and sediment] vary with the form of the metals (EPA 1992a). The form of the metal, and thereby the toxicity of a metal, are highly influenced by environmental conditions such as pH, alkalinity, REDOX potential, and the availability of complexing ions or ligands. Very generally, it can be said that the dissolved fraction of metals seems to account for most toxicity, however, some particulate forms of some metals also exhibit toxicity (EPA 1992a).

Metals in water can generally be measured as total (total recoverable) dissolved metal. Currently, the EPA recommends using water effects ratios for evaluating the impact of metals on surface water quality (EPA 1993). Conduct toxicity tests using water from a specified site, and compare the toxicity with reference toxicity tests in relatively pure water. The resulting "water effects ratio" can then be used to adjust either a total recoverable metal criterion or effluent limitation, or dissolved metals water quality criterion (preferred in areas of highly variable suspended solids concentrations) to account for local conditions.

In sediments, metals exhibit the same variety of forms as in water; they can dissolve as ions or soluble complexes in the interstitial pore water, precipitate as organic or inorganic compounds, or sorb to binding sites in the sediment. The complexity of metals behavior in water and sediments makes it impossible to accurately predict the levels at which toxic effects will occur. For metals, the primary concern in sediments is toxicity to benthic organisms. Metals can bioaccumulate in organisms. Bioaccumulation of metals is highly variable and dependent on the form of the metal and how it enters the organism (Doull et al., 1980). Different organs and tissues will have different affinities for different metals and species of metals. Metals can be absorbed by an organism but be bound by proteins known as metallothioneins into relatively harmless forms. Toxicity of metals are dependent on many environmental conditions and are difficult at best to predict consistently.

B. Establishing Screening Level Concentrations

Because of the inability to predict biological affects from metals concentrations in sediment, the best alternative is to identify adverse ecological effects that are attributable to sediment-borne metals concentrations, and measure what concentration caused the adverse effect. The Ontario Ministry of the Environment issued metals guidelines derived by the "Screening Level Concentration" approach. This is an effects-based approach which uses field data on co-occurrence of benthic animals and contaminants (Persaud et al., 1992). The Ontario guidelines span background, lowest effect levels and severe effect levels. The methods used to derive these guidelines do not account for the effects of organic content, acid volatile sulfide concentration, particle size distribution or iron and manganese oxide content, or other toxicity-mitigating factors on the bioavailability of metals within the sediments, because the total metals concentration is related directly to an observed, measurable ecological effect. It is possible that this methodology might not discern toxicity from other compounds besides metals.

Long and Morgan (1990) reviewed and categorized chemical effects data in sediments according to low and median toxic effects ["Effects Range-Low (ER-L)" and "Effects Range-Median (ER-M)" concentrations] and "Overall Apparent Effects Thresholds" for benthic organisms observed in field studies across the nation. Effects levels reported were associated with bulk sediment concentrations without normalizing for any toxicity mitigating factors. For metals, effects levels in Long and Morgan (1990) may be compared with effects levels taken from Persaud et al. (1992). Both are based on a selection of observed effects from field studies, although Persaud et al. (1 992) is restricted to Great Lakes data while Long and Morgan (1 990) used both fresh and salt water data. For six metals (arsenic, cadmium, chromium, copper, lead and nickel), the lowest effects levels described by Persaud et al. (1992) are lower than the ER-L (effects range-low) from Long and Morgan (1990). This could be because in the relatively pure waters of Lake Ontario, fewer ligands were available to complex metal ions, so biological affects were noted at lower metals concentrations. The Long and Morgan (1990) study included more eutrophic waters, wherein, metals could be complexed to a greater extent into biologically unavailable forms. Exposed organisms were able to tolerate higher total metals concentrations because the greater fraction of metal present was biologically unavailable.

To establish screening criteria for sediments in New York State, two levels of protection as a basis sediment quality screening criteria were established, following the Ministry of Ontario Guidelines definitions. These are the Lowest Effect Level and the Severe Effect Level. The Lowest Effect Level indicates a level of sediment contamination that can be tolerated by the majority of benthic organisms, but still causes toxicity to a few species. The Severe Effect Level indicates the concentration at which pronounced disturbance of the sediment

dwelling community can be expected (Persaud et al. 1992). The ER-L and ER-M

from Long and Morgan (1990) were compared with the Lowest Effect Level and Severe Effect Level from Persaud et al. (1 990). The lowest concentration in each of the two effect levels was selected as the New York sediment screening criteria. These sediment criteria for metals are listed in Table 2. If a total metals concentration in a sediment sample is less than the Lowest Effect Level listed in Table 2, the effects of the metal in the sediment are considered to be acceptable. If the concentration is greater than the lowest effect level but less than the severe effect level concentration, the sediment is considered to be contaminated, with moderate impacts to benthic life. If the concentration is greater than the severe effect level, the sediment is contaminated and significant harm to benthic aquatic life is anticipated.

Background concentrations described in Persaud et al. (1992) were not used to establish criteria. For some metals, cadmium and copper for example, Persaud lists a Lowest Effect Level that exceeds the typical background concentration. Because a metal concentration in sediment is considered to be naturally occurring, or background, does not mean that the concentration is not causing an adverse ecological effect.

As noted above, metals guidelines from Persaud et al. (1992) are based on freshwater sediments only, and effects levels in Long and Morgan (1990) reflect data from both fresh and salt water. Although differences in the bioavailability of metals in fresh and salt water sediments may be elucidated in the future, at this time, the sediment criteria identified in Table 2 are considered suitable for identifying areas of metal contaminated sediment, assessing potential risk, and identifying suitable follow-up tests, studies, and risk management options in both fresh and salt water sediments.

C. Limitations to Sediment Criteria for Metals

There are limitations to the application of the metals sediment quality criteria listed in Table 2:

1. Persaud et al. (1 992) values are based on oligotrophic waters with low concentrations of metals-complexing ligands. These criteria are possibly over-protective when applied to more eutrophic waters. However, many streams and ponds in New York are oligotrophic, and the low effects concentrations are justified. These criteria are intended to be used for screening; that is, to identify potentially contaminated sites and provide a qualitative estimate of risk. Once a site is found to be contaminated with metals, further studies are necessary to quantify risk and determine if remediation actions are necessary. Remediation should not be based solely on exceedances of these criteria.
2. These criteria have limited applicability to mixtures of metals. Metals

criteria are most clearly applicable to sediments with high concentrations of a single metal, or situations where one metal has a disproportionately greater abundance in a sediment sample than any other metal. The presence of one metal can significantly affect the impact that another metal has on an organism. The effect can be synergistic, additive, or antagonistic (Eisler, 1993). A reasonable level of protection can be expected if none of the criteria are exceeded for metals that are present, however, effects may be present if the sum of the fractions of criteria over sediment concentrations exceed one, for all of the metals present. For example, in a sediment sample, four metals are detected. The concentration of each metal in the sediment sample is 0.3 of its corresponding sediment criterion. The sum of the fractions would be 1.2. In this case, further testing is warranted.

3. Total metals, or the bulk metals concentration should be measured in sediment samples.

VII. Use of Sediment Criteria in Risk Management Decisions

Once it has been determined that a sediment criterion is exceeded, more information is required to determine if remediation is necessary and what actual risks to the environment are present. The volume and location of sediment exceeding a criterion, which levels of protection are exceeded, the persistence of the contaminant, the uncertainty about the criteria, and the results of more detailed, site specific sediment tests all play a role in making decisions about how, and how much sediment to clean up in order to eliminate or minimize adverse effects. If the volume of sediment that exceeds sediment criteria is small and the sediment is fairly accessible, the remediation of all contaminated sediment may be the most expedient action. If volumes of sediment are large and/or difficult to remediate either because of accessibility, sensitivity of the impaired habitat, or lack of efficacious technology, further risk management evaluations are warranted. In general the areal extent of the contaminated sediments should be a factor in considering the need for, and method of remediation.

Once the source of contaminants to sediments is terminated, the length of time a particular area of sediments remain contaminated will depend on the persistence of the chemicals, and the site-specific characteristics of the sediment such as: rate of sedimentation; resuspension; and biological and chemical degradation. If a contaminant is not persistent (e.g. contaminant concentrations would be expected to fall to acceptable levels within six months to a year), and the effect of the contaminant is not severe, then sediment remediation may not be necessary. Even for a persistent contaminant, it may not be necessary to re-mediate the sediments if the contaminated area is a deposition zone, and the natural burying of the contaminated sediments beneath the zone of biological

activity and availability would be expected to occur within a short time, and resuspension of the contaminants was unlikely.

EPA SAB (1 992) examined a number of factors relating to the uncertainty of EP based sediment criteria, including sediment composition variability, measurement variation and Kow - Koc correlations and measurements. They report that all these variabilities amount to an estimated uncertainty factor of five. This suggests with good confidence that sediment criteria exceeded by a factor of five will result in the onset of toxicity. Toxicity could also result from sediment contaminant concentrations just below the sediment criterion. The EPA SAB (1992) identifies the range of concentrations from 1/5 - 5 times an EP-derived sediment criterion as a "grey" area, where observable impacts may or may not occur. Based on the statistical analysis of EP-derived sediment criteria, there is a high degree of confidence that contaminant concentrations -< 1/5 of a sediment criterion pose little or no risk. Similarly, if a contaminant concentration in sediment exceeds an EP-derived sediment criterion by a factor of 5, there is little or no doubt that adverse ecological impacts are occurring. Within the range in-between, the actual occurrence of effects is unknown. However, to avoid making the criteria excessively overprotective or under protective, the best use of the factor of 5 is in interpreting the results of sediment screening, not to modify the criteria.

The onset of chronic toxicity may be difficult to detect in natural systems. Water quality criteria designed to prevent acute toxicity are generally about ten times greater than comparable chronic criteria. Therefore, in general, sediments with contaminants at 50 times chronic toxicity sediment criteria concentrations (a factor of five for uncertainty and a factor of ten based on acute to chronic toxicity ratios), will result in the onset of acute toxicity to benthic animals with a high degree of confidence.

It must also be noted that with this uncertainty the possibility exists that the sediment criteria may be somewhat underprotective as well as than overprotective.

Sediment criteria for metals are based on empirical evidence from both lab and field studies without an attempt to normalize for any toxicity mitigating factors in the sediment. Variability of toxicity from metals in any given sediment is evident (Appendix 2). Many of the Lowest Effect Levels from Persaud et al. (1 992) are lower than the mean background concentrations in Great Lake sediments. This suggests that in some sediments relatively low levels of metals, even below mean background, are toxic, whereas in other sediments fairly high levels, up to and possibly even above background, may not be toxic. For all metals, the Severe Effect Level criteria exceeds mean background considerably; consequently, significant and noticeable toxicity is expected in all sediments that exceed that level of protection.

VIll. Implementation of Sediment Criteria for Screening

Implementation guidance can be outlined in a strategy to apply sediment criteria for screening areas suspected of sediment contamination and recommending actions to take if they are exceeded.

1. Compare sediment contaminant concentrations with sediment criteria

    a. Quantify the area and volume of sediment wherein the criteria is exceeded; determine whether biota are exposed to contaminated sediment, e.g. deeply buried sediments may be below active biological zones.

    b. Describe the significance of exceedances in terms of the predicted effects. For example, would bioaccumulation or toxicity be the predominant impact. Based on the levels of protection exceeded, evaluate whether impacts are expected to be isolated or widespread through the ecosystem of concern. Consider the potential for transport of contaminants by natural processes to other areas.

2. For naturally occurring substances such as metals, compare sediment concentrations in the area of interest with local background concentrations in areas known to be unaffected by anthropogenic sources of contamination. Evaluate sediments relative to sediment criteria to identify contaminated sites. Compare suspected contaminated sites with uncontaminated sites, looking for adverse ecological impacts.

3. If sediment concentrations of a compound are less than all of the sediment criteria for that substance, aquatic resources can be considered to be not at risk (from that compound). However, additional testing would be warranted if the concentration of numerous contaminants were just below the criteria thresholds.

4. If sediment contaminant concentrations exceed criteria, and especially if widespread in the area of interest, steps may be taken to verify the need for remediation:

    a. For sediments with non-persistent, non-polar organic contaminants that are not causing observable acute or significant chronic toxicity, further remedial investigation or sediment remediation is not necessary if the source of contamination will be eliminated and the sediment will cleanse itself. Many chemicals with $\log K_{OW} < 3$ can be expected to be non-persistent in sediments. If it is decided not to remediate sediments contaminated with non-persistent chemicals, then, assurance

must be made that water quality standards in offsite waters will not be contravened, and the public is informed of risks related to the contamination.

b. For sediments exceeding criteria based on aquatic life toxicity, including metals Lowest Effect Levels:

1. Assess the degree of impairment to the benthic community; compare site specific impairment with sediment contaminant concentrations; correlate site specific level of impairment with other known level of impairments and contaminant concentrations.

2. Collect sediment samples and conduct acute and chronic toxicity tests with fish and benthic invertebrates; correlate toxicity test results with sediment contaminant concentrations. It is important to follow established toxicity identification evaluation (TIE) techniques to ensure correct identification of the cause of toxicity, e.g. ammonia is a common cause of toxicity to benthic animals that can be mistakenly attributed to other toxics. Similarly, dissolved oxygen depletion in organically enriched sites such as wetlands could be confused with acute toxicity from contaminants.

3. For non-polar organic contaminants, exceedance of sediment criteria based on aquatic life chronic toxicity by a factor of 50 in a significantly large area indicates that biota are probably impaired and to achieve restoration of the ecosystem will require remediation of organic contaminants present.

4. For metals, if Severe Effect Levels are exceeded in significant portions of the ecosystem of concern, biota are most likely impaired and to achieve restoration of the ecosystem would likely require remediation of metals present.

C. For sediments exceeding criteria based on human health concerns:

1. Collect data on residues in edible, resident biota from the areas of concern and compare with tolerances, action levels, guidance values, or 1×10^{-6} cancer risk levels, or

2. Collect sediment samples, expose representative edible biota to sediments, measure residue in biota.

d. For sediment contaminant concentrations exceeding sediment criteria for the protection of piscivorous wildlife:

1. Collect data on residues in resident prey of piscivorous wildlife and compare with fish flesh criteria for protection of wildlife.

2. Expose wildlife food supply to contaminated sediment and measure residues in the food supply; compare with food supply residue levels known to be toxic to wildlife.

If sediment concentrations and criteria are less than analytical detection limits, ecological assessments are necessary to measure toxicity of sediments or residues in organisms exposed to sediments suspected of contamination. Generally, it is reasonable to predict that some, possibly high, levels of toxicity or bioaccumulation may associated with contaminants in sediments below analytical detection.

Table 1. Sediment criteria for non-polar organic contaminants. Water quality criteria used are taken from Togs 1.1.1. If a water quality criterion was not listed in TOGS 1.1.1., then an EPA criterion was used. These are annotated with the suffix (E). EPA criteria were extracted from the "Water Quality Criteria Summary" chart (EPA, 1991). EPA water quality criteria for the protection of human health (bioaccumulation) were taken from the "Recalculated Values - Organisms Only" column. Wildlife (bioaccumulation) and Human Health (bioaccumulation) protection criteria were derived in Appendix 1, unless TOGS 1.1.1. (bioaccumulation) criteria already existed. Although these criteria are only proposed, they are useful as guidance for estimating potential human health risks. These criteria are annotated with a suffix (P), for "Proposed criteria values".

			Levels of Protection							
			Human Health Bioaccumulation		**Benthic Aquatic Life Acute Toxicity**		**Benthic Aquatic Life Chronic Toxicity**		**Wildlife Bioaccumulation**	
Contaminant	**LogK_{ow}**	**Fresh-FW Salt -SW Both -FS**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**
Acenapthene	4.33	FW SW						140(E)[2] 240(E)[1]		
Aldrin & Dieldrin	5.0	FS	0.001	0.1					0.0077 (P)	0.77
Azinphosmethyl	2.4	FW SW					0.005 0.01	0.001 0.003		
Azobenzene	3.82	FS	0.16 (P)	1.0						
Benzene	2.0	FS	6.0	0.6						
Benzo(a)pyrene[3]	6.04	FW SW	0.0012 0.0006	1.3 0.7						

[2]EPA proposed sediment quality criterion for the protection of benthic organisms.

[3]These values also apply to benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, and methylbenz(a)anthracene.

Contaminant	$LogK_{ow}$	Fresh-FW Salt -SW Both -FS	Levels of Protection: Human Health Bioaccumulation Water Qual Criteria µg/l	Human Health Bioaccumulation Sediment Criteria µg/gOC	Benthic Aquatic Life Acute Toxicity Water Qual Criteria µg/l	Benthic Aquatic Life Acute Toxicity Sediment Criteria µg/gOC	Benthic Aquatic Life Chronic Toxicity Water Qual Criteria µg/l	Benthic Aquatic Life Chronic Toxicity Sediment Criteria µg/gOC	Wildlife Bioaccumulation Water Qual Criteria µg/l	Wildlife Bioaccumulation Sediment Criteria µg/gOC
Benzidine	1.4	FW	0.1	0.003						
Bis(2-chloroethyl) ether	1.73	FS	0.5 (P)	0.03						
Bis(2-ethylhexyl) phthalate	5.3	FW					0.6	199.5		
Carbofuran	2.26	FW			10.0	1.82	1.0	0.2		
Carbon tetrachloride	2.64	FS	1.3 (P)	0.6						
Chlordane	2.78	FW SW	0.002 0.002	0.001 0.001	2.4 (E) 0.09 (E)	1.4 0.05	0.043 (E) 0.004 (E)	0.03 0.002	0.01 (P) 0.01 (P)	0.006 0.006
Chlorobenzene	2.84	FS			50.0	34.6	5.0	3.5		
Chloro-o-toluidine	≈2.0	FS	6.5 (P)	0.65						
Chlorpyrifos	5.11	FW SW			0.083 (E) 0.011 (E)	10.7 1.4	0.041 (E) 0.0056 (E)	5.3 0.72		
DDT, DDD, & DDE[4]	6.0	FW SW	0.00001 (P) 0.00001 (P)	0.01 0.01	1.1 (E) 0.13 (E)	1100 130	0.001 (E) 0.001 (E)	1.0 1.0	0.001 0.001	1.0 1.0
Diazinon	1.92	FW					0.08	0.007		
Dichlorobenzenes	3.38	FS			50.0	120.0	5.0	12.0		
1,2 Dichloroethane	1.48	FS	24.0 (P)	0.7						
1,1 Dichloroethylene	1.48	FS	0.8 (P)	0.02						

[4]Criteria for acute and chronic benthic toxicity apply to DDT only.

			Levels of Protection							
			Human Health Bioaccumulation		Benthic Aquatic Life Acute Toxicity		Benthic Aquatic Life Chronic Toxicity		Wildlife Bioaccumulation	
Contaminant	**LogK_{ow}**	**Fresh-FW Salt -SW Both -FS**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**
Dieldrin	5.0	FW SW	0.001 0.001	0.1 0.1				9.0 (E)[5] 17.0 (E)		
Diphenylhydrazine	3.03	FS	0.54 (E)	0.58						
Endosulfan	3.55	FW SW			0.22 0.034	0.78 0.12	0.009 0.001	0.03 0.004		
Endrin	5.6	FW SW	0.002	0.8				4.0 (E)[1] 0.73 (E)[1]	0.0019 (P)	0.8
Fluoranthene	5.19	FW SW						1020 (E)[1] 1340 (E)[1]		
Heptachlor & Heptachlor Epoxide	4.4	FW SW	0.00003 (P) 0.00003 (P)	0.0008 0.0008	0.52 (E) 0.053 (E)	13.1 1.3	0.0038(E) 0.0036(E)	0.1 0.09	0.001	0.03
Hexachlorobenzene	6.18	FW	0.0001 (P)	0.15	6.0 (E)	9081	3.68 (E)	5570	0.008 (P)	12
Hexachlorobutadiene	3.74	FW SW	0.06 (P) 0.06 (P)	0.3 0.3	10.0 3.0	55.0 16.4	1.0 0.3	5.5 1.6	0.7 (P) 0.7 (P)	4 4

[5]EPA proposed sediment quality criteria for the protection of benthic organisms.

			Levels of Protection							
			Human Health Bioaccumulation		Benthic Aquatic Life Acute Toxicity		Benthic Aquatic Life Chronic Toxicity		Wildlife Bioaccumulation	
Contaminant	**LogK_{ow}**	**Fresh-FW Salt -SW Both -FS**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**
Hexachlorocyclohexanes	3.8	FW SW	0.009 (P) 0.009 (P)	0.06 0.06	2.0 0.16	12.6 1.0	0.01 0.004	0.06 0.03	0.23 (P) 0.23 (P)	1.5 1.5
Hexachlorocyclopentadiene	3.99	FW SW			4.5 0.7	44.0 6.8	0.45 0.07	4.4 0.7		
Isodecyldiphenyl phosphate	5.4	FW			22	5526	1.7	427		
Linear Alkyl Benzene Sulfonates	3.97	FW					40	373		
Malathion	2.2	FS					0.1	0.02		
Methoxychlor	4.3	FS					0.03	0.6		
Mirex	5.83	FS	0.0001 (P)	0.07			0.001	0.7	0.0055 (P)	3.7
Octachlorostyrene	≈6.0	FS							0.0005 (P)	0.5
Parathion and Methyl Parathion	2.5	FW			0.065 (E)	0.02	0.008	0.003		
Pentachlorophenol	5.0	FW			1.0	100	0.4	40		
Phenanthrene	4.45	FW SW						120 (E)[6] 160 (E)[1]		
Phenols, total chlorinated	2.75	FW					1.0	0.6		

[6]EPA proposed sediment quality criteria for the protection of benthic organisms.

			Levels of Protection							
			Human Health Bioaccumulation		Benthic Aquatic Life Acute Toxicity		Benthic Aquatic Life Chronic Toxicity		Wildlife Bioaccumulation	
Contaminant	**LogK_{ow}**	**Fresh-FW Salt -SW Both -FS**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**
Phenols, total unchlorinated	2.0	FW					5.0	0.5		
PCB	6.14	FW SW	0.0000006 0.0000006	0.0008 0.0008	2.0 (E) 10.0 (E)	2760.8 13803.8	0.014 (E) 0.03 (E)	19.3 41.4	0.001 0.001	1.4 1.4
2,3,7,8-TCDD	7.0	FS	0.000001	0.01					$2x10^{-8}$ (P)	0.0002
1,1,2,2-Tetrachloroethane	2.56	FS	0.7 (P)	0.3						
Tetrachloroethylene	2.88	FS	1.0	0.8						
o-Toluidine	1.4	FS	18.0 (P)	0.5						
Toxaphene	3.3	FW SW	0.009 (P) 0.009 (P)	0.02 0.02	1.6 0.07	3.2 0.14	0.005 0.005	0.01 0.01		
Trichlorobenzenes	4.26	FS			50	910	5	91		
1,1,2-Trichloroethane	2.17	FS	4.0 (P)	0.6						
Trichloroethylene	2.29	FS	11.0	2.0						
Triphenyl phosphate	4.59	FW			40	1556	4	156		
Vinyl Chloride	0.6	FS	18.0 (P)	0.07						

			Levels of Protection							
			Human Health Bioaccumulation		Benthic Aquatic Life Acute Toxicity		Benthic Aquatic Life Chronic Toxicity		Wildlife Bioaccumulation	
Contaminant	**LogK_{ow}**	**Fresh-FW Salt -SW Both -FS**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**	**Water Qual Criteria µg/l**	**Sediment Criteria µg/gOC**
Anthracene	4.45	FW			35	986	3.8	107		
Benz(a)anthracene	5.61	FW			0.23	94	0.03	12		
Benzene	2.13	FW SW			760 670	103 90	210 190	28 26		
Ethylbenzene	3.15	FW SW			150 41	212 58	17 4.5	24 6.4		
Fluorene	4.18	FW SW			4.8 23	73 348	0.54 2.5	8 38		
Isopropylbenzene (cumeme)	3.66	FW			23	105	2.6	12		
2-methylnaphthalene	3.86	FW SW			42 48	304 348	4.7 4.2	34 30		
Naphthalene	3.37	FW SW			110 140	258 328	13 16	30 38		
Pyrene	5.32	FW			42	8775	4.6	961		
Toluene	2.69	FW SW			480 430	235 211	100 92	49 45		
1,2,4-trimethylbenzene	3.75	FW SW			290 170	1631 956	33 19	186 107		
Xylene	3.15	FW SW			590 170	833 240	65 19	92 27		

Table 2. Sediment Criteria for Metals. Two levels of risk have been established for metals contamination in sediments. These are the Lowest Effect Level and the Severe Effect Level. The Lowest Effect Level for each metal is the lowest of either the Persaud et al. (1992) Lowest Effect Level or the Long and Morgan (1990) Effect Range-Low. Similarly, the Severe Effect Level for each metal is the lowest of either the Persaud et al. (1992) Severe Effect Level or the Long and Morgan (1990) Effect Range-Moderate. A sediment is considered contaminated if either criterion is exceeded. If both criteria are exceeded, the sediment is considered to be severely impacted. If only the Lowest Effect Level criterion is exceeded, the impact is considered moderate. The units are µg/g, or ppm, except for iron, which is listed as a percentage. An "L" following a criterion means that it was taken from Long and Morgan (1990); a "P" following a criterion indicates that it is from Persaud et al. (1992). Complete tables from both sources can be found in appendix 2.

Metal	Lowest Effect Level µg/g (ppm)	Severe Effect Level µg/g (ppm)
Antimony	2.0 (L)	25.0 (L)
Arsenic	6.0 (P)	33.0 (P)
Cadmium	0.6 (P)	9.0 (L)
Chromium	26.0 (P)	110.0 (P)
Copper	16.0 (P)	110.0 (P)
Iron (%)	2.0% (P)	4.0% (P)
Lead	31.0 (P)	110.0 (L)
Manganese	460.0 (P)	1100.0 (L)
Mercury	0.15 (L)	1.3 (L)
Nickel	16.0 (P)	50.0 (L)
Silver	1.0 (L)	2.2 (L)
Zinc	120.0 (P/L)	270.0 (L)

Appendix 1. Basis for the Water Quality Criteria Used for Deriving Sediment Criteria for the Protection of Human and Health and Piscivorous Wildlife from Bioaccumulation Effects.

This appendix provides the basis and calculations for ambient water quality criteria in Table 1 with the suffix (P), which were developed by the Divisions of Fish and Wildlife and Marine Resources for use in calculation of sediment criteria.

Human health (bioaccumulation) based criteria in Table 1 with the (P) suffix are derived according to the method in 6NYCRR 702.8.

$$\text{Water Quality Criterion, ug/l} = \frac{\text{ADI, ug/d}}{0.033 \text{ kg/d} \times \text{BF}}$$

where

ADI, ug/d = acceptable daily intake for humans taken from fact sheets supporting drinking water standards and guidance values in TOGS 1. 1. 1

0.033 kg/d = the human daily intake from fish consumption cited in Part 702.8, and

BF = bioaccumulation factor

Wildlife residue based criteria in Table 1 with the (P) suffix are derived according to the method in 6NYCRR 702.13.

$$\text{Water Quality Criterion, ug/l} = \frac{\text{A, mg/kg}}{\text{BF}}$$

where

A = a fish flesh criterion for protection of piscivorous wildlife taken from Newell et a[(1987), and

BF = Bioaccumulation Factor

Bfs for human health based criteria are about 3% lipid based, whereas the BCF's for wildlife based criteria are about 10% lipid based. BFs were determined as a best judgement from review of available information in EPA water quality criteria documents, EPA (1 979), and other scientific literature.

Aldrin and Dieldrin

Wildlife Residue Based Criterion

$$0.0077 \text{ mg/l} = \frac{0.12 \text{ mg/kg}}{15570}$$

Azobenzene

Human Health Residue Based Criterion

$$0.16 \text{ ug/l} = \frac{1 \text{ ug/d}}{0.033 \text{ kg/d} \times 179}$$

Bis (2-chloro-ethyl) ether

Human Health Residue Based Criterion

$$0.5 \text{ ug/l} = \frac{0.06 \text{ ug/d}}{0.033 \text{ kg/d} \times 4}$$

Carbon tetrachloride

Human Health Residue Based Criterion

$$1.3 \text{ ug/l} = \frac{0.8 \text{ ug/d}}{0.033 \text{ kg/d} \times 19}$$

Chlordane

Wildlife Residue Based Criterion

$$0.01 \text{ ug/l} = \frac{0.5 \text{ mg/kg}}{47020}$$

Chloro-o-toluidine

Human Health Residue Based Criterion

$$6.5 \text{ ug/l} = \frac{1.4 \text{ ug/d}}{0.033 \text{ kg/d} \times 15}$$

DDT, DDD & DDE

Human Health Residue Based Criterion

$$0.00001 \text{ ug/l} = \frac{0.02 \text{ ug/d}}{0.033 \text{ kg/d} \times 53610}$$

1.2-Dichloroethane

Human Health Residue Based Criterion

$$24 \text{ ug/l} = \frac{1.6 \text{ ug/d}}{0.033 \text{ kg/d} \times 2}$$

1,1-Dichlorethylene

Human Health Residue Based Criterion

$$0.8 \text{ ug/l} = \frac{0.14 \text{ ug/d}}{0.033 \text{ kg/d} \times 2}$$

Endrin

Wildlife Residue Based Criterion

$$0.0019 \text{ ug/l} = \frac{0.025 \text{ mg/kg}}{13240}$$

Heptachlor & Heptachlor Epoxide

Human Health Residue Based Criterion

$$0.00003 \text{ ug/l} = \frac{0.018 \text{ ug/d}}{0.33 \text{ kg/d} \times 15666}$$

Hexachlorobenzene

Human Health Residue Based Criterion

$$0.0001 \text{ ug/l} = \frac{0.04 \text{ ug/d}}{0.033 \text{ kg/d} \times 12000}$$

Wildlife Residue Based Criterion

$$0.008 \text{ ug/l} = \frac{0.33 \text{ mg/kg}}{40000}$$

Hexachlorobutadiene

Human Health Residue Based Criterion

$$0.06 \text{ ug/l} = \frac{1 \text{ ug/d}}{0.033 \text{ kg/d} \times 545}$$

Wildlife Residue Based Criterion

$$0.7 \text{ ug/l} = \frac{1.3 \text{ ma/kg}}{1818}$$

Hexachlorocyclohexanes

Human Health Residue Based Criterion

$$0.009 \text{ ug/l} = \frac{0.04 \text{ ug/d}}{0.033 \text{ kg/d} \times 130}$$

Wildlife Residue Based Criterion

$$0.23 \text{ ug/l} = \frac{0.1 \text{ mg/kg}}{433}$$

Mirex

Human Health Residue Based Criterion

$$0.0001 \text{ ug/l} = \frac{0.08 \text{ ug/d}}{0.033 \text{ kg/d} \times 18100}$$

Wildlife Residue Based Criterion

$$0.0055 \text{ ug/l} = \frac{0.33 \text{ mg/kg}}{60333}$$

Octachlorostyrene

Wildlife Residue Based Criterion

$$0.0005 \text{ ug/l} = \frac{0.02 \text{ mg/kg}}{40000}$$

2,3,7,8-Tetrachlorodibenzodioxin

Wildlife Residue Based Criterion

$$2 \times 10\text{-}8 \text{ ug/l} = \frac{0.000003 \text{ mg/kg}}{150{,}000}$$

1,1,2,2-Tetrachloroethane

Human Health Residue Based Criterion

$$0.7 \text{ ug/l} = \frac{0.4 \text{ ug/d}}{0.033 \text{ kg/d} \times 17}$$

0-Toluidine

Human Health Residue Based Criterion

$$18 \text{ ug/l} = \frac{1.2 \text{ ug/d}}{0.033 \text{ kg/d} \times 2}$$

Toxaphene

Human Health Residue Based Criterion

$$0.009 \text{ ug/l} = \frac{0.02 \text{ ug/d}}{0.033 \text{ kg/d} \times 67}$$

1,1,2-Trichloroethane

Human Health Residue Based Criterion

$$4 \text{ ug/l} = \frac{1.2 \text{ ug/d}}{0.033 \text{ kg/d} \times 9}$$

Vinyl Chloride

Human Health Residue Based Criterion

$$18 \text{ ug/l} = \frac{0.6 \text{ ug/d}}{0.033 \text{ kg/d} \times 1}$$

Appendix 2. The following tables are photocopied directly from Long and Morgan (1990) and Persaud et. al. (1992). They are presented here to provide further information about the metals criteria developed in Table 2., and the text above.

Copied directly from Persuad et. al. (1992)

Table 1: Provincial Sediment Quality Guidelines for Metals and Nutrients.
(values[a] in ug/g (ppm) dry weight unless otherwise noted)

METALS	No Effect Level	Lowest Effect Level	Severe Effect Level
Arsenic	-	6	33
Cadmium	-	0.6	10
Chromium	-	26	110
Copper	-	16	110
Iron (%)	-	2	4
Lead	-	31	250
Manganese	-	460	1100
Mercury	-	0.2	2
Nickel	-	16	75
Zinc	-	120	820
NUTRIENTS			
TOC (%)	-	1	10
TKN	-	550	4800
TP	-	600	2000

[a] - values less than 10 have been rounded to 1 significant digit. Values greater than 10 have been rounded to two significant digits except for round numbers which remain unchanged (e.g., 400).

"-" - denotes insufficient data/no suitable method.

TOC - Total Organic Carbon TKN - Total Kjeldahl Nitrogen TP - Total Phosphorus

(June 1992)

Copied Directly from Long and Morgan (1990)

Table 70. Summary of ER-L, ER-M, and overall apparent effects thresholds concentrations for selected chemicals in sediment (dry weight).

Chemical Analyte	ER-L Concentration	ER-M Concentration	ER-L:ER-M Ratio	Overall Apparent Effects Threshold	Subjective Degree of Confidence in ER-L/ER-M Values
Trace Elements (ppm)					
Antimony	2	25	12.5	25	Moderate/moderate
Arsenic	33	85	2.6	50	Low/moderate
Cadmium	5	9	1.8	5	High/high
Chromium	80	145	1.8	No	Moderate/moderate
Copper	70	390	5.6	300	High/high
Lead	35	110	3.1	300	Moderate/high
Mercury	0.15	1.3	8.7	1	Moderate/high
Nickel	30	50	1.7	NSD*	Moderate/moderate
Silver	1	2.2	2.2	1.7	Moderate/moderate
Tin	NA	NA	NA	NA	NA
Zinc	120	270	2.2	260	High/high
Polychlorinated Biphenyls (ppb)					
Total PCBs	50	400	7.6	370	Moderate/moderate
DDT and Metabolites (ppb)					
DDT	1	7	7	6	Low/low
DDD	2	20	10	NSD	Moderate/low
DDE	2	15	7.5	NSD	Low/low
Total DDT	3	350	117	No	Moderate/moderate
Other Pesticides (ppb)					
Lindane	NA	NA	NA	NSD	NA**
Chlordane	0.5	6	12	2	Low/low
Heptachlor	NA	NA	NA	NSD	NA
Dieldrin	0.02	8	400	No	Low/low
Aldrin	NA	NA	NA	NSD	NA
Endrin	0.02	45	2250	NSD	Low/low
Mirex	NA	NA	NA	NSD	NA
Polynuclear Aromatic Hydrocarbons (ppb)					
Acenaphthene	150	650	4.3	150	Low/low
Anthracene	85	960	11.3	300	Low/moderate
Benzo(a)anthracene	230	1600	7	550	Low/moderate
Benzo(a)pyrene	400	2500	6.2	700	Moderate/moderate
Benzo(e)pyrene	NA	NA	NA	NSD	NA
Biphenyl	NA	NA	NA	NSD	NA
Chrysene	400	2800	7	900	Moderate/moderate
Dibenz(a,h)anthracene	60	260	4.3	100	Moderate/moderate
2,6-dimethylnaphthylene	NA	NA	NA	NSD	NA
Fluoranthene	600	3600	6	1000	High/high
Fluorene	35	640	18.3	350	Low/low
1-methylnaphthalene	NA	NA	NA	NSD	NA
2-methylnaphthalene	65	670	10.3	300	Low/moderate
1-methylphenanthrene	NA	NA	NA	NSD	NA
Naphthalene	340	2100	6.2	500	Moderate/high
Perylene	NA	NA	NA	NSD	NA
Phenanthrene	225	1380	6.1	260	Moderate/moderate
Pyrene	350	2200	6.3	1000	Moderate/moderate
2,3,5-trimethylnaphthalene	NA	NA	NA	NSD	NA
Total PAH	4000	35000	8.8	22000	Low/low

* NSD = not sufficient data
** NA = not available

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Appendix 4. Change in the Guidance for Marine and Estuarine Sediments

The 22 November 1993, Technical Guidance for Screening Contaminated Sediments (reprinted July 1994) makes use of the sediment guidance values from a number of sources, including the ER-L and ER-M guidance values from Long and Morgan (1990). Long, MacDonald, Smith, and Calder (1995) further refined and enhanced the marine and estuarine data used by Long and Morgan (1990) and published new ERL and ERM specifically for marine and estuarine sediments. **For evaluation of risk from contaminants in marine and estuarine sediment,** the Division of Fish, Wildlife and Marine Resources will now use the Long et al (1995) guidance values rather than the Long and Morgan (1990) values. For non-polar organic compounds not listed in Long et al (1995) (Table 4, below), the equilibrium partitioning-derived values in Table 1. (pp 20-24 above) for saltwater should be used. The following Tables 3 and 4 are reproduced directly from:

Long, E.R., MacDonald, D.D., Smith, S.L., and F.D. Calder, 1995. "Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments". Environmental Management 19(1):81-97.

Table 3. ERL and ERM guideline values for trace metals (ppm, dry wt.) and percent incidence of biological effects in concentration ranges defined by the two values.

	Guidelines		Percent (ratios) incidence of effects[a]		
Chemical	ERL	ERM	<ERL	ERL-ERM	>ERM
Arsenic	8.2	70	5.0 (2/40)	11.1 (8/73)	63.0 (17/27)
Cadmium	1.2	9.6	6.6 (7/106)	36.6 (32/87)	65.7 (44/67)
Chromium	81	370	2.9 (3/102)	21.1 (15/71)	95.0 (19/20)
Copper	34	270	9.4 (6/64)	29.1 (32/110)	83.7 (36/43)
Lead	46.7	218	8.0 (7/87)	35.8 (29/81)	90.2 (37/41)
Mercury	0.15	0.71	8.3 (4/48)	23.5 (16/68)	42.3 (22/52)
Nickel	20.9	51.6	1.9 (1/54)	16.7 (8/48)	16.9 (10/59)
Silver	1.0	3.7	2.6 (1/39)	32.3 (11/34)	92.8 (13/14)
Zinc	150	410	6.1 (6/99)	47.0 (31/66)	69.8 (37/53)

[a]Number of data entries within each concentration range in which biological effects were observed divided by the total number of entries within each range.

Table 4. ERL and ERM guideline values for organic compounds (ppb, dry wt) and percent incidence of biological effects in concentration ranges defined by the two values.

	Guidelines		Percent (ratios) incidence of effects[a]		
Chemical	ERL	ERM	<ERL	ERL-ERM	>ERM
Acenaphthene	16	500	20.0 (3/15)	32.4 (11/34)	84.2 (16/19)
Acenaphthylene	44	640	14.3 (1/7)	17.9 (5/28)	100 (9/9)
Anthracene	85.3	1100	25.0 (4/16)	44.2 (19/43)	85.2 (23/27)
Fluorene	19	540	27.3 (3/11)	36.5 (19/52)	86.7 (26/30)
2-Methyl naphthalene	70	670	12.5 (2/16)	73.3 (11/15)	100 (15/15)
Naphthalene	160	2100	16.0 (4/25)	41.0 (16/39)	88.9 (24/27)
Phenanthrene	240	1500	18.5 (5/27)	46.2 (18/39)	90.3 (28/31)
Low-molecular weight PAH	552	3160	13.0 (3/23)	48.1 (13/27)	100 (16/16)
Benz(a)anthracene	261	1600	21.1 (4/19)	43.8 (14/32)	92.5 (25/27)
Benzo(a)pyrene	430	1600	10.3 (3/29)	63.0 (17/27)	80.0 (24/30)
Chrysene	384	2800	19.0 (4/21)	45.0 (18/40)	88.5 (23/26)
Dibenzo(a,h)anthracene	63.4	260	11.5 (3/26)	54.5 (12/22)	66.7 (16/24)
Fluoranthene	600	5100	20.6 (7/34)	63.6 (28/44)	92.3 (36/39)
Pyrene	665	2600	17.2 (5/29)	53.1 (17/32)	87.5 (28/32)
High molecular weight PAH	1700	9600	10.5 (2/19)	40.0 (10/25)	81.2 (13/16)
Total PAH	4022	44792	14.3 (3/21)	36.1 (13/36)	85.0 (17/20)
p,p'-DDE	2.2	27	5.0 (1/20)	50.0 (10/20)	50.0 (12/24)
Total DDT	1.58	46.1	20.0 (2/10)	75.0 (12/16)	53.6 (15/28)
Total PCBs	22.7	180	18.5 (5/27)	40.8 (20/49)	51.0 (25/49)

[a]Number of data entries within each concentration range in which biological effects were observed divided by the total number of entries within each range.

Attachment B

Field Standard Operating Procedures (Electronic)

STANDARD OPERATING PROCEDURE

FD-001 Field Notebook and Boring Log Forms

1. Objective

Proper documentation of all site activities is a crucial part of the field investigation process. Documentation, relative to sampling procedures, includes sample labels, sample seals, field logbooks, boring log forms, chain of custody records, sample analysis request forms, and laboratory sample logs. The field notebook serves as a record of significant field activities performed or observed during the project. The field notebook provides a factual basis for preparing field observation reports, if required, and reports to clients and regulatory agencies. Example field notes are provided in Appendix A. The field notebook can be used to record all soil boring information or, if desired, a separate boring log form can be used to document all soil boring information. The boring log form provides a factual basis for generating graphical boring logs for inclusion in reports to clients and regulatory agencies. An example boring log form is provided in Appendix A.

2. Execution

- Use a separate all-weather bound notebook for each site/location/project number. If separate boring log forms are used for soil borings, use a new form for each boring.
- Write neatly using black or blue waterproof pen (or note if field conditions [i.e., cold or wet weather] require use of pencil).
- Write the project name, project number, book number (i.e., 1 of 3), and date on the front cover. On the inside cover, identify the project name, project number, and “Return Book To:” the office address of the project manager.
- Number all of the pages of the field book starting with the first entry.
- Record activities as they occur. If separate boring log forms are being used, the field notebook should refer to the particular form.
- Neatly cross out mistakes using a single line and initial them. Erasures are not permitted. If an error is made on a document assigned to one individual, that individual will make all corrections. The person who made the entry will correct any subsequent error discovered on an accountable document. All subsequent corrections will be initialed and dated.
- Sign or initial and date the bottom of every page with an entry. Place a diagonal line through unused portions of a page.
- Record the following information upon each arrival at the site:
    1. Date/time/weather/project number
    2. GEI personnel
    3. Purpose of visit/daily objectives

4. Record conversations with: [Recommendation - If possible, record telephone numbers of individual contacts for the site in the field notebook.]
5. Contractors
6. Clients
7. Visitors (include complete names, titles, and affiliations whenever possible).
8. GEI office staff
9. Landowners (site or abutters)
10. Note time of arrival and departure of individuals visiting the site

- Additional observations to record:
  1. Type and quantity of monitoring well construction materials used
  2. Use of field data sheets or electronic logging equipment (e.g. boring logs, monitoring well sampling logs, etc.)
  3. Ambient air monitoring data
  4. Locations and descriptions of sampling points
  5. Sample media (soil, sediment, groundwater, etc.)
  6. Sample collection method
  7. Number and volume of sample(s) collected and sample bottle preservatives used
  8. Sample identification number (s) and date and time of sample collection
  9. Approximate volume of groundwater removed before sampling
  10. Field observations
  11. Any field observations made such as pH, temperature, turbidity, conductivity, water level, etc.
  12. References for all maps and photographs of the sampling site(s)
  13. Information pertaining to sample documentation: bottle lot numbers/ dates, method of sample shipments, chain-of custody record numbers, and overnight shipping numbers.
  14. Surveying data (including sketches with north arrows)
  15. Changes in weather
  16. Rationale for critical field decisions
  17. Recommendations made to the client representative and GEI Project Manager
  18. Include a site sketch or representative site photograph of conditions at the end of the day, if required
  19. Time
  20. Summarize work completed/work remaining

- Place a diagonal line though and sign portions of pages not used or skipped
- Bottom of each page signed and dated

3. Limitations

- Only record facts.
- Allow time at the end of the day to write your journal, and make it a priority, even at the expense of observing time.
- Record all observations regardless of relevancy.
- Identify conditions or events that could affect/impede your ability to observe conditions.
- Do not use spiral notebooks because pages can be easily removed.

4. Field Book and Boring Log Form Maintenance

Field notebooks and boring log forms are the primary sources of factual information that is the basis for technical reports. As such, their physical condition must be protected and maintained.

- When possible, digital scans of all field documents should be made at the end of each day and saved to the GEI network server in the appropriate project files.
- If digital scans cannot be generated and saved, hard copies should be made and saved separately from the field book and boring log forms.
- Regardless, when a field project is completed and field staff have returned to the office, a complete digital scan of all documents will be generated and saved to the network server in the appropriate project files.
- All original hard copies will be stored in file cabinets in the office, along with other relevant project files and managed per GEI's document retention policies.

5. References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

Yerington Mine Site SOP-03 Standard Operating Procedure Field Notes and Documentation, Revision 0 Revision Date: June 6, 2006.

6. Attachments

Attachment A - Example Field Notes

7. Contact

Jerry Zak

STANDARD OPERATING PROCEDURE

QA-001 Equipment Decontamination

1. Objective

This SOP describes methods used for preventing or reducing cross-contamination, and provides general guidelines for sampling equipment decontamination procedures. Preventing or minimizing cross contamination in sampled media and in samples is important for preventing the introduction of error into sampling results and for protecting the health and safety of site personnel. Removing or neutralizing contaminants that have accumulated on sampling equipment ensures protection of personnel from permeating substances, reduces or eliminates transfer of contaminants to clean areas, prevents the mixing of incompatible substances, and minimizes the likelihood of sample cross-contamination.

2. Execution

- Inspect equipment for cleanliness prior to moving onto a site and prior to relocating to each new sampling location. All contractor-provided equipment (augers, rods, spoons, backhoe buckets) shall be decontaminated by steam cleaning **prior to coming on site.**
- Equipment decontamination is a sequential procedure consisting of the following general steps: Alconox-solution wash (or equivalent non-phosphate detergent); potable water rinse; methanol wash, and three distilled-water rinses.
- Alconox solution is a mixture of approximately 1 cup of Alconox per 1 gallon of potable water. Alconox solution wash requires scrubbing the equipment with a brush soaked in Alconox solution and removing any visible contamination or dirt from the equipment.
- Before advancing each boring, drilling equipment (including augers, casing, rods, and washtub) must be decontaminated by steam cleaning.
- Split-spoon samplers must be decontaminated prior to collecting each sample. The split-spoon decontamination procedure includes: a gross wash and scrub in a bucket of Alconox solution; potable water rinse; methanol wash, and three distilled-water rinses.
- Pumps and tubing used for sample collection and well development must be decontaminated by flushing with a minimum of one gallon of potable water; then flushing with a minimum of one pint of methanol and rinsing twice with distilled water.
- For pumps and tubing, perform a final rinse of the sampling equipment with the water being sampled.

3. Limitations

- Do not store the deionized/distilled water in polyethylene bottles, use Nalgene, glass, or Teflon. Polyethylene may leach phthalates.
- Do not attempt to decontaminate string or rope - replace it.
- Due to eye and skin absorption hazards, safety glasses and gloves must be worn when handling decontamination solvents.
- The decontamination procedure may require modification based on site specific conditions and methods used should not interfere with the site-specific chemical analyses. The procedure may also require modification based on state regulations.
- Steam cleaning with potable water is an acceptable decontamination method for drilling equipment (i.e., augers).
- If sampling for metals, the decontamination procedure requires modification to include rinsing with a 1:1 nitric acid and rinsing with deionized water in place of distilled water.
- Dedicated equipment need not be decontaminated beyond initial decontamination prior to field use.

4. References

Environmental Response Team (ERT), US EPA. Sampling Equipment Decontamination, SOP No. 2006, Revision 0.0. August 11, 1994.

US EPA Region 9. Sampling Equipment Decontamination, SOP No. 1230, Revision 1.September 1999.

5. Attachments

None

6. Contact

Brian Conte

SUMMARY GUIDANCE

SS-001 Water Safety

1. Objective

The safe deployment and return of personnel during field activities while aboard a boat.

2. Execution

Boat safety practices will be conducted in general accordance with guidance provided in the United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM) 385-1-1. Personnel will board the barge at specified locations to be determined and agreed upon prior to field deployment. The following safety practices shall be adhered to:

- Every employee shall wear a Personal Flotation Device (PFD) at all times when underway aboard any boat less than 25 feet except when that boat is equipped with a fully enclosed cabin and the employee is inside. Boats under 25 feet must also, at a minimum, have Coast Guard approved PFDs on board for each person and at least one throwable flotation device, such as a seat cushion.
- For every boating activity, a trip plan must be communicated to someone in a position to know when you are overdue and take appropriate action.
- For every trip requiring more than one day, daily voice-radio communications with an appropriate base must be maintained.
- The consumption of alcoholic beverages and the use of illegal drugs shall not be permitted at any time aboard boats owned and/or operated by the department.
- Firearms shall not be kept in a loaded condition aboard boats owned and/or operated by the department except when carried by law enforcement personnel or when actively being fired for work related purposes.
- Contractors working in an exposed marine location shall monitor the National Oceanic and Atmospheric Administration (NOAA) marine weather broadcasts and shall use other local commercial weather forecasting services as may be available.
- Type III Personal Floatation Devices (PFDs) will be worn by boat/barge occupants at all times when working over water.
- For retrieving a person overboard, the boat operator will throw a life ring and line, and use a ladder attached to the barge or the support

boat step transom to allow the person to climb out of the water. For retrieving a person overboard, the support boat will also be equipped with a life ring attached to approximately 90 feet of rope. The barge and the support boat will be equipped with an ABC rated fire extinguisher(s).

- Emergency procedures for fire and man overboard will be reviewed on the first day of operations and any time a change of personnel occurs.

3. Limitations

None

4. References

United States Army Corps of Engineers, Safety and Health Requirements Manual (EM), 385-1-1.November 3, 2003 – Section 19 Floating Plant and Marine Activities

5. Attachments

None

6. Contact

Robin DeHate, GEI Corporate Health & Safety Officer

STANDARD OPERATING PROCEDURE

SS-002 Ponar or Shipek Grab Sampler

1. Objective

Surficial sediment samples will be collected from the upper 6 inches (approximate) using a Ponar or Shipek type grab sampler. Both of these sampling devices have the advantages of being relatively easy to handle and operate, readily available, moderately priced, and versatile in terms of the range of substrate types they can effectively sample. In addition, both of these grab samplers provide sufficient sample volume (8.2 or 2.4 cubic liters, respectively) to allow sub sampling for multiple analytes.

2. Materials

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

- Ponar/Shipek Sampler
- Stainless steel sampling tools
- Laboratory provided sample bottles
- Resealable plastic bags
- Ice
- Coolers, packing material
- Chain of custody records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Tape measure
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent markers
- Sample bottle labels
- Paper towels
- Personal Protection Equipment (PPE)
- Global Positioning System (GPS)

3. Execution

- Prior to sample collection, the grab sampler will be decontaminated.
- When deploying the grab sampler, the speed of descent should be controlled, with no “free fall” allowed. In deep waters, use of a winching system is recommended to control both the rate of descent and ascent.
- The sampler will be carefully lowered the last few feet to minimize dispersal of fine material due to a sampler-induced shock wave.

- At the time of the sample collection, the sample location will be surveyed with GPS survey equipment.
- After the sample is collected, the sampling device should be lifted slowly off the bottom and raised to the surface at a slow and steady rate.
- Sediments in direct contact with sides or teeth of the grab sampler will be excluded from samples to prevent potential contamination from the grab sampling device when possible.
- Prior to sampling directly from the grab sampler, the overlying water will be removed by opening the jaws of the Ponar slightly and allowing the water to drain. If the overlying water is turbid, then the suspended solids will be allowed to settle, if possible, prior to draining.
- Where sampling directly from the sampler is not possible or feasible, the sampler will be slowly opened over a sample platform. The sampler will be placed such that the sample may be deposited with minimal disturbance.
- Photograph the sample in color with a camera. Place a small label with sample field ID number and approximate depth so that it appears in each frame. SOP FD-004 Photodocumentation provides further guidance on photodocumentation.
- Sediments will be described in accordance with the soil description procedure listed below in SOP SM-003 Soil Classification.
- Place sediment samples into pre-cleaned laboratory provided jars for the appropriate analyses as determined in the work plan. Label each jar with the unique grab sample identification number and depth of the sample.
- Place the sample containers into plastic sealable bags or bubble wrap and place them in an iced cooler until transfer shipment to the analytical laboratories. Add the sample to the chain of custody form.

4. Limitations

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

There are two primary interferences or potential problems associated with sediment sampling. These include cross contamination of samples and improper sample collection.

- Cross contamination problems can be eliminated or minimized through the use of dedicated or disposable sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary.

- Improper sample collection can involve using contaminated equipment, equipment that is potentially not compatible with the contaminants of concern, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed or non-representative area. Be sure to use sampling equipment of an appropriate composition based upon the suspected contaminants and analyses to be performed.

Following proper decontamination procedures, minimizing disturbance of the sample site, and careful selection of sampling locations will eliminate these problems.

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

5. References

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

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

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

Newfield's Environmental Forensics Laboratory, 2005. Geochronologic Sample Handling Procedure.

6. Attachments

None

7. Contact

Kim Bradley

STANDARD OPERATING PROCEDURE

FD-003 Sample Handling and Chain of Custody

1. Objective

To properly collect, label, document, preserve, package, transport environmental samples, and to provide a record of the custody of any environmental field sample from time of collection to delivery to the laboratory. The Chain-of-Custody (COC) can be used as a legal document to guarantee that samples were not mishandled and that they were delivered to the laboratory within the timeframe necessary to start analysis. A sample is under custody if:

a) it is in GEI's possession; or
b) it is in GEI's view after being in GEI's possession; or
c) it was in GEI's possession and then it was locked up to prevent tampering; or
d) it is in a designated secure area. GEI facilities are designated secure areas.

2. Execution

- Review the work plan prior to sampling to determine the following:
  i. The analysis required by the period and sample volumes required by the laboratory to perform those analysis. (Be explicit when requesting analysis on the COC (e.g. rather than "VOCs" (Volatile Organic Compounds) write "VOCs 8260".)
  ii. The turnaround time required by the project.
  iii. If the data will be sent directly from the laboratory to the data validator or Data Group.
  iv. Holding time restrictions for sampling media and analytical methods.
- Label the jar or bottle not on the cap.
- Following sample collection, the sample container is labeled using a waterproof marker with the sample ID, the date and time (military time) of sample collection, project number, sample preservatives, and the sampler's initials. Sample custody begins at this time.
- Record the above information in the field notebook.
- Individually wrap sample jars with packing material. Place samples in a chilled (4°C) cooler immediately after collection.
- Complete a chain of custody (COC) for the samples as described below, and sign off on the COC each time a new person takes possession of the samples. A COC form must accompany each shipment/delivery of samples to the laboratory. GEI or Laboratory COC forms may be used as long as the laboratory form contains the same required information as described below.

- An example COC is provided in Attachment A.
- Place a custody seal on the cooler if shipping.
- Transport samples to the laboratory as soon as possible. It is preferable the samples are sent from the field rather than brought back to the office for submission at a later date.

2.1. Chain-of-Custody (COC) Completion

- Record the project name and number, the sampler's name(s) and the state where the samples were collected.
- For each sample, enter the sample identification number, date and time (military time) collected, whether the sample is a grab or composite sample and the number of sample containers. Record the type of analysis (including laboratory method; e.g. EPA-SW846 Method XX) requested and the preservative (if appropriate) in the vertical boxes.
- When samples are ready to be relinquished, complete the bottom of the form with date and time (military time) and signatures of relinquisher and receiver of samples as indicated. The sample collector is always the first signature while the analytical laboratory is the final signature. Theoretically, all individuals handling the samples between collection and laboratory should sign the form; however, if a common carrier (i.e., Federal Express, UPS) is used for shipping, GEI must identify the carrier in the 'Received by' box on the COC. If the sampler hand delivers the samples to the laboratory, the received box must be signed by the laboratory.
- The forms are in triplicate (white, yellow, and pink copies). The pink copy should be retained by the sampling personnel and provided to the Data Group for proper filing. The white and yellow copies should accompany the samples to the laboratory.
- Prior to sample shipment, the COC must be placed inside the cooler (in a ziplock bag or other watertight package taped inside the lid of the cooler), and the cooler must be sealed with a signed COC seal.
- If a common carrier such as FedEx is used to transport the samples to the laboratory, include the carrier tracking number and identify the carrier in the "Received by" box on the COC.
- Any unused sampling containers/media that is sent back to the lab should be included on the COC. Return samples to the laboratory in a timely manner.
- Field duplicates should be anonymous to the laboratory, but must be recorded for use by the Data Group. To keep track of this information, link the field duplicate with the proper sample in the field copy of the COC and also the field book.

- After the samples are sent to the laboratory, the field copy must be sent to the Data Group. You can send the field copy with duplicate information in the mail to the Data Group.

3. Limitations

- The field notebook must document all GEI personnel who had custody of any samples prior to shipping the samples to the laboratory, the samples must be relinquished to the shipper and the COC signed and dated by the sampler and the shipper, even if both people are GEI personnel.
- Keep the number of people involved in collecting and handling samples and data to a minimum.
- Only allow people associated with the project to handle samples and data.
- Always document the transfer of samples and data from one person to another on chain-of-custody forms.
- Always accompany samples and data with their chain-of-custody forms.
- Give samples and data positive identification at all times that is legible and written with permanent ink.
- When sending samples via a common carrier, use one COC per package.
- Do not send samples from more than one site with separate COCs in a single package.

4. References

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

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

Determination of Volatile Organic Compounds, Version 2.0 February 28, 2006.

5. Attachments

Attachment A – Example Chain of Custody

6. Contact

Brian Skelly

STANDARD OPERATING PROCEDURE

SC-002 Sample Handling

1. Objective

Sample handling involves the collection and shipping of environmental samples to a laboratory for chemical analysis. The overall objective of sample handling is to ensure that samples are properly:

- labeled and documented;
- preserved;
- packaged; and
- transported to laboratories.

2. Execution

- Prior to mobilizing to the field, select a shipper or arrange for a courier for sample delivery to the laboratory. If using a shipper (i.e., Federal Express, or UPS) determine the time constraints for pickup requests, the location and hours of the nearest shipping office, and any size/weight restrictions.
- Label all laboratory glassware with waterproof ink prior to collecting samples. The label should have an adhesive and be placed on the jar or bottle, not on the cap. In addition, clear packing tape should be placed over the sample label to secure it to the bottle as moisture from the samples can loosen the label adhesive.
- Record the following information on the label and in the field notebook (See Field Notebook SOP FD-001): project number, sample identification (i.e. MW-201 or SS-2), date, and time (military time) of collection, sampler's initials, and preservative, if present.
- If sample jars are not pre-preserved, add preservative as appropriate.
- At each sampling location, samples must be collected in order of volatility, most volatile first. Samples collected for volatile analysis must be placed in sample containers immediately upon retrieval of the sample.
- Aqueous samples for volatile analysis must be collected without air bubbles. Soil samples for volatile analysis should be compacted to eliminate as much headspace as possible. Other laboratory glassware should also be filled when possible. Care must be taken to avoid getting soils on the threads of sample jars, which can cause a faulty seal.
- If compositing of samples is performed in the field, specify basis for composite (i.e. volume, weight, spoon recovery, etc.) and record procedure for compositing sample in the field book.

- The sample cooler should have any water drains securely sealed with duct tape, both on the inside and outside of the cooler. A layer of packing material should be placed on the bottom of the cooler as a cushion. A large plastic bag will then be placed inside the cooler to contain all sample containers and ice for chilling samples. Refer to TestAmerica Packing Samples for Shipment Back to the Laboratory Attachment for reference.
- Once samples have been collected, place samples in a cooler with ice or a blue pack (if allowed) to chill samples to 4°C and start the chain-of-custody form (SOP FD-003 Sample Handling and *Chain of Custody*). Only use double bagged ice and not loose ice when packing cooler.
- For shipping, individually wrap each sample bottle with bubble packing or suitable packing material and place the wrapped bottles upright in the cooler with sufficient packing material between samples to avoid breakage.
- Place a layer of packing material above and below the sample bottles. Place blue ice packs or ice bags on top of the packing material. Fill the remaining space in the cooler with packing material to eliminate the possibility of vertical movement of samples.
- Seal the large plastic bag with the samples and ice inside.
- Place the completed and signed chain-of-custody form in a plastic ziplock-type bag and place on top of the packing material in the cooler, or taped to the inside lid of the cooler.
- Fill out the appropriate shipping or courier forms and attach to the top or handle of the cooler. If necessary, place the proper shipping labels on the cooler. Have the courier sign the COC form (or write pickup by FEDEX, UPS, etc. with date and time). Place a signed and dated custody seal on the cooler.
- All samples should be submitted as soon as possible. It is preferable for samples to be mailed prior to returning to the office.
- A copy of the waybills must be kept by the field supervisor to track shipments if necessary.

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health and Safety Plan.
- Field personnel must be aware of analyses which have short holding times and schedule sampling events and shipping accordingly. Shipment of samples for analyses with short holding times must be planned in advance. Refer to the project work plan, quality assurance project plan, or state/federal regulations for holding time and preservative information. Contact the laboratory ahead of time when

shipping samples with short holding time to ensure the lab is prepared for these analyses.

- In general, glassware for aqueous samples contains preservatives, (i.e. HNO3, HCl, etc). When collecting the sample, take care not to overfill the container, thus flushing the preservative out of the bottle.
- Never composite samples for VOCs in the field. Collect individual aliquots and direct the laboratory to perform compositing.
- Collection of aqueous samples should not be performed over the opening of a monitoring well. Preservatives from overfilling, a marker pen or other objects could fall into the well.
- If the recharge volume for a monitoring well is low, completely fill all volatile vials and then collect the minimum sample volume required for each remaining analysis.
- During subsurface soil sampling, if the recovery from the split-spoon sample is inadequate, if appropriate, resample the bottom of the borehole to obtain proper sample volume.
- Laboratories will homogenize and test the contents of the sample container, unless directed otherwise. Samples should not contain rocks, twigs, leaves, etc. unless these materials are of interest.

4. References

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

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

Determination of Volatile Organic Compounds, Version 2.0 February 28, 2006.

5. Attachments

Attachment 1 - General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

Attachment 2 – TestAmerica Packing Samples for Shipment Back to the Laboratory

6. Contact

Jennifer Sandorf

US Environmental Rental Corporation
Rentals · Sales · Service

To ensure accuracy, prevent lost time, and avoid additional fees:

- Do not store or use this equipment in a wet environment.
- Do not store this equipment in extremely high or low temperature environments.
- Use care to ensure that water and debris does not contact internal parts, connections, or accessories.
- Place re-chargeable batteries (if provided) on charge for at least 4 hours prior to use.
- Do not mark equipment or accessories with permanent marker or duct tape
- All contaminants must be removed from equipment and accessories prior to return.

The following items are included for the rental term. If they are not returned at the end of the rental or sustain damage, the replacement cost will be applied to your invoice.





Handheld Display



Cable



Flow Cell



Stand



Storage Cup



Comm. Cable



Sensor Guard



Manual

YSI FIELD CALIBRATION GUIDE

- Turn 650 MDS on.
- Press enter on sonde menu. (Sonde will connect with display.)
- Scroll down sonde menu and highlight Report. Press enter and scroll down to DO CHG and Ph mV and press enter. When there is a solid dot next to the parameter that means it is turned on. Also make sure the following parameters are turned on: Temp C; SpCond µS/cm; Cond µS/cm; DOsat%; DO mg/L; pH; and Orp mV. Press esc.
- Select Calibrate, and press enter.
- It is our recommendation that our calibration procedures and our calibration solutions are used. Failure to use our procedures with our solutions may compromise the accuracy of your results.
- **Start your calibration with conductivity first.**
  - Using our conductivity calibration solution, 1000 µS/cm, completely submerge probes in solution. Highlight Conductivity and press enter.
  - Highlight SpCond and press enter.
  - Now at "enter value" screen, enter the value, (If using our solutions enter 1 mS/cm, and it will calibrate to 1000 µS/cm.) Press enter once value is entered.
  - Here is where you need to check your DO CHG. **It should read 50 with an accuracy range of +/- 25.**
  - Check your SpCond, and Cond readings. If they display a drastic spike every few seconds try re-skinning the DO probe again. You may also need to change your KCL Solution. (6 month shelf life mixed)
  - If SpCond reading seems too high pre-cal, (1200+), you might want to change your cal solutions.
  - When the SpCond and Cond readings have become stable, count to ten and press enter.
  - The values for SpCond, and Cond will calibrate.
  - Press enter to return to calibration parameters screen.
  - Rinse and dry probes thoroughly.
- **Calibrate Ph Second**
  - Highlight Ph and press enter.
  - Highlight 3 point cal and press enter.
  - Always start your Ph calibration with 7. Press enter.
  - Check your Ph mV readings and make sure they are within specifications.

    Buffer 7 = 0 +/- 50 mv
    Buffer 4 = +180 +/- 50 mv
    Buffer 10 = -180 +/- 50 mv
  - When the Ph readings have become stable, count to ten and press enter.
  - Once calibrated press enter again to proceed to the next "enter value" screen. Rinse and dry probes thoroughly between each solution.
  - Enter 4, and press enter.
  - Repeat steps.
  - Enter 10 for last Ph value and press enter.
  - Repeat step.
  - Press enter again to return to the 1, 2, and 3 point cal screen. Press escape to return to calibration parameters screen. Rinse and dry probes thoroughly.
- **ORP Calibration**
  - Before you do your ORP calibration you need to be aware of the temperature so you can enter the correct value.
  - Place Orp container on Ph/Orp combo probe. Orp solution in calibration cup needs to be changed after 3 – 5 uses. Mixed Zobell solution has a shelf life of six months from the day it was mixed. Unmixed Zobell solution has an expiration date on the bottle.
  - Highlight Orp and press enter. "Enter value" screen will appear.
  - Enter correct value corresponding with temperature on chart and press enter.

°C	100mV ORP	Zobell
10	124.4	250.5
15	116.7	244
20	109.1	237.5
25	100	231
30	93.1	224.5
35	84.9	218
40	76.3	211.5

  - When the Orp value has become stable, count to ten and press enter.
  - Press enter to continue to calibration parameter screen.
  - Remove Orp container, being careful not to disturb the DO o-ring and membrane, rinse and dry probes thoroughly.
- **DO Calibration**
  - Put on storage/calibration container. (Make sure there is a wet sponge in the container, and container is on loosely.)
  - With the storage/calibration container on, highlight DO and press enter.
  - Highlight DO% and press enter. Press enter again for the barometric pressure displayed.
  - When the DO% value has become stable, count to ten and press enter.
  - Press enter to return to calibration parameter screen.
- **Exiting Calibration Mode**
  - Press escape from calibration parameter screen to return to sonde menu screen.
  - Scroll down and highlight Report and press enter.
  - Scroll down to Ph mV and DO CHG, and turn them off by highlighting them and pressing enter. No solid dot next to the parameter means that it is turned off. Ph mV, and DO CHG are only needed for calibration and checking the status of the probes, and are not needed for field reports.
  - Once parameters are selected for field reports and are turned on, press escape twice and return to the 650 menu.

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STANDARD OPERATING PROCEDURE

BS-008 Fish and Benthic Macroinvertebrate Tissue Sampling

1. Objective

This SOP details the methods for proper collection, documentation, and handling for whole body tissue analysis for fish, crab, and mussel.

2. Materials

Equipment needed for collection of tissue samples may include:

- Commercial minnow trap
- Commercial crab pot
- Canned cat food (bait)
- Hand scraper
- 5 gallon bucket
- Measuring board (1 millimeter increments, at least 500 mm long)
- Scale (at least 1 gram increments)
- Aluminum foil
- Labeling tape
- Plastic bags (small and 5 gallon sizes)
- Ice or dry ice
- Coolers, packing material
- Chain of custody records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent markers
- Sample bottle labels
- Paper towels
- Personal Protection Equipment (PPE)
- Global Positioning System (GPS)

3. Execution

- Bait minnow traps and crab pots and deploy at designated sample locations. Traps should be tied to a stake or other secure object along shore and an identification card should be secured to the line denoting location number and relevant contact information.
- Traps containing organisms should not be permitted to become exposed (and dry) at low tide.
- Check traps at least twice daily; once in the morning and once in the evening.
- Transfer any captured organisms into a 5 gallon bucket containing surface water.
- After traps have been emptied, bait and redeploy traps.
- Time deployed and each time checked, weather conditions, tide level, organisms captured, and time redeployed should be recorded within the field notebook.
- Mussels should be collected using a hand scraper to dislodge individuals exposed during low tide.

Sample Processing

- Photograph any organism captured and record length and weight. Measurements and photograph number should be recorded in the field book, along with date, species, and location. Any abnormalities in organisms should also be recorded.
- Non-targeted species should be returned to the water after measurement.
- Length of fish is defined as the maximum body length, measured from tip of the head to the end of the longest caudal fin ray. Crabs should be measured for the maximum lateral distance across the carapace. Mussel shell length should be measured from the hinge to the outer-most portion of the shell.
- Refer to the SAP for details on target species and, tissue biomass or number of individuals need for tissue analysis.
- Individual fish should be wrapped in aluminum foil and a sample label should be placed on the outside of the foil denoting the date, sample location, fish species, length, and weight.

- Place wrapped fish in individually labeled plastic bags, which should then be placed in a labeled 5 gallon bag; one 5 gallon bag per sample location.
- Crabs and mussels should similarly be wrapped in aluminum foil and placed in individually labeled plastic bags. Individual bags should be placed in the larger bag for that sample location.
- All bags should immediately be placed on ice and stored in a cooler and maintained at 3 °C.
- Large Location sample bags should be bubble wrapped and placed in an iced cooler until transfer shipment to the analytical laboratories. Samples should be added to chain of custody form.
- If shipping time is to exceed 24 hours, samples should be frozen on dry ice.

4. Limitations

There is potential that not enough organisms will be collected at each sample location for tissue analysis. If not enough biomass can be recovered, alternative species may have to be targeted, or composite samples from multiple locations may be required.

Careful handling of organisms is required to avoid damaging of tissues and to prevent unnecessary stress to targeted and non-targeted organisms.

5. References

U.S. Environmental Protection Agency (USEPA). 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1 – Fish Sampling and Analysis. Third Edition. Office of Water. EPA 823-B-00-007. November.

6. Attachments

None

7. Contact

Kim Bradley

STANDARD OPERATING PROCEDURE

SM-009 Porous Surface Sampling for Polychlorinated Biphenyls (PCBs)

1. Objective

Describe methods for collection of porous surface samples (0-0.5 inches) for polychlorinated biphenyls (PCBs) analysis.

Two techniques of sample collection for PCBs are described in this procedure: hard and soft porous sampling. Hard-porous surfaces include concrete, brick, and asphalt. Soft-porous surfaces include wood, wall plasterboard, rubber, caulking, and low density plastics.

The hard-porous sampling method produces a uniform, finely ground powder that is easily homogenized, extracted and analyzed. The soft porous sampling uses a chisel or sharp knife to generate a representative sample to be extracted for analysis.

2. Execution

2.1 Hard-Porous Sampling

- Hard-porous samples are collected using an impact hammer drill, which generates a dust or powder. Having several decontaminated impact drill bits on hand will help expedite sampling when numerous sample locations are to be drilled.
- Sample locations may be pre-marked using a crayon or a non-contaminating spray paint. Note, the actual sample point must not be marked.
- Depending on the appearance of the sample location, or the objectives of the sampling, it may be appropriate to wipe the surface with a clean dry cloth prior to sampling.
- All sampling decisions and activities should be noted in the field notebook (See Limitations Below).
- Suspected stained areas should be preferentially selected.
- A ½-inch deep hole (using a 1-inch diameter drill bit) generates about 10 grams of powder.
- At each sample location, collect at least three samples of each type of hard porous surface, regardless of the amount of each type of porous surface present.
- Drill bits and sample collection pans (if used), must be decontaminated between samples.
- Lock a clean 1-inch diameter carbide drill bit into the impact hammer drill and plug the drill into an appropriate power source. A gasoline generator will be needed if electricity is not available.

- Begin drilling in the designated location. Apply steady even pressure and let the drill do the work. Applying too much pressure will generate excessive heat and dull the drill bit prematurely. The drill will provide a finely ground powder that can be easily collected, homogenized, and analyzed.
- A decontaminated stainless steel scoop can be used to collect the sample. The powder can be collected directly from the surface.

2.2 Soft-Porous Sampling

- If possible, remove any non-porous inclusions from the sampling location by brushing or wiping, as appropriate.
- Samples should be collected at a depth of no more than 0.5 inches using a metal chisel of sharp cutting knife.
- It is important to collect at least 10 grams for analysis.

2.3 Sample Handling, Preservation, and Storage

- Samples must be collected in glass two-ounce containers with a Teflon-lined cap.
- Samples ate to be shipped refrigerated and maintained at 4°C until the time of extraction and analysis.
- The holding time for PCB samples is 14 days to extraction.
- SC-002 Sample Handling provides additional guidance.
- Complete Sample Collection Logs, if appropriate, and Chain of Custody Forms, label sample containers, and complete documentation.

2.4 Decontamination

- Assemble two decontamination buckets. The first bucket contains a detergent and potable water solution, and the second is for rinsate.
- Place all used drill bits and utensils in the detergent and water bucket.
- Scrub each piece thoroughly using a scrub brush.
- Rinse each piece with water and hexane.
- Place the rinsed pieces on clean paper towels and individually dry and inspect each piece. Note: all pieces should be dry prior to reuse.
- All investigational-derived waste must be handled and disposed of in accordance with federal, state, and local regulations. Further guidance on Investigational Derived Waste is provided in GEI SOP SC-003. The waste will be treated as PCB waste if the samples are positive for PCBs.

3. Limitations

- This SOP does not cover multiple depth interval sampling.
- Sampling of wood surfaces can employ the hard or soft porous methodology.
- Porous sampling may require removing tiles or laminate coverings with asbestos containing adhesives. These coverings should not be removed without an assessment of the presence of asbestos. If asbestos is present,

the asbestos-containing material will need to be removed prior to any concrete sampling.

- If collecting multiple samples using this method, avoid cross-contamination by decontaminating all sampling tools prior to collecting the next sample. If the sampler's gloves come in contact with the sampled material during sampling, gloves should also be changed prior to collecting the next sample.

4. References

Standard Operating Procedures for Sampling Porous Surfaces for Polychlorinated Biphenyls (PCBs), The United States Environmental Protection Agency Region 1, May 2011.

Environmental Restoration Project Standard Operating Procedure for Los Alamos National Laboratory, Los Alamos National Laboratory, December 2001.

5. Contact

Brian Conte

STANDARD OPERATING PROCEDURE

SW-001 Surface Water Sampling

1. Objective

This Standard Operating Procedure (SOP) is applicable to the collection of representative surface water samples from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth as well as samples collected from the surface. These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report. Location, equipment, and sampling situations will dictate the applicable method of sample collection for each point. Representative surface water samples will be collected from one of these four techniques.

- Kemmmer bottle
- Van Doren sampler
- Direct method
- Peristaltic pump

2. Materials

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

- Kemmerer bottles
- Van Doren sampler
- Line and messengers
- Peristaltic pump
- Teflon™/polyethylene tubing
- Laboratory provided sample bottles
- Resealable plastic bags Ice
- Coolers, packing material
- Chain of custody records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent marker
- Sample bottle labels
- Paper towels

- Secchi Disk – Illustration provided as Figure 1
- Personal Protection Equipment (PPE)
- Global Positioning System (GPS) survey equipment

3. Execution

3.1. Pre-Sampling Procedures

3.1.1. Sample Location

A GPS navigation system will be used to identify and record sample location coordinates. If required, the proposed locations may be adjusted based on sample location access and obstructions.

3.1.2. Water Quality Data

Water quality data will be collected during sampling from the sample depth interval using an appropriate instrument to measure pH, specific conductance, temperature, turbidity, dissolved oxygen, and oxidation-reduction potential. In addition, water clarity will be measured at each sample location using a secchi disk. The water quality meter will be calibrated daily in accordance with manufacturer's specifications.

3.2. Sample Collection

3.2.1. Kemmerer Bottle

A Kemmerer bottle will be used in most situations to collect representative samples at the specific depths that are required. A picture of the Kemmerer bottle is provided as Figure 2. Sampling procedures are as follows:

- Prior to sample collection, the Kemmerer bottle will be properly decontaminated. The sampling device will be set so that the upper and lower stoppers are pulled away from the body of the sampler, allowing the surface water to enter tube.
- Lower the pre-set sampling device to the predetermined depth while avoiding disturbance of the bottom sediments.
- When the Kemmerer bottle is at the required depth, send the weighted messenger down the suspension line, closing the sampling device.
- Retrieve the sampler and discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve.
- This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited or transferred directly to appropriate sample containers.

3.2.2. Van Doren Sampler

A Van Doren sampler will be used to collect surface water from a very specific sampling depth or from a shallow water body. A picture of the Van Doran sampler is provided as Figure 3. Since the sampler is suspended

horizontally, the depth interval sampled is the diameter of the sampling tube. The sampling procedure is as follows:

- Prior to sample collection, the Van Doren Sampler will be properly decontaminated. The sampling device will be set so that the end stoppers are pulled away from the body allowing surface water to enter the tube.
- Lower the pre-set sampling device to the predetermined depth. Avoid disturbance of the bottom.
- When the Van Doren is at the required depth, send the weighted messenger down the suspension line, closing the sampling device.
- Retrieve the sampler and discharge the first 10-20 mL from the drain to clear potential contamination from the valve.
- This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited or transferred directly to appropriate sample containers.

3.2.3. Direct Method

For surface water samples collected within the top 6-inches of the water column, the direct method will be utilized to collect water samples directly into unpreserved the sample container(s).

- Analytical samples that require field preservation will be transferred from the unpreserved container to a laboratory pre-preserved sampling container.
- Ensure that all samples are collected using adequate protective clothing in accordance with the site-specific Health and Safety Plan (HASP).
- Samples will be collected in a downstream to upstream direction. In shallow locations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector.
- Avoid disturbing the sediment surface during collection. The sample container will be held below the surface to avoid the collection of floating debris.

3.2.4. Peristaltic Pump

A peristaltic pump will be used to collect surface water from a very specific sampling depth or from a remote location that cannot be accessed with other sampling methods. Since the tubing can be weighted and suspended horizontally, the depth interval sampled is the opening of the sampling tubing. The sampling procedure is as follows:

- Prior to sample collection, the tubing weights will be thoroughly decontaminated. Clean, disposable Teflon™ or polyethylene tubing will be cut to the predetermined sampling depth. The outside of the tubing will be marked with appropriate gradations to determine actual

sample depth. The tubing will be affixed to an YSI, *In-situ* Troll 9000 or similar water quality meter to ensure water quality measurements are representative of the sample interval conditions.

- Lower the tubing and water quality meter to the predetermined sample depth. Avoid disturbance of the bottom.
- When the tubing is at the required depth, turn on the peristaltic pump.
- Discharge the two submerged tubing volumes from the pump to obtain a representative surface water sample.

3.2.5. Sample Interferences

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

- Cross Contamination: Eliminated or minimized through the use of dedicated or disposable sampling equipment where appropriate. Where the use of dedicated or disposable sampling equipment is not possible or practical, the equipment will be decontaminated in accordance with the SOP QA-001 Equipment Decontamination.

- Improper Sample Collection: Typical improper sample collection techniques include:
  i. Improper decontamination of sampling equipment
  ii. Use of sampling equipment or sample containers that are not compatible with the contaminants of concern or the laboratory analytical method
  iii. Excess sediment in the sample due to disturbance of the canal sediments by sampling equipment
  iv. Sample collection in an obviously disturbed or non-representative area
  v. Sample collection during a period of increased surface water velocity that causes significant re-suspension of canal sediments (i.e. tidal influences, storm surge)

3.2.6. Quality Assurance/Quality Control (QA/QC)

QA/QC procedures that apply to the these activities include QA/QC laboratory samples including blind duplicate, matrix spike and matrix spike duplicate (MS/MSD) samples, and field blank samples. QA/QC samples are detailed in the Work Plan and the Draft Quality Assurance Project Plan (QAPP). Prior to collection of the QA/QC samples, equipment will be decontaminated in accordance with procedures described in SOP QA-001 Equipment Decontamination.

The following general QA procedures apply:

- All data must be documented on field data sheets or within site field notebooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented as indicated in the Draft QAPP.
- To avoid the incidental inclusion of disturbed sediment in the sample, surface water should be collected from a downstream to upstream direction and upstream of any activity that may disturb the sediment (i.e., wake from boat).

4. Limitations

There are two primary interferences or potential problems associated with surface water sampling. These include cross contamination of samples and improper sample collection.

- Cross contamination problems can be eliminated or minimized through the use of dedicated or disposable sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary.
- Improper sample collection can involve using contaminated equipment, equipment that is potentially not compatible with the contaminants of concern, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed or non-representative area. Be sure to use sampling equipment of an appropriate composition based upon the suspected contaminants and analyses to be performed.

Following proper decontamination procedures, minimizing disturbance of the sample site, and careful selection of sampling locations will eliminate these problems. Proper timing for the collection of samples must be taken into consideration due to tidal influences and low or fast-flowing streams or rivers.

5. References

Wilde, F.D., D.B. Radtke, J. Gibs and R.T. Iwatsubo. 1998. National Field Manual for the Collection of Water-Quality Data - Selection of Equipment for Water Sampling. U.S. Geological Survey Techniques of Water - Resources Investigations, Book 9, Chap. A2, variously paged. http://water.usgs.gov/owq/FieldManual/index.html and http://water.usgs.gov/owq/FieldManual/mastererrat.html

U.S. Environmental Protection Agency. 1984. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA/600/4-84-076.

U.S. Environmental Protection Agency. 2002. U.S. EPA Environmental Response Team, Standard Operating Procedures #2013, Surface Water Sampling. EPA, 12/17/02.

6. Attachments

Figures 1, 2, and 3

7. Contact

Steven Canton

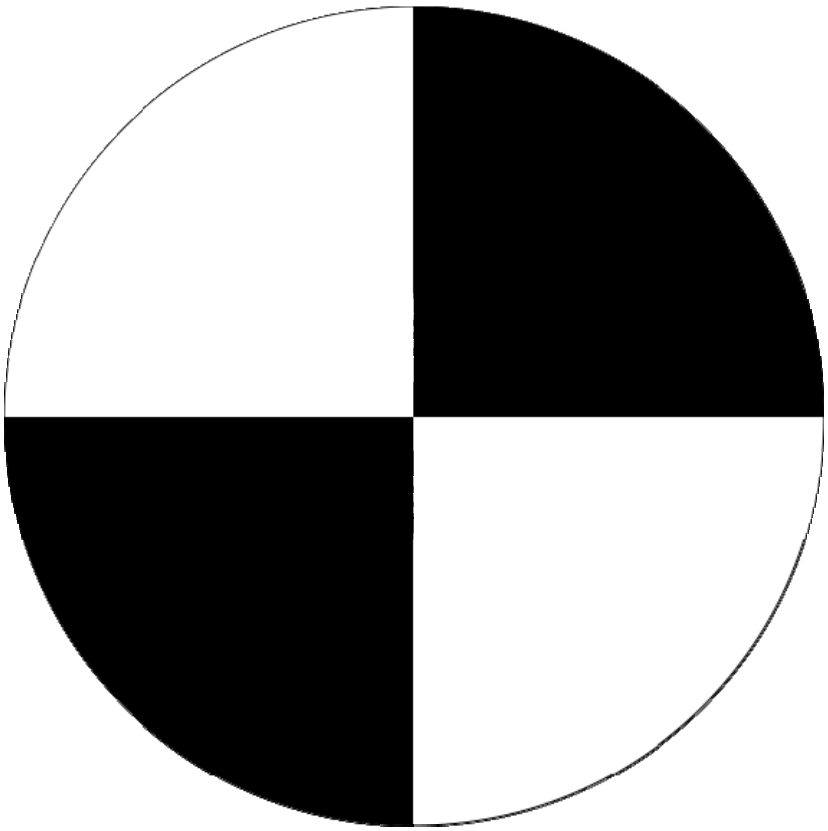


Figure 1 - Secchi Disk



Figure 2 – Kemmerer Bottle

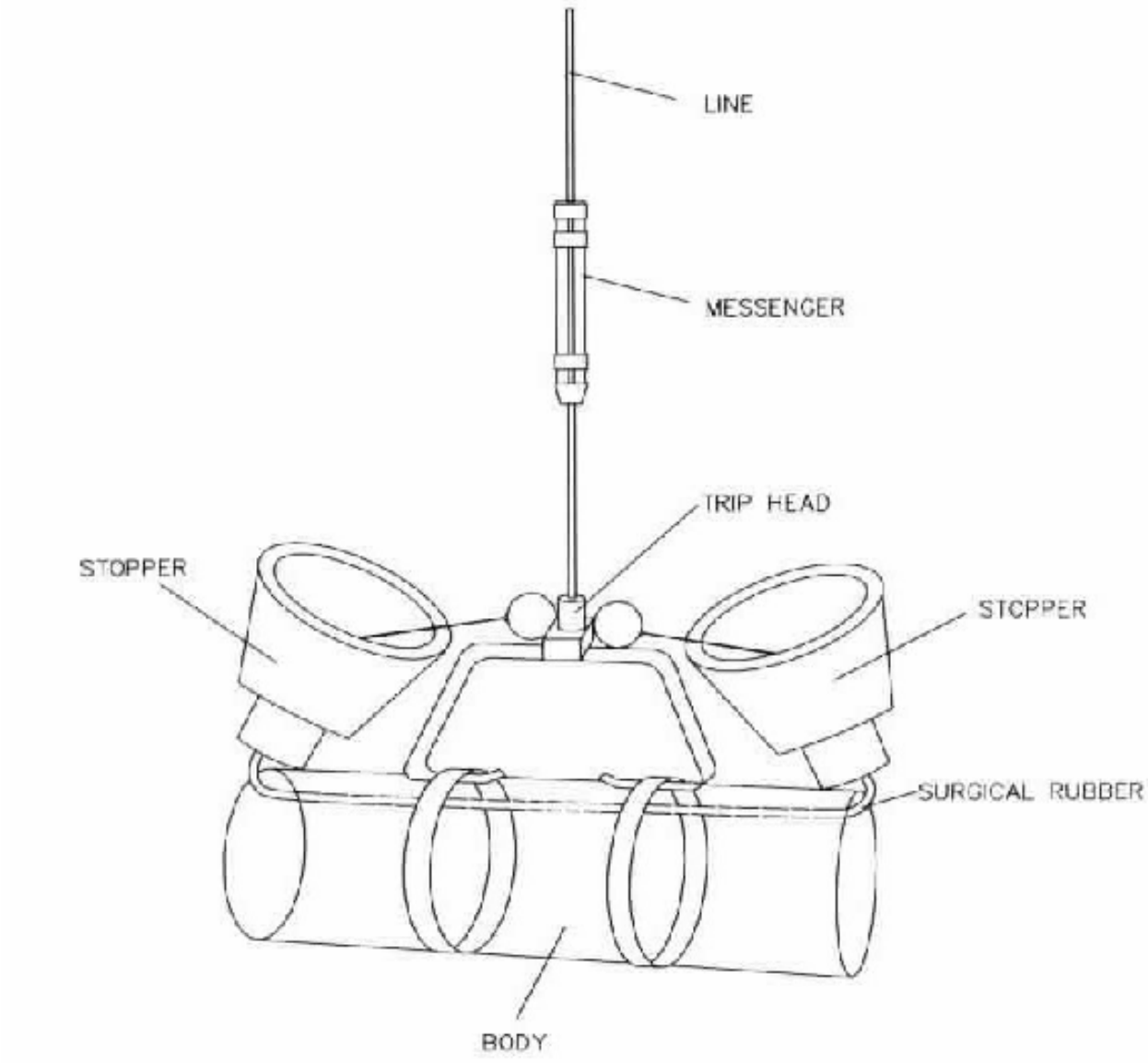


Figure 3 - Van Doran Sampler

STANDARD OPERATING PROCEDURE

BS-009 Mussel Handling and Tissue Extraction

1. Objective

This SOP details the methods for proper extraction of soft tissue from mussels for tissue analysis.

2. Materials

Equipment needed for collection of tissue may include:

- Commercial shucking knife
- Ice
- DI water

3. Execution

- Specimens should be unwrapped and inspected upon arrival to ensure samples have not been compromised. Any samples deemed unsuitable should be placed back in storage and the project manager should be informed of any issues. Compromised specimens should not be processed unless permission is given by the project manager or replacement samples are obtained.

Sample Processing

- If frozen, mussels should not be thawed to prevent the loss of liquids during tissue removal
- Organisms should be rinsed thoroughly with organic- and metal-free water prior to tissue removal to remove any external debris
- Using a shucking knife, the byssal threads (i.e. “beard”) from mussels should be removed and should not be included in the tissue analysis
- Insert the shucking knife near the hinge of the mussel
- Once the knife is able to penetrate into the shell, run the knife around the entire length of the shell in order to sever the adductor muscle
- Working the knife blade at the front of the shell, separate the two shell halves
- Scrape all soft tissue from the top and bottom shell halves. This includes viscera, meat, and body fluids
- Tissues should be placed on a clean surface or in a clean container until further processing or compositing of samples

4. Limitations

There is potential that not enough organisms will be collected at each sample location for tissue analysis. If not enough biomass can be recovered, alternative species may have to be targeted, or composite samples from multiple locations may be required.

5. References

U.S. Environmental Protection Agency (USEPA). 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1 – Fish Sampling and Analysis. Third Edition. Office of Water. EPA 823-B-00-007. November.

6. Attachments

None

7. Contact

Kim Bradley

STANDARD OPERATING PROCEDURE

SM-008 Wipe Sampling

1. Objective

Describe methods to standardize the collection of wipe samples.

2. Execution

- Determine the appropriate surface area (typically in cm^2) to be wiped.
- Choose appropriate sampling points and mark the surface area to be sampled. Photo documentation is recommended.
- Record surface area to be wiped.
- Don a new pair of disposable surgical gloves.
- Open new sterile package of gauze pad.
- Soak the pad with required solvent unless the laboratory has provided pre-soaked pads.
- Wipe the marked surface area using firm strokes. Wipe vertically, then horizontally to insure complete surface coverage.
- Place the gauze pad in an appropriately prepared sample container with a Teflon-lined cap.
- Cap the sample container, attach the label and custody seal, and place in a plastic bag. Record all pertinent data in the site fieldbook and/or on field data sheets.
- Store samples out of direct sunlight.
- Follow proper decontamination procedures, then deliver sample(s) to the laboratory for analysis.

3. Limitations

- Wipe sampling may require removing tiles or laminate coverings with asbestos containing adhesives. These coverings should not be removed without a determination of the presence of asbestos. If asbestos is present, the asbestos-containing material will need to be removed prior to any concrete sampling.
- If collecting multiple samples using this method, avoid cross-contamination by decontaminating all sampling tools prior to collecting the next sample. If the sampler's gloves come in contact with the sampled material during sampling, gloves should also be changed prior to collecting the next sample.

4. References

"Wipe Sampling and Double Wash/Rinse Cleanup as Recommended by the Environmental Protection Agency PCB Spill Cleanup Policy," dated June 23, 1987 and revised on April 18, 1991.

Environmental Restoration Project Standard Operating Procedure for Los Alamos National Laboratory, Los Alamos National Laboratory, December 2001.

5. Contacts

Brian Conte
Leslie Lombardo

Attachment C

Laboratory Standard Operating Procedures (Electronic)

SOP Change in Progress Attachment (CIPA)

SOP Number	SOP Title	SOP Revision	SOP Effective Date	CIPA Effective Date
BR-EX-005	Separatory Funnel Extraction (SW-846 3510C)	9	11/08/11	10/01/12

The following revisions were made to this standard operating procedure (SOP). These changes are effective as of the CIPA Effective Date. This change to this document is authorized by the laboratory's QA Department.

Page 7 of 12, Section 10.4 Extraction Concentration (KD-Technique):

Remove the phrase (KD-Technique) from header 10.4 so that the new header reads:

10.4 Extraction Concentration

Insert the following text between 10.4 and 10.4.1:

The following sections describe the procedures for the concentration of extracts. Any of the three techniques described may be used. However some techniques are more efficient than others to achieve the final extract volume. Use the following guidelines to select the concentration technique: For the concentration of volumes greater than 5 mL, use Macro Concentration. To concentrate extract volumes between 5 and 1 mL use Micro Concentration. To concentrate extract volumes below 1 mL, use Nitrogen Blowdown.

Title: SEPARATORY FUNNEL EXTRACTION (SW-846 3510C)

Approval Signatures:

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Approval Date: November 8, 2011

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1.0 Scope and Application

This SOP describes the laboratory procedure for the isolation of organic compounds from aqueous samples by separatory funnel liquid-liquid extraction.

1.1 Analytes, Matrix(s), and Reporting Limits

Refer to analytical methods for analyte lists and reporting limits.

2.0 Summary of Method

A measured volume of sample, usually 1 L, is serially extracted at a specified pH with methylene chloride using a separatory funnel rotator. The extract is dried with anhydrous sodium sulfate then concentrated, and if necessary, exchanged into a solvent compatible for extract cleanup or the determinative analysis method.

This SOP is based on the following reference method:

- SW-846 Method 3510C Separatory Funnel Liquid-Liquid Extraction, Revision 3, December, 1996.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

Method interference may be caused by contaminants in solvents, reagents, glassware and other sample processing equipment that can cause interference and/or elevated baselines in chromatography. All reagents and solvents used during this procedure should be reagent grade or high purity in order to minimize interference. All glassware must be cleaned in accordance with laboratory SOP BR-EX-017 *Glassware Cleaning Procedure* and rinsed with acetone and methylene chloride prior to use.

The decomposition of some analytes has been demonstrated under basic extraction conditions. Organochlorine pesticides may dechlorinate, phthalate esters may exchange, and phenols may react to form tannates. These reactions increase with increasing pH, and are decreased by the shorter reaction times available in Method 3510. Method 3510 is preferred over Method 3520 for the analysis of these classes of compounds. However, the recovery of phenols may be optimized by using Method 3520, and performing the initial extraction at the acid pH.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

Nitrile gloves should be used when performing this extraction. Latex and vinyl gloves provide no significant protection against the organic solvents used in this SOP and should not be used.

During Kuderna-Danish (KD) concentration do not allow the extract to boil to dryness. The solvent vapors remaining in the KD apparatus may superheat and create an explosion or fire hazard.

The use of separatory funnels to extract aqueous samples with methylene chloride creates excessive pressure very rapidly. Initial venting should be done immediately after the sample container has been sealed and inverted. Vent the funnel into the hood away from people and other samples. This is considered a high-risk activity, and a face shield should be worn over safety glasses or goggle when it is performed.

The following analytes have been tentatively classified as known or suspected, human or mammalian carcinogens: benzo(a)anthracene, benzidine, 3,3'dichlorobenzindine, benzo(a)pyrene, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, dibenz(a,h)anthracene, N-nitrosodimethylamine, 4,4'-DDT, and polychlorinated biphenyl compounds. Primary standards of these toxic compounds should be prepared in hood.

During Kuderna-Danish (KD) concentration, do not allow the extract to boil to dryness. The solvent vapors remaining in the KD apparatus may superheat and create an explosion or fire hazard.

The KD apparatus has ground glass joints which can become stuck. Technicians must use Kevlar or other cut/puncture resistant gloves when separating stuck joints.

5.2 Primary Materials Used

Table 1 lists those materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Extraction Equipment

- Separatory Funnel Shaker, Glas-Col or equivalent.
- Teflon Separatory funnel: 2 Liter, with stopcock and cap, Fisher Scientific or equivalent.
- Glass Funnel: 75mm, Fisher Scientific or equivalent.

6.2 Extract Concentration (KD Apparatus)

- Concentrator Tube: 10 mL graduated, ChemGlass Catalog Number CG-1316-11 or equivalent.
- Snyder Column: Three ball macro AMK Catalog Number SC2-01 or equivalent.
- Snyder Column: Two ball micro AMK Catalog Number SC3-01 or equivalent.
- Evaporation Flask: 500 mL attached to concentrator tube with clip, AMK Catalog Number KDF-500 or equivalent.
- Boiling Chips: silicon carbide, approximately 10/40 mesh, solvent extracted in methylene chloride, Troemner Catalog Number 133B or equivalent.
- Heating mantle rheostat controlled for water bath capable of temperature control (± 5°C). ChemGlass Catalog Number PL3122 or equivalent.
- Water Bath: capable of temperature control to ±5°C, Barnstead Corporation Catalog Number HM0500-HS1 or equivalent.
- Solvent Vapor Recovery System: Kontes K-54000-1006, K-547300-000, Ace Glass Catalog Number 6614-30 or equivalent.

6.3 Miscellaneous

- pH Paper/Strips: Range 1-14.
- pH Meter. Denver Instruments Model UB5 or equivalent.
- Pasteur Glass Pipettes: 1 mL, disposable. Fisher Scientific or equivalent.
- 0.5 mL – 2.0 mL Syringes: Hamilton Gastight® Syringes or equivalent.
- Vials and Caps: 1.8, 4, 8, 16, and 40 mL with Teflon lined septa and screw caps. Fisher Scientific.
- Graduated Cylinder: 1 Liter, Class A. Fisher Scientific or equivalent.
- Glass Wool

7.0 Reagents and Standards

7.1 Reagents

- Sodium Sulfate (granular, anhydrous), Na_2SO_4. J.T. Baker or equivalent. Purify by heating at 400°C for at least 4 hours.
- Methylene Chloride (CH_2C_{12}): Pesticide Quality, J.T. Baker or equivalent.
- Hexane, (C_6H_{14}), Pesticide Quality, J.T. Baker or equivalent.
- Acetone, ($(CH_3)_2CO$), Pesticide Quality, J.T. Baker or equivalent.
- Reagent Water: RO water filtered through a Nanopure System.
- Sodium Hydroxide (NaOH): Reagent Grade, J.T. Baker.
- Sulfuric Acid, (H_2SO_4): Reagent Grade, J.T. Baker.

7.1.1 Prepared Reagents

- NaOH Solution (6N): In a 2.5 L clear glass bottle dissolve 240 g NaOH in reagent water and dilute to 1 Liter. Store the solution in reagent bottle at room temperature. Assign an expiration date of 6 months from date of preparation unless the parent material expires earlier, in which case, use the earliest expiration date.

- H_2SO_4 Solution (1:1 v/v): Add 500 mL of reagent water to a 1 L volumetric flask. Slowly add 500 mL of H_2SO_4 to the flask to dilute to volume. Store the solution in reagent bottle at room temperature. Assign an expiration date of 6 months from date of preparation unless the parent material expires earlier, in which case, use the earliest expiration date.

7.2 Standards

Purchase stock standards as certified solutions from commercial vendors. Prepare surrogate and spiking solutions in the laboratory by diluting a known volume of the stock standard solutions in an appropriate solvent. Record the preparation of standard in the LIMS (TALS) module established for this purpose.

Store prepared standard solutions in glass containers at 4°C or below. Unless otherwise specified, assign an expiration date of 6 months from the date of preparation or in accordance with the expiration date of the parent standard, whichever is sooner. The recommended formulation for each standard used in this procedure is provided in the analytical method along with the recommended source materials, expiration dates and storage conditions.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method.

Listed below are the minimum sample size for collection, preservation for shipment to the laboratory and holding time requirements as specified by SW-846 Chapter 4, Table 4-1. Footnotes to this table specify this information is guidance and does not represent EPA requirements. Selection of containers, preservation techniques and sample collection size should be based on project specific data quality objectives.

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time[1]	Reference
Water	1L Amber Glass	4X1L	Cool to ≤ 6°	Extraction: 7 days	SW-846 Chapter 4

[1]Extraction holding time is determined from sampling date.

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Analytical SOP
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Analytical SOP
Matrix Spike(s) MS/MSD	Client Request	See Analytical SOP
Sample Duplicate (SD)	Client Request	See Analytical SOP

9.2 Instrument QC

Refer to the analytical SOP for the determinative test method.

10.0 Procedure

10.1 Instrument Calibration

Check the calibration of the pH meter and the balance each day of use prior to use and record these checks in the logbook designated for this purpose.

Verify the calibration of any mechanical pipettes used is current and if it is not, notify QA. The QA department checks the calibration of pipettes quarterly in accordance with the procedures specified in laboratory SOP BR-QA-008.

10.2 Equipment Preparation

Prepare glassware using the procedures described in laboratory SOP BR-EX-017 and rinse with acetone and methylene chloride prior to use. Label the glassware for each field and QC sample clearly and unambiguously during each step of the extraction procedure. Solvent will erase grease pens and “sharpie ink”; so use caution to ensure labels are not obliterated during the procedure.

Assemble a drying funnel for each field and QC sample by placing a plug of glass wool in a 75mm glass funnel then add a sufficient amount of purified granular sodium sulfate to fill the funnel ¾ full. Rinse the funnel with ~30 mL of acetone and ~ 30 mL of methylene chloride each and discard the solvent rinse.

Assemble a KD setup for each field and QC sample by attaching a 10 mL concentrator tube to a 500 mL evaporation flask and attach this to the drying funnel.

10.3 Extraction

If samples were received in 1 L containers, mark the meniscus of the sample container with a permanent marker. If a different size container was provided, measure 1 L of sample into a graduated cylinder. Transfer 1 L of reagent water to individual separatory funnels to serve as the method blank and LCS.

Add the proper type and volume of surrogate solution to each sample container (or graduated cylinder) and to the MB and LCS. Add the proper type and volume of spike solution to any samples designated as MS/MSD and to the LCS. See the extraction conditions workbook for type, concentration and amount of surrogate and spike solution to use for each test method. If the sample container is filled to the top of the bottle, remove and discard an amount of sample sufficient to add the spike and surrogate solution.

Check the pH of each sample using a calibrated pH meter or wide range pH paper. Adjust the pH, if necessary, using 1:1 sulfuric acid solution or 6N sodium hydroxide solution. See the extractions conditions workbook to determine the extraction pH for each test method. If using the pH meter, thoroughly rinse the probe of the pH meter with reagent water between each sample in order to avoid cross-contamination. If using pH paper, do not dip the paper into the sample, instead aliquot a drop of sample onto the pH paper.

Quantitatively transfer the entire sample into the 2 L separatory funnel. Rinse the sample container with ~60 mL methylene chloride and pour the rinsate into the separatory funnel extractor. To measure the sample volume, fill the sample container with tap mater to the mark of

the meniscus and pour the water into a graduated cylinder for volume measurement. Record the sample volume in the TALS worksheet.

Note: If high analyte concentrations are anticipated, a smaller sample volume may be taken and diluted to 1L with reagent water. If smaller volumes are used, it may be necessary to adjust the volume of surrogate and spike solution. Consult with the Department Supervisor for further guidance.

Cap and shake each separatory funnel vigorously for 15-20 seconds. Immediately after the first shake, vent the separatory funnel into a fume hood. Place the separatory funnel on the Sep. Funnel shaker and shake for 2 minutes. After the 2 minute shake is complete allow sufficient time for the organic layer to separate from the water layer. If an emulsion forms and it is more than one-third the size of the solvent layer, filter, centrifuge, or stir the extract to remove the emulsion.

Drain the solvent portion from the extractor into the drying funnel/concentration apparatus and repeat the extraction two more times using fresh portions of methylene chloride, combining the three extracts. If further pH adjustment and secondary extraction is required adjust the pH and repeat the extraction three more times.

Concentrate the extract using KD technique and adjust the extract to the final volume required for the test method.

10.4 Extract Concentration (KD Technique)

10.4.1 Macro Concentration

Macro Snyder Column (K-D)

Add one or two clean boiling chips to the K-D evaporation flask and attach a three-ball Snyder column to the flask. Add ~1 mL of methylene chloride to the top of the column then place the K-D apparatus in a hot water bath (60-70°C) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed in hot water vapor.

Attach the solvent vapor recovery glassware to the Snyder column. Adjust the vertical position of the apparatus and check the water bath temperature. The water bath temperature should be between 54.8 – 74.8°C when methylene chloride is the extraction solvent and 84-89°C when hexane is the extraction solvent. Higher water bath temperatures may be used so long as the recovery of target analytes is not impacted. The boiling point of each solvent is provided in the following table:

Solvent	Boiling Point	Water Bath Temperature
Hexane	69°C	84 – 89°C
Methylene Chloride	39.8°C	54.8 – 74.8°C

Monitor the concentration and do not let the extract evaporate to dryness. At the proper rate of distillation the balls of the column will actively chatter but the chambers will not flood with solvent.

When the apparent volume of the extract reaches desired amount remove the K-D apparatus from the water bath and allow it to drain and cool for at least 10 minutes.

10.4.2 Micro Concentration

Add one or two clean boiling chips to the concentrator tube and attach a two ball micro-Snyder column to the tube. Place the concentrator tube into the water bath so that the concentrator tube is partially immersed in hot water. Adjust the vertical position of the concentrator tube and check the temperature of the water bath to ensure the proper temperature for the extract solvent.

Continuously monitor the distillation process to ensure sample extracts do not evaporate to dryness. At the proper rate of distillation, the balls of the column will actively chatter, but the chambers will not flood with solvent. Remove setup when desired sample volume is reached.

10.4.3 Nitrogen Blowdown

Nitrogen blow down may be used to concentrate extracts as needed.

Place the concentrator tube in a warm water bath maintained at a temperature of 35°C. Apply a steady stream of nitrogen until the desired final extract volume is achieved. Rinse the internal wall of the concentrator tube several times with the appropriate solvent during the evaporation and ensure the solvent level in the concentrator is positioned such to prevent water condensations. Monitor the concentration carefully and do not allow the extract to evaporate to dryness.

10.5 Extract Preparation & Handling

Transfer the extract to labeled Teflon lined screw cap vial.

Adjust the extract to volume using a reference vial for final extract volumes greater than 1 mL and by using the tip of concentration tubes for volumes 1 mL and less. Before using the reference vial, verify the reference vials were prepared on the same day by an analyst authorized to prepare reference vials. Place the extracts in refrigerated storage maintained at a temperature of 4°C±2 in preparation for subsequent cleanup or analysis as specified by the method chain.

If the TALS log-in does not include cleanup methods in the method chain and there is reason to believe the extract may require cleanup (color, odor, viscosity, etc.) notify the PM of the situation so he/she can determine if cleanup should be performed prior to analysis.

Complete the TALS batch worksheet and perform primary review of the extraction batch.

11.0 Calculations / Data Reduction

11.1 Calculations

Calculations are provided in the analytical SOP for each method parameter.

11.2 Data Review

Refer to laboratory SOP BR-QA-019 for the required elements of each step of data review.

11.2.1 Primary Review

Review the batch worksheet for correctness and completeness. Record any problems encountered during the extraction process with a nonconformance memo (NCM).

11.2.2 Secondary Review

Review the batch worksheet for correctness and completeness and to ensure the extraction performed is consistent the SOP and project specifications.

Print the output worksheets and release extracts and output worksheet to the analytical department or to the next step in the method chain such as extract cleanup.

If the TALS log-in does not include cleanup methods in the method chain and there is reason to believe the extract may require cleanup (color, odor, viscosity, etc.) notify the PM of the situation so he/she can determine if cleanup should be performed prior to analysis.

For additional guidance regarding the laboratory's protocol and required elements for data review refer to laboratory SOP BR-QA-019.

12.0 Method Performance

12.1 Detection Limit (DL), Limit of Detection (LOD) and Limit of Quantitation (LOQ)

Refer to the analytical SOP for DL, LOD and LOQ requirements.

12.2 Demonstration of Capabilities (DOC)

Each analyst must complete an Initial Demonstration of Capability prior to unsupervised performance of this method.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures

are incorporated by reference to BR-EH-001 *Hazardous Waste*. The following waste streams are produced when this method is carried out.

- Organic Solvents - Satellite container: 55 Gallon Covered and Vented Drum.
- Extracted water samples - Satellite Container: 55 Gallon Covered and Vented Drum.
- Vials containing extracts - Satellite Container: 5 Gallon Covered Bucket (inside fume hood).
- Solid Waste - Satellite Container: Solid Waste 5 Gallon Plastic Bucket (inside fume hood).

15.0 References / Cross-References

- SW-846 Method 3510C Separatory Funnel Liquid-Liquid Extraction, Revision 3, December 1996.
- Laboratory SOP BR-EX-017
- Laboratory SOP BR-QA-019
- Laboratory SOP BR-QA-005
- Laboratory SOP BR-EH-001
- Corporate Environmental Health and Safety Manual

16.0 Method Modifications

There are no modifications of the referenced method.

17.0 Attachments

- Table 1: Primary Materials Used
- Appendix A: Terms and Definitions

18.0 Revision History

Revision 9:
- Title Page: Update Approval Signatures and copyright date
- Section 8: Updated text to cite regulatory reference and add that this information is guidance per the language in SW-846 Chapter 4.
- Section 10.5: Added procedure for use of reference vials and final extract volume adjustment and added laboratory policy for cleanups when cleanups are not included in method chain.
- Section 11.0: Added statement about laboratory for cleanups when cleanups are not included in the method chain.

Revision 8:
- Updated Title Page
- All Sections: Added TALS terminology and removed reference to bench sheets and added reference to extraction conditions workbook.
- All Sections: Changed Sep Funnel rotator to Sep. Funnel shaker.
- Section 10.3: Changed sequence of procedure so that surrogate and spike solutions are added to sample container before transfer to extraction vessel and to perform pH measurement and adjustment before transfer to extraction vessel.

Revision 7:
- Sections 5.0 & 5.2: Updated with new language.
- Section 6.3: Remove balance and added glass wool.

Table 1: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and symptoms of exposure
Acetone	Flammable	1000 ppm-TWA	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.
Hexane	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.
Sulfuric Acid[1]	Corrosive Oxidizer Dehydra-dator	1 mg/m^3	This material will cause burns if comes into contact with the skin or eyes. Inhalation of vapors will cause irritation of the nasal and respiratory system.
Sodium Hydroxide	Corrosive Poison	2 ppm, 5 mg/m^3	This material will cause burns if comes into contact with the skin or eyes. Inhalation of Sodium Hydroxide dust will cause irritation of the nasal and respiratory system.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.

[1] *Always add acid to water to prevent violent reactions.*
[2] *Exposure limit refers to the OSHA regulatory exposure limit.*

Appendix A: Terms and Definitions

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Title: HOMOGENIZATION OF BIOTA & TISSUE

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1.0 Scope and Application

This SOP describes the laboratory procedure for the whole body homogenization and extraction of biota and tissue samples by tissuemizer in preparation for analysis by a variety of chromatographic procedures.

NOTE: Pre-preparation of tissue such as dissection, sportsman filet, sample compositing, shucking, etc. may be performed by the laboratory per customer specification. These procedures are project specific and instructions are not included in this SOP.

2.0 Summary of Method

2.1 Homogenization

Tissue samples are homogenized using a titanium blade homogenizer. Biota samples are homogenized using stainless steel knives and/or a food processor. The homogenized sample(s) are transferred to labeled glass jars and stored in a freezer maintained at a temperature of -15ºC (±5ºC) in preparation for extraction.

The laboratory's standard procedure is to perform whole body homogenization of the tissue sample. Any customer specifications for dissection or homogenization of certain parts of the tissue sample, compositing multiple samples or other must be negotiated with the laboratory during project initiation and specific instructions for sample processing must be prepared and provided to the extraction laboratory by the laboratory PM. In the absence of instruction, the laboratory will homogenize the entire sample.

The homogenization procedure is a laboratory developed procedure based on the procedures described in the Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992, Volume IV, National Status and Trends Program for Marine Environmental Quality.

2.2 Extraction

A portion of homogenized sample is mixed with anhydrous sodium sulfate then macerated for 3 minutes in an appropriate extraction solvent using the Tissumizer. The solvent layer decanted poured through sodium sulfate and collected in a collection vessel. The extraction is repeated two more times with fresh portions of extraction solvent. After extraction, the combined extracts are concentrated to an appropriate final volume using K-D Technique. Percent lipids are determined following procedures given in laboratory SOP BR-EX-016 Percent Lipid Determination and extract cleanup is performed when necessary.

The extraction procedure is a laboratory developed procedure based on the procedures described in the Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992, Volume IV, National Status and Trends Program for Marine Environmental Quality.

3.0 Definitions

- Biota: flora and fauna. For this SOP, all reference to "biota" refers to plant material.

- Tissue: an aggregate of cells usually of a particular kind together with their intercellular substance that form one of the structural materials of a plant or animal. For this SOP, all reference to "tissue" refers to structural materials from an animal.

A list of general terms and definitions are provided in Appendix A.

4.0 Interferences

Method interference may be caused by contaminants in solvents, reagents, glassware and other sample processing equipment that can cause interference and/or elevated baselines in chromatography. All reagents and solvents used during this procedure should be reagent grade or high purity in order to minimize interference. All glassware must be cleaned in accordance with laboratory SOP BR-EX-017 Glassware Cleaning, and rinsed with acetone and methylene chloride prior to use.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

Nitrile gloves should be used when performing this extraction. Latex and vinyl gloves provide no significant protection against the organic solvents used in this SOP, and should not be used.

During Kuderna-Danish (KD) concentration, do not allow the extract to boil to dryness. The solvent vapors remaining in the KD apparatus may superheat and create an explosion or fire hazard.

5.2 Primary Materials Used

Table 1 lists those materials used in this procedure that have a serious or significant hazard rating along with the exposure limits and primary hazards associated with that material as identified in the MSDS. **NOTE: This list does not include all materials used in the method.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Homogenization Equipment

- Cutting Board- High density polyethylene 16X23"

- Homogenizer equipped with 55 mm Titanium Blade Omni International or equivalent.
- Food Processor Cuisinart or equivalent
- Stainless steel knives
- Glass Jars, wide mouth; 125 mL-1000 mL. ESS or equivalent.
- Meat Grinder

6.2 Extraction Equipment

- Tissuemizer equipped with a 20 mm x 195 Generator probe. Omni International PowerGen 700 or equivalent.
- Filter Funnels – 100 mm diameter for filtration/drying. Fisher Scientific or equivalent.
- No. 54 Filter paper. Whatman 18.5 cm, or equivalent.
- Beakers – 400 mL. Fisher Scientific or equivalent.

6.3 Extract Concentration (KD Apparatus)

- Concentrator Tube, 10 mL Graduated: ChemGlass Catalog # CG-1316-11 or equivalent
- Snyder Column: Three ball macro, AMK Catalog # SC2-01 or equivalent
- Snyder Column: Two ball micro, AMK Catalog # SC3-01 or equivalent
- Evaporation Flask: 500 mL attached to concentrator tube with clip, AMK Catalog Number KDF-500 or equivalent.
- Boiling Chips: Silicon carbide, approximately 10/40 mesh, solvent extracted in methylene chloride, Troemner Catalog # 133B or equivalent.
- Heating Mantle: Rheostat controlled for water bath capable of temperature control (±5°C). ChemGlass Catalog # PL3122 or equivalent.
- Water Bath, capable of temperature control to ±5°C. Barnstead Corporation Catalog # HM0500-HS1 or equivalent.
- Solvent Vapor Recovery System, Kontes K-54000-1006, K-547300-000, Ace Glass Catalog # 6614-30 or equivalent.

6.4 Miscellaneous

- Disposable Glass Pasteur Pipette and bulb: Fisher Scientific or equivalent.
- Top Loading balance: Capable of measuring to 0.01 gram accuracy, Mettler Model # PM4800 or equivalent.
- Vials and caps: 2, 4, 8, and 16 mL with Teflon lined septa and screw caps, Fisher Scientific or equivalent.
- Teflon and Stainless Steel Spatulas, Fisher Scientific or equivalent.
- Adjustable Pipette: Finnpipette or equivalent
- 0.5 mL – 2.0 mL Hamilton Gastight® syringes or equivalent.
- Paper towels

7.0 Reagents and Standards

7.1 Reagents

- Sodium Sulfate (Na_2SO_4), Granular Anhydrous: J.T. Baker or equivalent. Purify by heating at 400°C for at least 4 hours.
- Methylene Chloride (CH_2C_{12}): Pesticide Quality, J.T Baker or equivalent.

- Hexane, (C_6H_{14}): Pesticide Quality, J.T. Baker or equivalent.
- Acetone, ($(CH_3)_2CO$): Pesticide Quality, J.T. Baker or equivalent.
- Reagent Water: RO water filtered through a Nanopure System.
- Alkaline Liquid Detergent: Contrex or equivalent.

Methylene Chloride/Acetone (1:1): In a 4 L amber glass bottle mix 2 L methylene chloride with 2 L acetone. Store the solution in a fume hood. Assign an expiration date of 6 months from date of preparation unless the parent material expires earlier, in which case, use the earliest expiration date.

Hexane /Acetone (1:1): In a 4 L amber glass bottle mix 2 L hexane with 2 L acetone. Store the solution in a fume hood. Assign an expiration date of 6 months from date of preparation unless the parent material expires earlier, in which case, use the earliest expiration date.

7.2 Standards

Purchase certified stock standards from commercial vendors and from these prepare surrogate and spiking solutions by diluting a known volume of the stock standard solutions in an appropriate solvent. Record the preparation of all standards in the LIMS module. The formulations for the preparation of surrogate and spiking standards are provided in analytical SOPs.

Unless otherwise specified in the analytical SOP store prepared in glass containers at 4°C or below and assign an expiration date of 6 months from the date of preparation unless the parent standards expire earlier in which case use the earliest expiration date.

Assay surrogate and spike solutions before each use to verify the made to concentration is within specifications. Maintain records of the assay per the procedure established for the work section.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP.

The laboratory recommends that tissue and biota samples be collected in glass jars or sealable plastic bags. Immediately following collection, biota samples should be iced to a temperature of 4°C (±2°C) and tissue samples should be frozen and maintained at a temperature of -15°C (±5°C) until the time of homogenization. After homogenization, all homogenized samples must be stored in a freezer maintained at a temperature of -15°C (±5°C).

Tissue and biota samples must be extracted within the holding time specified in the client's quality assurance plan. In the absence of client specifications, the following HT will be used:

SVOA GC/MS: 14 Days from Date of Collection
Pesticides: 14 Days from Date of Collection
PCB: 365 Days from Date of Collection
Mercury: 28 Days from Date of Collection
Metals: 180 Days from Date of Collection

After extraction any remaining sample should be returned immediately to the freezer or stored per the project specifications.

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Analytical SOP
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Analytical SOP
Matrix Spike(s) MS/MSD	Client Request .	See Analytical SOP
Sample Duplicate (SD)	Client Request	See Analytical SOP

10.0 Procedure

10.1 Instrument Calibration

Check the calibration of the balance each day of use prior to use.

Check the calibration of the adjustable pipettes quarterly.

Perform periodic maintenance on the tissuemizer's generator probe as necessary. Maintenance may include but is not limited to the replacement of Teflon bearings and rotor shafts when a loud squealing noise is heard. Refer to the PowerGen 700 Homogenizer Instruction Manual for further guidance and for the manufacturer's recommended maintenance program.

10.2 Whole Body Homogenization of Tissue Samples

Remove the samples from storage and let the sample(s) thaw completely.

Wash all equipment with detergent and hot water, then rinse with reagent water and acetone prior to use and also after each sample.

Prepare a equipment blank to ensure the equipment is clean. To prepare the blank, transfer a representative amount of reagent water (similar to the size of the samples) to a clear glass jar. Let the water come into contact with all equipment that will be used to homogenize the samples. This process should be done randomly during homogenization to verify the cleaning process.

If possible obtain a glass jar large enough to accommodate the entire sample. Label the jar with the sample's lab ID and place the jar on the analytical balance. Tare the balance. Put on a pair of nitrile gloves and with your hands transfer the sample from the storage container to the labeled jar. Record the pre-homogenization weight of the sample in the worksheet.

Transfer the sample to a pre-cleaned cutting board. Cut the sample into 1-3" sections using a stainless steel knife then place the sections of samples in the labeled jar.

Insert the titanium blade into the jar and homogenize the sample at 2000-4000 RPM until the sample becomes slurry. Manual mixing with a stainless steel or Teflon spatula may be required

to insure complete homogenization. Remove the blade from the sample jar and scrape any remaining sample from the blade into the labeled jar. Place the jar on the top-loading balance and record the post homogenization weight in the worksheet.

NOTE: Samples greater than 12 inches or samples with weight measurements that exceed 1-2 pounds should be homogenized in a stainless steel meat grinder prior to use of the titanium blade. If the sample is extremely large homogenization with a knife may be necessary. If the homogenized tissue sample cannot fit into a single container, pass the sample through the meat grinder multiple times, homogenize the slurry and transfer to multiple containers.

10.3 Homogenization of Biota Samples

Wash all equipment with detergent and hot water, then rinse with reagent water and acetone prior to use and also after each sample.

Prepare a equipment blank to ensure the equipment is clean. To prepare the blank, transfer a representative amount of reagent water (similar to the size of the samples) to a clear glass jar. Let the water come into contact with all equipment that will be used to homogenize the samples. This process should be done randomly during homogenization to verify the cleaning process.

Remove the samples from storage and let warm to ambient temperature. Select a glass jar large enough to accommodate the entire sample. Label the jar with the sample's lab ID and place the jar on the top-loading balance. Tare the balance. Remove the biota sample from the storage container and place in the labeled jar. Record the pre-homogenization weight of the sample into the worksheet.

Remove the sample and place on a pre-cleaned cutting board. Slice the material into very fine sections using a stainless steel knife or a food processor. Return homogenized sample back into the jar and place on the top-loading balance. Record the post homogenization weight into the worksheet.

10.4 Extraction

Clean all glassware prior to use following the procedure given in laboratory SOP BR-EX-017. Label all glassware with field and QC samples ID numbers clearly and unambiguously during each step of the extraction procedure. Solvents will erase grease pens and "sharpie ink", so caution must be taken to ensure that the labels are not obliterated during the procedure.

Assemble a KD apparatus set-up and prepare a glass funnel for each sample to be extracted. Fold a 185 mm Whatman® 54 filter into quarters and place a filter in each funnel. Fill each funnel ~3/4 full with purified granular anhydrous sodium sulfate. Rinse the funnel with ~30 mL acetone and methylene chloride each and discard the solvent rinse. Place a prepared funnel onto each K-D setup.

Assemble the Tissuemizer by attaching the 20 mm x 195 mm-generator probe to the Tissumizer motor. Place the Tissuemizer in the fume hood and attach to the aluminum staging using clamps. Clean the Tissuemizer prior to use by running the generator probe for 10 seconds in a 400 mL beaker filled with ~ 200 mL of reagent water. Discard the reagent water and repeat with another aliquot of reagent water. Repeat the cleaning step two more times each with ~250 mL of acetone.

Mix the sample using a stainless steel or Teflon spatula. Place a labeled 400 mL beaker onto the top-loading balance and depress the "tare" button. Referring to the extraction condition spreadsheet, weigh out the appropriate amount of sample and record sample weight ± 1 gram into TALS. Repeat for all samples. Transfer two additional aliquots of the sample selected for the MS and MSD into labeled 400 mL beakers. Transfer the same weight of sodium sulfate each into labeled 400 mL beakers to serve as the method blank (MB) and laboratory control sample (LCS).

Add a sufficient volume of granular sodium sulfate to each sample and mix thoroughly with a stainless steel spatula until a free-flowing mixture is formed.

Add the appropriate volume of surrogate spike to each field sample and QC sample. Add the appropriate volume of spike solution to the laboratory control samples and the MS/MSD.

Add 100 mL of the appropriate extraction solvent to each beaker. Use 1:1 $MeCl_2$/Acetone for samples to be analyzed by GC/MS and 1:1 Hexane/Acetone for GC/ECD.

Refer to the Extractions Condition Worksheet to determine the type and amounts of solution added and the extraction solvent used for each test method.

Immerse the generator probe in the first sample beaker so that it is approximately ½" into the extraction solvent. Turn on the Tissuemizer. Adjust the speed on the motor until the solvent begins to vortex in the beaker, but does not splash out of the beaker. Extract the sample for 3 minutes. During extraction move the beaker in a circular motion to ensure that the entire sample is subject to extraction. Remove the beaker and decant the extraction solvent into the sample's corresponding funnel and K-D apparatus. Repeat the extraction 2 more times with ~100 mL of extraction solvent. After the 3rd extraction, pour the entire contents of the beaker into the funnel, rinse the beaker with more of the extraction solvent, and pour this into the funnel as well.

Rinse the funnel with ~30 mL of extraction solvent and allow the solvent to completely drain into the K-D apparatus. Remove the funnel from the K-D apparatus and discard the contents of the funnel. Clean the generator probe and repeat the extraction for each sample.

Concentrate the extracts following the procedure given in section 10.5 in preparation for percent lipids determination and extract cleanup. After concentration and prior to extract cleanup, set aside a 1 mL aliquot of the concentrated extract and determine the percent lipids following procedures given in laboratory SOP BR-EX-016 *Percent Lipids Determination.*

Perform extract cleanup as appropriate following procedures given in laboratory SOPs BR-EX-002 and BR-EX-011. Refer to extraction condition spreadsheet for details. After cleanup, concentrate the extracts following the procedure given in section 10.5.

Enter the extraction data into the TALS. Assemble any associated paperwork and submit the extracts to the supervisor for a final project check. After review is complete, relinquish the extracts to the appropriate analytical department and place in the refrigerated storage area.

Note: Immediately following concentration, all sample extracts must be stored in a refrigerator maintained at a temperature of 4ºC (±2°C) in order to maintain thermal preservation.

10.5 Extract Concentration (KD Apparatus)

10.5.1 Macro Concentration

Macro Snyder Column (K-D)

Add one or two clean boiling chips to the K-D evaporation flask and attach a three-ball Snyder column to the flask. Add ~1 mL of methylene chloride to the top of the column then place the K-D apparatus in a hot water bath (60-70°C) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed in hot water vapor.

Attach the solvent vapor recovery glassware to the Snyder column. Adjust the vertical position of the apparatus and check the water bath temperature. The water bath temperature should be between 54.8 – 74.8°C when methylene chloride is the extraction solvent and 84-89°C when hexane is the extraction solvent. Higher water bath temperatures may be used so long as the recovery of target analytes is not impacted. The boiling point of each solvent is provided in the following table:

Solvent	Boiling Point	Water Bath Temperature
Hexane	69°C	84 – 89°C
Methylene Chloride	39.8°C	54.8 – 74.8°C

Monitor the concentration and do not let the extract evaporate to dryness. At the proper rate of distillation the balls of the column will actively chatter but the chambers will not flood with solvent.

When the apparent volume of the extract reaches desired amount remove the K-D apparatus from the water bath and allow it to drain and cool for at least 10 minutes.

Micro Synder Column (K-D)

Add one or two clean boiling chips to the concentrator tube and attach a two ball micro-Snyder column to the tube. Place the concentrator tube into the water bath so that the concentrator tube is partially immersed in hot water. Adjust the vertical position of the concentrator tube and check the temperature of the water bath to ensure the proper temperature for the extract solvent.

Continuously monitor the distillation process to ensure sample extracts do not evaporate to dryness. At the proper rate of distillation, the balls of the column will actively chatter, but the chambers will not flood with solvent. Remove setup when desired sample volume is reached.

Nitrogen Blowdown

Nitrogen blow down may be used to concentrate extracts as needed.

Place the concentrator tube in a warm water bath maintained at a temperature of 35°C. Apply a steady stream of nitrogen until the desired final extract volume is achieved. Rinse the internal wall of the concentrator tube several times with the appropriate solvent during the evaporation and ensure the solvent level in the concentrator is positioned such to prevent water condensations. Monitor the concentration carefully and do not allow the extract to evaporate to dryness.

11.0 Calculations / Data Reduction

11.1 Data Review

11.1.1 Primary Review

Review the TALS worksheet for correctness and completeness. Record any problems encountered during the extraction process into TALS or complete a NCM, when necessary. Set aside the extracts and paperwork for secondary review.

11.1.2 Secondary Review

Review the TALS worksheet against the extraction conditions spreadsheet and/or project notes to ensure the extraction performed is consistent with project specifications. Authorize release of the extracts to the appropriate analytical department.

For additional guidance regarding the laboratory's protocol and required elements for data review refer to laboratory SOP BR-QA -019 *Data Review*.

12.0 Method Performance

12.1 Limit of Detection (LOD) and Limit of Quantitation (LOQ)

Refer to the SOP for the test method for requirements for determination of LOD and LOQ. These procedures are not included in sample preparation SOPs.

12.2 Demonstration of Capabilities (DOC)

Each analyst must complete an Initial Demonstration of Capability prior to unsupervised performance of this method.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001 *Hazardous Waste*. The following waste streams are produced when this method is carried out.

- Organic Solvents - Satellite container: 55 gallon covered and vented drum.
- Vials containing extracts - Satellite container: 5 gallon covered bucket in fume hood.

- Methylene Chloride-Waste-Satellite Container: 55 Gallon Waste Drum
- Sulfuric Acid Waste-Satellite Container: 2.5L Waste Bottle Labeled with appropriate acid type (sulfuric).
- Solid Waste-Satellite Container: Solid Waste 5 Gallon Plastic Bucket (inside fume hood)

15.0 References / Cross-References

- Comprehensive Descriptions of Trace Organic Analytical Methods given in the Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992, Volume IV, National Status and Trends Program for Marine Environmental Quality.

- GERG Trace Organic Contaminant Analytical Techniques published in NOAA Technical Memorandum NOS Orca 71, Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992, Volume IV, Comprehensive Descriptions of Trace Organic Analytical Methods, July 1993.

- CW-E-M-001 *Corporate Environmental Health and Safety Manual*
- BR-EX-016 *Percent Lipid Determination*
- BR-EX-017 *Glassware Cleaning*
- BR-EX-002 *Extract Cleanup Procedure*
- BR-EX-011 *Gel-Permiation Cleanup*
- BR-QA -019 *Data Review*
- BR-QA-005 *Determination of LOD, LOQ, & RLs*
- BR-EH-001 *Hazardous Waste*

16.0 Method Modifications

Not applicable.

17.0 Attachments

- Table 1: Primary Materials Used
- Appendix A: Terms and Definitions

18.0 Revision History

Revision 5, Effective Date 5/20/08:
- Title Page: Updated approval signatures.
- Section 6.0: Inserted vendor information
- Section 8.0: Inserted table
- Section 15.0: Added cross referenced methods with the SOP
- All Sections: Fixed typographical errors

Revision 6, Effective Date 05/20/10:
- Title Page: Updated approval signatures
- Section 6.1: Addition of Meat Grinder to equipment list
- Section 10.1: Changed pipette calibrations to be done quarterly
- All Sections: Fixed typographical errors
- All Sections: Changed benchsheets reference to extraction condition spreadsheet
- All Sections: Changed LIMS references to TALS

Revision 7, Effective Date 08/01/12

- Section 8.0: Updated Holding Time requirements
- Section 9.1: Changed frequency of MS/MSD to client request

Table 1: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and symptoms of exposure
Acetone	Flammable	1000 ppm-TWA	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.
Hexane	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.

[1] *Always add acid to water to prevent violent reactions.*
[2] *Exposure limit refers to the OSHA regulatory exposure limit.*

Appendix A: Terms and Definitions

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

SOP Change in Progress Attachment (CIPA)

SOP Number	SOP Title	SOP Revision	SOP Effective Date	CIPA Effective Date
BR-EX-027	Soxtherm Extraction (SW-846 3541)	0	11/10/10	10/01/12

The following revisions were made to this standard operating procedure (SOP). These changes are effective as of the CIPA Effective Date. This change to this document is authorized by the laboratory's QA Department.

Page 7 of 12, Section 10.5 Extraction Concentration (KD-Apparatus):

Remove the phrase (KD-Apparatus) from header 10.4 so that the text is:

10.5 Extraction Concentration

Insert the following text between 10.5 and 10.5.1:

The following sections describe the procedures for the concentration of extracts. Any of the three techniques described may be used. However some techniques are more efficient than others to achieve the final extract volume. Use the following guidelines to select the concentration technique: For the concentration of volumes greater than 5 mL, use Macro Concentration. To concentrate extract volumes between 5 and 1 mL use Micro Concentration. To concentrate extract volumes below 1 mL, use Nitrogen Blowdown.

Change the text in the header for 10.5.1 from Micro Snyder Column Concentration to Macro Snyder Column Concentration.

10.5.1 Macro Snyder Column Concentration

Title: AUTOMATED SOXHLET EXTRACTION (SW-846 3541)

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1.0 Scope and Application

This SOP describes the laboratory procedure for automated soxhlet extraction of organic analytes from soils, sediment and waste solids and the subsequent concentration of the extracts in preparation for analysis by GC or GC/MS.

1.1 Analytes, Matrix(s), and Reporting Limits

Refer to analytical methods for analyte lists and reporting limits.

2.0 Summary of Method

A portion of sample is dried with anhydrous sodium sulfate, placed in an extraction thimble and extracted with an appropriate solvent for 3 hours. Following extraction the extract is concentrated using a Kuderna-Danish (K-D) apparatus to an appropriate final volume in preparation for cleanup and/or determinative analysis.

This procedure is based on the following reference method:

SW-846 Method 3541, Automated Soxhlet Extraction, Revision 0, 1994. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Third Edition, September 1986.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

Method interferences may be caused by contaminants in solvents, reagents, glassware and other sample processing equipment. These contaminants can lead to elevated baselines and discrete artifacts that appear in gas chromatograms. These materials are demonstrated to be free of interferences by the analysis of method blanks. Interferences from phthalate esters can also pose a problem for the chlorinated pesticides analysis. To avoid this type of interference, the use of plastics in the laboratory must be minimized.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

Nitrile gloves should be used when performing this extraction. Latex and vinyl gloves provide no significant protection against the organic solvents used in this SOP, and should not be used.

The following analytes have been tentatively classified as known or suspected, human or mammalian carcinogens:benzo(a)anthracene,benzidine, 3,3'dichlorobenzindine, benzo(a)pyrene, alpha-BHC,beta-BHC, gamma-BHC, delta-BHC, dibenz(a,h)anthracene, N-nitrosodimethylamine, 4,4'-DDT, and polychlorinated biphenyl compounds. Primary standards of these toxic compounds should be prepared in hood.

During Kuderna-Danish (KD) concentration, do not allow the extract to boil to dryness. The solvent vapors remaining in the KD apparatus may superheat and create an explosion or fire hazard.

The KD apparatus has ground glass joints which can become stuck. Technicians must use Kevlar or other cut/puncture resistant gloves when separating stuck joints.

5.2 Primary Materials Used

Table 1 lists those materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Extraction Equipment

- Automated Soxhlet Extraction System: Gerhardt SX001-6 place extraction unit or equivalent.
- 54 mm Glass beaker, AMK Glass or equivalent.
- 45 mm Extraction Thimble w/holder, AMK Glass or equivalent.
- Water Chiller, VWR or equivalent.
- Ultra-High Purity Nitrogen.

6.2 Extract Concentration (KD Apparatus)

- Concentrator tube, 10 mL graduated. ChemGlass Catalog Number CG-1316-11 or equivalent
- Snyder Column, Three ball macro AMK Catalog Number SC2-01 or equivalent
- Snyder Column, Two ball micro AMK Catalog Number SC3-01 or equivalent
- Evaporation Flask, 500 mL attached to concentrator tube with clip. AMK Catalog Number KDF-500 or equivalent
- Boiling Chips, silicon carbide, approximately 10/40 mesh, solvent extracted in methylene chloride. Troemner Catalog Number 133B or equivalent.
- Heating mantle rheostat controlled for water bath capable of temperature control (± 5°C). ChemGlass Catalog Number PL3122 or equivalent.
- Water Bath, capable of temperature control to ±5°C. Barnstead Corporation Catalog Number HM0500-HS1 or equivalent.
- Solvent Vapor Recovery System, Kontes K-54000-1006, K-547300-000, Ace Glass Catalog Number 6614-30 or equivalent.

6.3 Miscellaneous

- Disposable glass Pasteur pipette and bulb.
- Top Loading balance: Capable of measuring to 0.01 gram accuracy. Mettler Model Number PM4800 or equivalent.
- Teflon and Stainless Steel Spatulas
- Adjustable pipette, capable of measuring 200 uL to 5 mL, Finnpipette or equivalent.
- 0.5 mL – 2.0 mL Hamilton Gastight® syringes or equivalent.
- 2, 4, 8, or 16 mL Teflon lined screw vial Fisher Scientific or equivalent

7.0 Reagents and Standards

7.1 Reagents

- Sodium Sulfate (granular, anhydrous), Na_2SO_4. J.T. Baker or equivalent. Purify by heating at 400°C for at least 4 hours
- Methylene Chloride (CH_2C_{12}), Pesticide quality, J.T Baker or equivalent.
- Hexane, (C_6H_{14}), Pesticide Quality. J.T. Baker or equivalent.
- Acetone, ($(CH_3)_2CO$), Pesticide quality. J.T. Baker or equivalent.

7.2 Prepared Reagents

Methylene Chloride/Acetone (1:1): In a 4 L amber glass bottle mix 2 L methylene chloride with 2 L acetone. Store the solution in a fume hood.

Hexane /Acetone (1:1): In a 4 L amber glass bottle mix 2 L hexane with 2 L acetone. Store the solution in a fume hood.

7.3 Standards

Purchase stock standards as certified solutions from commercial vendors. Prepare surrogate and spiking solutions in the laboratory by diluting a known volume of the stock standard solutions in an appropriate solvent. Record the preparation of standard in the LIMS (TALS) module established for this purpose.

Store prepared standard solutions in glass containers at 4°C or below. Unless otherwise specified, assign an expiration date of 6 months from the date of preparation or in accordance with the expiration date of the parent standard, whichever is sooner. The recommended formulation for each standard used in this procedure is provided in the analytical method along with the recommended source materials, expiration dates and storage conditions.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method.

Listed below are minimum sample size, preservation and holding time requirements:

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time[1]	Reference
Solid	Glass with PTFE lined lid	50g	4°C	Extraction: 14 days	SW-846 3540C
Tissue	Glass with PTFE lined lid	50g	-10°C	Extraction: 14 days	SW-846 3540C

[1]Extraction holding time is determined from sampling date.

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Analytical SOP
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Analytical SOP
Matrix Spike(s) MS/MSD	Client Request	See Analytical SOP
Sample Duplicate (SD)	Client Request	See Analytical SOP

9.2 Instrument QC

For information regarding instrument QC refer to the analytical SOP for the determinative test method.

10.0 Procedure

10.1 Instrument Calibration

Check the calibration of the balance each day of use prior to use and record these checks in the logbook designated for this purpose.

Check the calibration of any mechanical pipettes quarterly in accordance with the procedures specified in laboratory SOP BR-QA-008.

10.2 Glassware & Equipment Set-Up

Prepare glassware using the procedures described in laboratory SOP BR-EX-017 and rinse with acetone and methylene chloride prior to use. Label the glassware for each field and QC sample clearly and unambiguously during each step of the extraction procedure. Solvent will erase grease pens and “sharpie ink”; so use caution to ensure labels are not obliterated during the procedure.

Turn on the water chiller to the soxtherm unit. Check to ensure there is sufficient water in the unit and refill if necessary.

Start the flow of ultra-high purity nitrogen to the extraction units and set the pressure to 70 psi. Check the pressure gauge of the nitrogen cylinder and replace the tank if the pressure reading is less than 500 psi.

Initiate the following cleaning program using 120 mL of the 1:1 acetone/methylene chloride solution then discard the solution to the appropriate waste collection vessel after use.

Pre-Cleaning Operating Conditions (Program #2)

Temp Max:	150°C
Boiling Time:	20 Minute
Solvent Reduction A:	2 X 15 mL
Extraction Time:	20 Minute
Solvent Reduction B:	1X15 mL
Cool Time:	10 Minute
Total Process Time:	1 hours and 3 minutes.

The recommended operating conditions for the soxtherm units are:

Operating Conditions (Program #1)

Temp Max:	150°C
Boiling Time:	55 Minute
Solvent Reduction A:	5 X 15 mL
Extraction Time:	55 Minute
Solvent Reduction B:	1X15 mL
Cool Time:	20 Minute
Total Process Time:	2 hours and 55 minutes.

10.3 Sample Preparation

Mix samples thoroughly following the procedures specified in laboratory SOP BR-QA-020. Do no decant water from sediment samples if a large amount of water is present, contact the Project Manager for further guidance.

Initiate an extraction batch in TALS module ADII.

Place a labeled beaker on the balance and tare the balance. Measure 15 g (+/- 0.05 g) into the tared beaker and upload the sample mass into the TALS worksheet. Repeat for each sample and any designated MS/MSD or sample duplicates. Use anhydrous granular sodium sulfate for the method blank and LCS.

Mix each sample with a sufficient amount of granular anhydrous sodium sulfate to ensure a free-flowing mixture then transfer the sample into an extraction thimble.

Add ~6-12 silicon carborundum chips to each extraction beaker then place the extraction thimble into an extraction beaker.

Pipette the proper type and volume of surrogate solution to the sample container (or graduated cylinder) and add the proper type and volume of spike solution to the sample container for the

MS/MSD and LCS. See the extraction conditions workbook for type, concentration and amount of surrogate and spike solution used for each test method.

Add 120 mL of extraction solvent to each extraction beaker. For GC methods use 1:1 acetone/hexane solution as the extraction solvent and for GC/MS, use 1:1 acetone/methylene chloride.

10.4 Extraction

Place the extraction beakers into the extraction unit to ensure a tight seal between the extraction beaker and extraction unit. Check to ensure the chilled water and nitrogen systems are on and operating properly.

Turn on the soxtherm controller, press number "1" on controller pad to select program 1 and depress the enter key twice to begin the extraction process.

Periodically check the extraction units and do not allow the solvent in the extraction beaker to evaporate to dryness. If the solvent volume becomes low, lift the beakers off the boiling plate by switching the pneumatic control switch and add an additional amount of solvent to assure sufficient solvent volume until the extraction cycle is complete.

When the extraction cycle is finished, remove the beakers from the extraction unit and allow them to cool. Shut the soxtherm and Chiller "off" by depressing the "on" button. Shut the nitrogen off by turning the gas regulator counter clockwise.

Concentrate the extracts to an appropriate final volume.

10.5 Extract Concentration (KD Apparatus)

10.5.1 Micro Snyder Column Concentration

Transfer the extract to a 25 mL concentrator tube. Rinse the extraction beaker with 1~2 mL of the appropriate extraction solvent and transfer the rinsate to the concentrator tube to complete quantitative transfer.

Add one or two clean boiling chips to the K-D evaporation flask and attach a three-ball Snyder column to the flask. Add ~1 mL of methylene chloride to the top of the column then place the K-D apparatus in a hot water bath so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed in hot water vapor. Attach the solvent vapor recovery glassware to the Snyder column. Adjust the vertical position of the apparatus and check the water bath temperature.

The water bath temperature should be between 54.8 – 74.8°C when methylene chloride is the extraction solvent and 84-89°C when hexane is the extraction solvent. Higher water bath temperatures may be used so long as the recovery of target analytes is not impacted. The boiling point of each solvent is provided in the following table:

Solvent	Boiling Point	Water Bath Temperature
Hexane	69°C	84 – 89°C
Methylene Chloride	39.8°C	54.8 – 74.8°C

Monitor the concentration and do not let the extract evaporate to dryness. At the proper rate of distillation the balls of the column will actively chatter but the chambers will not flood with solvent.

When the apparent volume of the extract is near the desired final volume remove the K-D apparatus from the water bath and allow it to drain and cool for at least 10 minutes. If samples require a solvent exchange add approximately 5-6 mL of the exchange solvent to the concentrator tube and return to the hot water bath for further concentration. Further concentrate the extract to final volume using micro-synder concentration or nitrogen blow down. Refer to the Extraction Conditions Spreadsheet for final extract volume for each test method, method.

Caution: *Do not allow extracts designated for 8270 PAH to concentrate to less than 1 mL in order to minimize volatilization of target compounds.*

Micro-Snyder Concentration: Add one or two clean boiling chips to the concentrator tube and attach a two ball micro-Snyder column to the tube. Place the concentrator tube into the water bath so that the concentrator tube is partially immersed in hot water. Adjust the vertical position of the concentrator tube and check the temperature of the water bath to ensure the proper temperature for the extract solvent.

Continuously monitor the distillation process to ensure sample extracts do not evaporate to dryness. At the proper rate of distillation, the balls of the column will actively chatter, but the chambers will not flood with solvent. Remove setup when desired sample volume is reached.

Nitrogen Blow Down: Place the concentrator tube in a warm water bath maintained at a temperature of 35°C. Apply a steady stream of nitrogen until the desired final extract volume is achieved. Rinse the internal wall of the concentrator tube several times with the appropriate solvent during the evaporation and ensure the solvent level in the concentrator is positioned such to prevent water condensations. Monitor the concentration carefully and do not allow the extract to evaporate to dryness.

10.6 Extract Preparation & Handling

For final extract volumes less than or equal to 1.0 mL adjust the extract volume using a graduated concentrator tube. For final extract volumes greater than 1.0 mL use a comparison vial. Transfer the extract to labeled Teflon lined screw cap via and store refrigerated. Complete the batch worksheet and perform primary review.

11.0 Calculations / Data Reduction

11.1 Calculations

Calculations are provided in the analytical SOP for each method parameter.

11.2 Data Review

Primary Review: Review the batch worksheet for correctness and completeness. Record any problems encountered during the extraction process with a nonconformance memo (NCM).

Secondary Review: Review the batch worksheet for correctness and completeness and to ensure the extraction performed is consistent the SOP and project specifications. Print the output worksheets and release extracts and output worksheet to the analytical department or to the next step in the method chain such as extract cleanup.

For additional guidance regarding the laboratory's protocol and required elements for data review refer to laboratory SOP BR-QA-019.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

A Method Detection Limit (MDL) Study must be determined for each test method associated with this extraction procedure during initial method set-up or prior to the analysis of field samples. The MDLs are verified annually or after major instrument maintenance. The procedure for the determination of MDLs is described in laboratory SOP BR-QA-005.

12.2 Demonstration of Capabilities (DOC)

Each analyst must complete an Initial Demonstration of Capability prior to unsupervised performance of this method.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001 *Hazardous Waste*. The following waste streams are produced when this method is carried out.

- Solid Waste – Satellite Container: 5 Gallon Polyethylene Bucket
- Solvent Waste- Satellite Container: Steel 55 Gallon Drum

15.0 References / Cross-References

- SW-846 Method 3541, Automated Soxhlet Extraction, Revision 0, 1994. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Third Edition, September 1986.
- Laboratory SOP BR-EX-017 *Glassware Cleaning*
- Laboratory SOP BR-WC-006 *Percent Solids*
- Corporate Environmental Health and Safety Manual (CW-E-M-001)
- Laboratory SOP BR-QA-020 *Procedures for Sample Homogenization & Subsampling*
- Laboratory SOP BR-QA -019 *Data Review*
- Laboratory SOP BR-QA-005 *Determination of LOD, LOQ, & RL*

- Laboratory SOP BR-EH-001 *Hazardous Waste*
- Laboratory SOP BR-EX-002 *Extract Cleanup Procedures*

16.0 Method Modifications

None

17.0 Attachments

- Table 1: Primary Materials Used
- Appendix A: Terms and Definitions

18.0 Revision History

This is the first version of this SOP.

Table 1: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and symptoms of exposure
Acetone	Flammable	1000 ppm-TWA	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.
Hexane	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.

[1] *Always add acid to water to prevent violent reactions.*
[2] *Exposure limit refers to the OSHA regulatory exposure limit.*

Appendix A: Terms and Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Title: Polychlorinated Biphenyls (PCBs) by GC/ECD (SW846 8082A)

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1.0 Scope and Application

This SOP describes the laboratory procedure used to determine the concentration of polychlorinated biphenyls (PCBs) as Aroclors using dual column gas chromatography with electron capture detectors (GC/ECD).

This SOP is applicable to instrument analysis only. Extraction and extract cleanup procedures are provided in separate SOPs.

1.1 Analytes, Matrices, and Reporting Limits

This procedure may be used for a variety of matrices including: water, soil, sediment and tissue.

The list of target compounds that can be determined from this method along with the associated reporting limits (RL) is provided in Table 1.

2.0 Summary of Method

2 uL of extract is injected into a dual capillary column gas chromatograph equipped with electron capture detectors (GC/ECD). The chromatographic data is used to determine the list of analytes provided in Table 1.

This SOP is based on the following reference method:

- SW-846 Method 8082A Polychlorinated Biphenyls (PCBs) by Gas Chromatography, Revision 0, February 2007.

If the laboratory procedure is modified from the above reference method, a list of modifications will be provided in Section 16.0 of this SOP.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

- Method interference may be caused by contaminants in the extraction solvent. Solvents should be stored away from organochlorine compounds to minimize contamination.

- Non-target compounds co-extracted from the sample matrix can also cause interference, the extent of which will vary depending on the nature of the samples. Elemental sulfur is often found in sediment samples and its presence will result in broad peaks. Samples are screened prior to analysis, and those samples that contain high levels of sulfur are subject to sulfur cleanup (SW-846 3660B). Cleanup procedures that may be used for this method include: GPC (SW-846-3640A), silica gel (SW-846 3630C), Florisil (SW-846 3620B), and Sulfuric acid Cleanup (SW-846 3665A).

- Phthalate esters introduced during sample preparation can pose a problem in the determination of target analytes. Common flexible plastics contain varying amounts of

phthalate esters. These phthalate esters can be easily extracted or leached during extraction. To minimize this interference, avoid contact with any plastic materials.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats, and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

The gas chromatograph contains zones that have elevated temperatures. The analyst must be aware of the locations of those zones and must cool them to room temperature prior to working on them.

There are areas of high voltage in the gas chromatograph. Depending on the type of work involved, either turn the power to the instrument off or disconnect it from its source of power.

5.2 Primary Materials Used

Table 2 lists materials used in this method which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- Autosampler Vials, National Scientific or equivalent.
- Hydrogen Generator: Parker Balston.
- Volumetric Syringes, Class “A” (10µl, 25µl, 50µl, 100µl, 250µl and 500µl), Hamilton or equivalent.

6.2 Analytical System

- Computer Hardware/Software: GC Acquisition Platform - VAX 4505 (GVAX) Multichrom V2.11. Data Processing - Hewlett-Packard 9000-series computers, an HP 9000 K200 (Chemsvr5)/ HP-UX 10.20 and Target V3.5 or higher.

- GC/ECD: with dual columns, dual ECDs, and auto-sampler capable of a 2-µl injection split onto two columns: HP 5890 with Leap Technology CTC A200SE and A200S Fisons autosamplers, Agilent Technologies 6890N with 7683 Series injector, or equivalent.
- GC Columns: A dual fused silica capillary column system that will provide simultaneous primary and confirmation analyses:

    - RTX-5, (30m x 0.25 mmID x 0.25um)
    - RTX-35, (30m x 0.25 mmID x 0.25um)

Equivalent columns may be used provided the elution orders are documented and compound separations are maintained.

7.0 Reagents and Standards

7.1 Reagents

- Hexane, Ultra-Resi Analyzed, JT Baker or equivalent.

7.2 Standards

Purchase stock standard solutions from commercial vendors and from these prepare calibration and working standards by diluting a known volume of stock standard in an appropriate solvent to the final volume needed to achieve the desired concentration. The recommended formulation for each standard used in this procedure is provided in Appendix B along with the recommended source materials, expiration dates and storage conditions.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection, so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method. Listed below are minimum sample size, preservation, and holding time requirements needed for this test.

Matrix	Sample Container	Minimum Sample Size	Preservation	Extract Holding Time	Reference
Water	Glass	1 L	Chilled to 4°C	40 Days	SW-846 8082A
Solid	Glass	50 g	Chilled to 4°C	40 Days	SW-846 8082A

[1]Analytical holding time is determined from date of initiation of extraction.

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 3
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 3

Matrix Spike(s) MS/MSD	Client Request	See Table 3
Sample Duplicate (SD)	Client Request	See Table 3

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Table 3
Second Source Calibration Verification (ICV)	Once, after each ICAL	See Table 3
Continuing Calibration Verification (CCV)	Daily, every 10 samples, end of sequence	See Table 3
Retention Time Windows	As Needed	See Table 3

10.0 Procedure

10.1 Instrument Operating Conditions

Install a five meter deactivated guard column into the injection port and connect the guard column to the separate analytical columns using a glass "Y". The analytical columns are installed into independent ECD detectors.

The recommended instrument operating conditions are as follows:

Initial Temperature:	130°C for 1 minute Temperature Program: 20°C per minute to 190°C to 5°C per minute to 225°C to 20.0°C per minute to 300°C. Hold for 6 minutes.
Detector Temperature	300°C
Injector Temperature:	200°C
Injection volume:	2μL
Carrier Gas:	Hydrogen (supplied by hydrogen generators)

Optimize the flow rate of the carrier gas by injecting an un-retained substance onto the column at an isothermal oven state and adjusting the flow to obtain the recommended dead volume time.

10.2 Retention Time Window Establishment

Whenever a new GC column is installed, establish RT windows for each analyte by analyzing three standards over a 72-hour period. Calculate the mean RT and Standard Deviation (SD). The RT window is calculated as the mean RT ± 3SD. If the SD is <0.01 minutes, a default SD of 0.01 minutes may be used.

If this procedure results in RT windows that are too tight, favoring false negatives, the laboratory may opt to use an alternate method to determine the RT windows. An alternate method consists of using a RT window of ± 0.05 minutes. The center of the RT window is set at the midpoint calibration level in the initial calibration sequence. RT windows are then updated daily (minimum frequency), re-centering the windows on the retention times established in a CCV.

10.3 Instrument Calibration

10.3.1 Initial Calibration (ICAL)

Clean the injection port and column with a hexane instrument blank prior to calibration.

To calibrate the instrument analyze a standard containing a mixture of Aroclor 1016 and Aroclor1260 (AR1660) at a minimum of five concentrations and use this multi-point calibration to determine the concentration of AR1016 and AR1260 in sample.

The mixed AR1660 standard includes most of the peaks represented in the other Aroclors so the multi-point calibration can also be used to demonstrate linearity of the instrument and that a sample does not contain peaks that represent the other Aroclors but it is not sufficient for pattern recognition. For the remaining Aroclors analyze a single-point standard at a concentration near the mid-point of the calibration and use these standards for pattern recognition and calculation of a single-point calibration factor. The laboratory does not perform a multi-point calibration for the remaining Aroclors unless requested for the project or by regulatory requirement.

Prepare the calibration standards using the formulations provided in Appendix B then transfer ~100 ugL to an autosampler vial insert. Place the vials in the autosampler, set the autosampler to inject 2-µl of each standard onto the instrument and initiate the analytical sequence.

A minimum of 3 peaks must be chosen for each Aroclor, and preferably 5 peaks. The peaks must be characteristic of the Aroclor in question. Choose peaks in the Aroclor standards that are at least 25% of the height of the largest Aroclor peak. For each Aroclor, the set of 3 to 5 peaks should include at least one peak that is unique to that Aroclor. Use at least five peaks for the Aroclor 1016/1260 mixture.

The data processing system calculates the Calibration Factor (CF), mean CF, and Percent Relative Standard Deviation (%RSD) for each analyte on both columns. The %RSD for each target analyte must be less than or equal to 20% in order to use the mean CF for quantification. This evaluation is performed for each quantitation peak chosen for each Aroclor. All peaks must pass the 20% evaluation, not the average of the 5 peaks chosen for quantitation. If this criterion is not met, use another suitable quantification method for that analyte or correct the problem and repeat the calibration. Once a method of quantification is chosen for a specific compound, it must be consistent throughout the entire analytical sequence until a new initial calibration is performed.

The calibration factor is used to determine the linearity of the calibration.

Alternate Quantification Option:

Linear Regression: Generate a curve of concentration vs. response for each analyte and calculate the correlation coefficient. The calibration must have a correlation coefficient (r) $\geq$ 0.995. If this criterion is not met, correct the problem and repeat the calibration. The use of linear regression requires a minimum of 5 calibration points.

10.3.2 Second Source Calibration Verification (ICV)

Immediately after each calibration and prior to the analysis of any QC or field samples, verify the accuracy of the initial calibration by analyzing a second source ICV.

Prepare the ICV using the formulation provided in Appendix B. Inject 2 µl of the ICV standard onto the instrument in the same manner as performed for the initial calibration standards.

The percent recovery of the average concentration of the peaks chosen for quantitation must be within ± 20% of the expected value (%R 80-120). If this criterion is not met, correct the problem and reanalyze the ICV. If reanalysis fails, remake the calibration standards and/or perform instrument maintenance and recalibrate. The acceptance criteria must be met on both columns.

10.3.3 Continuing Calibration Verification (CCV)

Analyze a CCV (1660) at or below the mid-calibration range each day before sample analysis, after every ten sample injections and at the end of each analytical sequence.

Note: The laboratory does not perform a CCV for the remaining Aroclors unless requested for the project or by regulatory requirement.

The data system calculates the calibration factor (CF) and percent difference using the average percent difference of the peaks chosen for quantitation.

The percent difference or drift must be within ±20% and the retention time (RT) must be within the established RT window. Acceptance criteria must be met on both columns.

If the CCV fails, it may be repeated once. If repeat analysis fails, corrective action must be taken. If the two CCVs do not meet the criteria, recalibration is required prior to running samples. Samples must be bracketed by passing CCVs. Samples analyzed before and after CCV failures must be reanalyzed, unless the CCV is high and there are no detects in the associated samples. (NELAC Requirement)

10.4 Troubleshooting

Check the following items in case of calibration failures:

- ICAL Failure – Perform injection port maintenance, install new guard column, check detector ends to see if detector jet has slipped. In extreme cases, install new columns, particularly if the chromatography has degraded as evidenced by peak shapes.
- CCV Failure – Perform Injection port maintenance; if injection port maintenance does not restore CCV, install a new guard column and remove one or more loops from each analytical column.
- Needle crushed during injection - Replace the needle and check the injection port for obstructions and check the autosampler for misalignment.
- Auto-sampler failure - Reset the auto-sampler.
- Power failure - Reset run in Multichrom and re-acquire or re-initiate run sequence.

10.5 Analysis

Remove the extract from refrigerated storage and warm to room temperature.

Transfer approximately 100 uL of extract to an autosampler vial and place the vials in the autosampler in a sequence that begins with the calibration standards followed by the analysis of an ICV, QC samples, field samples and continuing calibration verification standards (CCVs).

Enter the sample ID's into the data acquisition program in the order that the samples were placed in the autosampler tray and initiate the analytical sequence.

An example analytical sequence that includes calibration is as follows:

Injection Number	Lab Description
1	Instrument Blank
2	Instrument Blank
3	Instrument Blank
4	AR1221 (200 ppb)
5	AR1232 (200 ppb)
6	AR1242 (200 ppb)
7	AR1248 (200 ppb)
8	AR1254 (200 ppb)
9	AR1262 (200 ppb)
10	AR1268 (200 ppb)
11	AR1660 (50 ppb)
12	AR1660 (100 ppb)
13	AR1660 (200 ppb)
14	AR1660 (400 ppb)
15	AR1660 (800 ppb)
16	Instrument Blank
17	ICV
18-27	10 injections
28	CCV (AR1660 200ppb)
	Repeat steps 18-28

Cleaning blanks (IBLK) consisting of hexane may be analyzed after high-level samples at the discretion of the analyst.

11.0 Calculations / Data Reduction

11.1 Qualitative Identification

The data processing system identifies the target analytes by comparing the retention time of the peaks to the established retention time windows.

Review and accept or reject the qualitative identifications made by the data processing system using the following guidelines:

Compare the retention time of the peak to the established RT window, taking into account the shift of the surrogate peaks. If the surrogate peaks have shifted, open the retention time window in the direction of the shift. The processing system identifies the peak in the retention time window that is closest to the expected retention time set in the Target method, so the peak may need to be re-identified if a shift has occurred. The data system does not recognize Aroclor patterns. The analyst manually identifies Aroclors by comparing the pattern in the samples to the patterns in the initial calibration standards. Weathering of PCB's in the environment may alter the PCB's to the point that the pattern no longer matches the pattern established for that Aroclor in

the initial calibration. The laboratory takes the best pattern match approach to the identification and quantification of weathered PCB's.

Look for shoulders on the side of large peaks that may be peaks of interest. The processing system does not always automatically integrate shoulders from larger peaks, so manual integration (split) of the shoulder may be necessary.

Each target analyte must be detected on each column for qualitative identification to be made.

11.2 Quantitative Identification

Using an average of the chosen quantification peaks per Aroclor the data system calculates the corrected concentration for each target analyte using the equations given in Appendix C. If sample interference is suspected, the laboratory may remove up to two quantification peaks per column. The higher value between the two columns is reported as the primary result unless there is evidence of chromatographic anomalies, in which case the lower value will be reported. This deviation must be noted in the project narrative.

11.3 Calculations

See Appendix C.

11.4 Data Review

See laboratory SOP BR-QA-019 for data review requirements.

11.4.1 Primary Review

Review project documents to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Confirm qualitative and quantitative identification criteria using the criteria provided in Sections 11.1 and 11.2. If the data system does not properly integrate the peaks perform manual integration in accordance with laboratory SOP BR-QA-006.

Upload the data files from the data processing system to the laboratory information management system (TALS). Complete the batch information for standards and reagents and verify ICAL and QC sample associations. Review the results and set results to primary, secondary, acceptable or rejected as appropriate. Dilute and reanalyze samples whose results exceed the calibration range. The dilution analysis should result in a determination within the calibration range, preferably in the upper half of the calibration range. A more concentrated analysis is not necessary unless the project requires it. Dilution analyses may be performed to minimize matrix interference.

If a sample was analyzed immediately following a high concentration sample, review the results of the sample for any sign of carryover. If carryover is suspected, reanalyze the sample.

Create a non-conformance report (NCM) for any calibration, QC and sample data that is reported outside established acceptance criteria and/or schedule necessary corrective action. Set batch to 1st level review and complete the data review checklist.

11.4.2 Secondary Data Review

Verify quantitative and qualitative identification in the initial calibration standards and spot check such for ~15% of the remaining data in the batch.

If manual integrations were performed:

- Review each integration to verify that the integration meets the requirements for manual integration as specified in laboratory SOP BR-QA-006. If an error is suspected or found consult with the analyst that performed the integration analyst and request correction or notify the Department Manager, Technical Director or QA Manager. Do not "fix" the integration. Reintegration by a secondary data reviewer must not be performed except in limited circumstances as approved by the department supervisor or other laboratory management. If those instances where the secondary reviewer performs the integration, this person is now considered the primary analyst and each integration performed by the secondary reviewer must be subsequently reviewed by a peer analyst or the department supervisor to verify the integration is consistent and compliant with the requirements specified in laboratory SOP BR-QA-006.

- Check to ensure an appropriate technical reason code is provided for each manual integration. Acceptable technical reason codes are provided in laboratory SOP BR-QA-005.

Review project documents to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Verify that the acceptance criteria for the calibration and QC items listed in Table 1 were met. If the results do not fall within the established limits verify the recommended corrective actions were performed. If not, initiate corrective actions and/or verify an NCM was created to document the criteria exception. Verify analytical results are qualified accordingly. Set batch to 2nd level review and complete the data review checklist.

11.5 Data Reporting

The report format, application of data qualifiers and creation of the data deliverable is performed by the LIMS using the formatter set by the project manager during log-in.

Records of electronic and hardcopy data are maintained as described in laboratory SOP BR-QA-014.

12.0 Method Performance

12.1 Limit of Detection (LOD) and Limit of Quantitation (LOQ)

Establish a LOD and LOQ at initial method set up following the procedures specified in laboratory SOP BR-QA-005. Verify the LOD and LOQ at the frequency established for the method using the procedures specified in same SOP. The frequency of LOD and LOQ verification depends on the strictest frequency of the regulatory program for which the method supports. The frequency requirement is documented in a spreadsheet maintained by the QA Department.

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in the laboratory SOP for employee training.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of the SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

14.1 Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001. The following waste streams are produced when this method is carried out.

- Vials containing sample extracts: Satellite container: 15 gallon bucket connected to a fume hood.
- Solvent Waste: Satellite container: 1 L glass bottle located in fume hood.

15.0 References / Cross-References

- SW-846 Method 8082A Polychlorinated Biphenyls (PCBs) by Gas Chromatography, Revision 0, February 2007.
- Corporate Environmental Health and Safety Manual (CW-E-M-001)
- Laboratory SOP BR-QA-011
- Laboratory SOP BR-LP-011
- Laboratory SOP BR-QA-014
- Laboratory SOP BR-QA-006
- Laboratory SOP BR-QA-005

16.0 Method Modifications

Not applicable.

17.0 Attachments

- Table 1: Target Compound List and Reporting Limit
- Table 1A: Accuracy and Precision Limits
- Table 2: Primary Materials Used
- Table 3: QC Summary & Recommended Corrective Action
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: Equations

18.0 Revision History

BR-GC-005, Rev. 11:

- Title Page: Updated method reference
- Section 2.0: Updated method reference
- Section 10.3: Changed CCV criteria from 15% to 20%
- Table 3: Changed CCV criteria from 15% to 20%

BR-GC-005, Rev. 10:

- Updated approval signatures
- Section 10: Inserted note regarding multi-point calibrations for other Aroclors.

BR-GC-005, Rev. 9

- Updated reference method in Section 2.0.
- Changed QC criteria for %D from 15% to 20%.
- Added language to Section 10.2 to allow for updating RT windows using CCVs.
- Added language to Section 11.4.1 to allow for dilution to minimize matrix interference.
- Added standard preparation tables to Appendix B to allow for the preparation of 5 point calibrations for each of the Aroclors

Table 1: Routine Target Analyte List & Reporting Limits (RL)

ANALYTE	Routine Reporting Limit (RL)[1,2]	
	Water (ug/L)	Solid (ug/Kg)
AR1016	0.50	17
AR1221	0.50	17
AR1232	0.50	17
AR1242	0.50	17
AR1248	0.50	17
AR1254	0.50	17
AR1260	0.50	17
AR1262	0.50	17
AR1268	0.50	17

[1]*The routine RL is the unadjusted value that can be achieved in a blank matrix.*
[2]*The RL for tissue matrix is project defined.*

Table 1A: Routine Accuracy and Precision Limits[1]

Analyte	In-House Limits (%R)		Precision (RPD) (≤)
	Water	Solid	
AR1016	55-120	55-120	30
AR1260	60-125	55-125	30
Surrogate: Decachlorobiphenyl (DCB)	30-150	45-125	NA
Surrogate:TCX (Advisory)[2]	55-120	30-130	NA

[1] *The limits in this table are those used as of the effective date of this SOP. Current limits are stored in the LIMS database.*
[2] *The control limits for TCX are advisory. Corrective action is not performed when recovery is outside limits.*

Table 2: Primary Materials Used

Material [1]	Hazards	Exposure Limit[2]	Signs and symptoms of exposure
Hexane	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.

[1] *Always add acid to water to prevent violent reactions.*
[2] *Exposure limit refers to the OSHA regulatory exposure limit.*

Table 3: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action[1]
ICAL	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	Option 1: RSD for each analyte ≤ 20% Option 2: Linear Regression: r ≥ 0.995	Correct problem, reanalyze, repeat calibration.
ICV	After each initial calibration	(% R) ± 20% from expected value	Correct problem and verify second source standard. If that fails, repeat initial calibration.
CCV	Daily before sample analysis, every 10 samples and at the end of the analytical sequence	% Difference or Drift ±20%	See Section 10.3
MB	One per extraction batch of 20 or fewer samples	Target Analyte < RL	Examine project DQO's and take appropriate corrective action, which may include re-analysis of MB, re-extraction of batch, and/or non-conformance report (NCR). Corrective action must be documented on NCR. If there are no detects in samples, or if all detects are > 10 X MB level, re-prep and reanalysis may not be required.
LCS	One per extraction batch of 20 or fewer samples	See Table 1A	Examine project DQO's and take appropriate corrective action, which may include re-analysis of LCS, re-extraction of batch, and/or non-conformance report (NCR). Corrective action must be documented on NCR. Flag all reported values outside of control limits.
MS/MSD SD	Per client request	See Table 1A	Evaluate data and determine if a matrix effect or analytical error is indicated. If analytical error, re-analyze and/or re-extract. Flag all reported values outside of control limits.
Surrogate	All field and QC samples	See Table 1A	Evaluate data and determine if a matrix effect or analytical error is indicated. If analytical error, re-analyze or re-extract. If matrix effect, review project DQOs to determine if a matrix effect must be confirmed by re-analysis. Flag all reported values outside of control limits.

[1]*The recommended corrective action may include some or all of the items listed in this column. The corrective action taken may be dependent on project data quality objectives and/or analyst judgment but must be sufficient to ensure that results will be valid. If corrective action is not taken or is not successful, data must be flagged with appropriate qualifiers.*

Appendix A: Terms and Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are only produced in this range and qualified with the proper data reporting flag when a project requires this type of data reporting.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Appendix B: Standard Preparation Tables

The standard formulations contained in this Appendix are recommended and are subject to change. If the concentration of the stock standard is different than those noted in this table, adjust the standard preparation formulation accordingly. Unless otherwise specified, prepare the standard solutions in hexane using Class A volumetric glassware and Hamilton syringes. Unless otherwise specified for a standard solution, assign an expiration date of 6 months from date of preparation unless the parent standard expires sooner in which case use the earliest expiration date. Store the prepared solutions under refrigeration and protected from light at a temperature of 4ºC (±2). See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance.

Intermediate Calibration Standards (10 mg/L)

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
AR1660[1]	Restek #32039	Aroclor 1016 Aroclor 1260	1000	0.40	40	10
AR1254	Restek #32011	Aroclor 1254	1000	0.40	40	10
AR1248	Restek #32010	Aroclor 1248	1000	0.40	40	10
AR1242	Restek #32009	Aroclor 1242	1000	0.40	40	10
AR1232	Restek #32008	Aroclor 1232	1000	0.40	40	10
AR1221	Restek #32007	Aroclor 1221	1000	0.40	40	10
AR1262	Restek #32409	Aroclor 1262	1000	0.40	40	10
AR1268	Restek #32410	Aroclor 1268	1000	0.40	40	10

[1] *Standard is a mix of AR1016/AR1260. Concentration shown is the concentration of each Aroclor in the mixed standard.*

Intermediate ICV Standard (10 mg/L)

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
AR1660	Ultra Scientific PPM8082	Aroclor 1016 Aroclor 1260	1000	0.40	40	10

Surrogate Solution (10 mg/L)

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
Pesticide Surrogate	Restek #3200	TCX DCB	1000	0.40	40	10

Working ICV Standard (200 ug/L)

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Intermediate ICV	Laboratory Prepared	Aroclor 1016 Aroclor 1260	10	0.80	40	200
Surrogate	Laboratory Prepared	TCX DCB	10	0.080		20

AR1660 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1660 Intermediate	Laboratory Prepared	Aroclor 1016 Aroclor 1260	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1660 calibration standards*

AR1660 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1660 Level 5	AR1660 CAL Level 4	800	20	40	400
AR1660 Level 5	AR1660 CAL Level 3	800	10	40	200
AR1660 Level 5	AR1660 CAL Level 2	800	5.0	40	100
AR1660 Level 5	AR1660 CAL Level 1	800	2.5	40	50

AR1221 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1221 Intermediate	Laboratory Prepared	Aroclor 1221	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1221 calibration standards*

AR1221 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1221 Level 5	AR1221 CAL Level 4	800	20	40	400
AR1221 Level 5	AR1221 CAL Level 3	800	10	40	200
AR1221 Level 5	AR1221 CAL Level 2	800	5.0	40	100
AR1221 Level 5	AR1221 CAL Level 1	800	2.5	40	50

AR1232 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1232 Intermediate	Laboratory Prepared	Aroclor 1232	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1232 calibration standards*

AR1232 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1232 Level 5	AR1232 CAL Level 4	800	20	40	400
AR1232 Level 5	AR1232 CAL Level 3	800	10	40	200
AR1232 Level 5	AR1232 CAL Level 2	800	5.0	40	100
AR1232 Level 5	AR1232 CAL Level 1	800	2.5	40	50

AR1242 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1242 Intermediate	Laboratory Prepared	Aroclor 1242	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1242 calibration standards*

AR1242 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1242 Level 5	AR1242 CAL Level 4	800	20	40	400
AR1242 Level 5	AR1242 CAL Level 3	800	10	40	200
AR1242 Level 5	AR1242 CAL Level 2	800	5.0	40	100
AR1242 Level 5	AR1242 CAL Level 1	800	2.5	40	50

AR1248 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1248 Intermediate	Laboratory Prepared	Aroclor 1248	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1248 calibration standards*

AR1248 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1248 Level 5	AR1248 CAL Level 4	800	20	40	400
AR1248 Level 5	AR1248 CAL Level 3	800	10	40	200
AR1248 Level 5	AR1248 CAL Level 2	800	5.0	40	100
AR1248 Level 5	AR1248 CAL Level 1	800	2.5	40	50

AR1254 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1254 Intermediate	Laboratory Prepared	Aroclor 1254	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1254 calibration standards*

AR1254 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1254 Level 5	AR1254 CAL Level 4	800	20	40	400
AR1254 Level 5	AR1254 CAL Level 3	800	10	40	200
AR1254 Level 5	AR1254 CAL Level 2	800	5.0	40	100
AR1254 Level 5	AR1254 CAL Level 1	800	2.5	40	50

AR1262 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1262 Intermediate	Laboratory Prepared	Aroclor 1262	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1262 calibration standards*

AR1262 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1262 Level 5	AR1262 CAL Level 4	800	20	40	400
AR1262 Level 5	AR1262 CAL Level 3	800	10	40	200
AR1262 Level 5	AR1262 CAL Level 2	800	5.0	40	100
AR1262 Level 5	AR1262 CAL Level 1	800	2.5	40	50

AR1268 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1268 Intermediate	Laboratory Prepared	Aroclor 1268	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1268 calibration standards*

AR1268 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1268 Level 5	AR1268 CAL Level 4	800	20	40	400
AR1268 Level 5	AR1268 CAL Level 3	800	10	40	200
AR1268 Level 5	AR1268 CAL Level 2	800	5.0	40	100
AR1268 Level 5	AR1268 CAL Level 1	800	2.5	40	50

Appendix C: Equations

Calibration Factor (CF_x) = $\frac{\text{Peak area or height}_{(x)}}{\text{Standard concentration}_{(ug/L)}}$

Mean Calibration Factor ($\overline{CF}$) = $\frac{\sum_{i=1}^{n} CF_i}{n}$

where: n = number of calibration levels

Standard Deviation of the Calibration Factor (SD) = $\sqrt{\frac{\sum_{i=1}^{n}\left(CF_i - \overline{CF}\right)2}{n-1}}$

where: n = number of calibration levels

Percent Relative Standard Deviation (RSD) of the Calibration Factor =
$\frac{SD}{\overline{CF}} \times 100\%$

Percent Difference (%D) = $\frac{CF_v - \overline{CF}}{\overline{CF}} \times 100\%$ Add absolute value signs

where: CF_v = Calibration Factor from the Continuing Calibration Verification (CCV)

Percent Drift = $\frac{\text{Calculated Concentration – Theoretical Concentration}}{\text{Theoretical Concentration}}$ X 100%

Percent Recovery (%R) = $\frac{C_s}{C_n} \times 100\%$

where: C_s = Concentration of the Spiked Field or QC Sample
C_n = Nominal Concentration of Spike Added

Percent Recovery (%R) for MS/MSD = $\frac{C_s - C_u}{C_n} \times 100\%$

where: C_s = Concentration of the Spiked Sample
C_u = Concentration of the Unspiked Sample
C_n = Nominal Concentration of Spike Added

Relative Percent Difference (RPD) = $\dfrac{|C_1 - C_2|}{\left(\dfrac{C_1 + C_2}{2}\right)} \times 100\%$

where: C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Sample Concentration

Extract

$C_{extract}\,(ug/L) = \dfrac{\text{Peak Area (or Height)}}{\overline{CF}}$

Note: The concentrations of the 3-5 peaks chosen for quantification is calculated and the average is then taken for final calculation.

Water

$$C_{sample}(ug/L) = C_{extract}(ug/L) \times \frac{\text{extract volume (L)}}{\text{sample volume (L)}} \times DF$$

Solid

$$C_{sample}(ug/Kg) = C_{extract}(ug/L) \times \frac{\text{extract volume (L)}}{\text{sample weight (Kg)}} \times \frac{100}{\%\,\text{solids}} \times DF$$

Quality Assurance Manual

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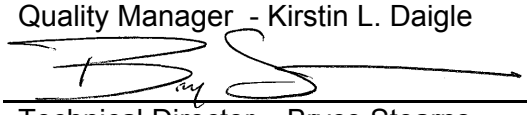
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Title Page:

Quality Assurance Manual
Approval Signatures

	October 25, 2011
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	October 24, 2011
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	October 24, 2011
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SECTION 2. TABLE OF CONTENTS

Sec. No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005 (E) Reference	Page No.
-	COVER PAGE	V1M2 Sec. 4.2.8.3		1
1.0	TITLE PAGE			2
2.0	TABLE OF CONTENTS	V1M2 Secs. 4.2.8.3-4.2.8.4		3
3.0	INTRODUCTION, SCOPE AND APPLICABILITY	V1M2 Sec. 4.2.8.4		12
3.1	Introduction And Compliance References	V1M2 Secs. 1.1; 1.2; 2.0; 3.2; 4.1.2; 4.2.4	4.1.2; 4.2.4	12
3.2	Terms And Definitions	V1M2 Secs. 3.0; 4.2.4	4.2.4	13
3.3	Scope / Fields Of Testing	V1M2 Secs. 1.2; 4.2.4	4.1.2; 4.2.4	13
3.4	Management Of The Manual	V1M2 Secs. 4.2.1; 4.2.7; 4.3.3.2; 4.3.3.3	4.2.1; 4.2.7; 4.3.3.2; 4.3.3.3	13
4.0	MANAGEMENT REQUIREMENTS	V1M2 Sec. 4		14
4.1	Overview	V1M2 Secs. 4.1.1, 4.1.3; 4.1.5	4.1.1; 4.1.3; 4.1.5; 4.2.6	14
4.2	Roles And Responsibilities	V1M2 Secs. 4.1.4; 4.1.5; 4.1.6; 4.2.1; 4.2.6; 5.2.4	4.1.3; 4.1.5; 4.1.6; 4.2.1; 4.2.6; 5.2.4	14
4.3	Deputies	V1M2 Secs. 4.1.5; 4.1.7.2; 4.2.7	4.1.5; 4.2.7	16
5.0	QUALITY SYSTEM			20
5.1	Quality Policy Statement	V1M2 Secs. 4.1.5; 4.2.2; 4.2.3; 4.2.8.3	4.1.5; 4.2.2; 4.2.3	20
5.2	Ethics And Data Integrity	V1M2 Secs. 4.1.5; 4.16; 4.2.2; 4.2.8.1; 5.2.7	4.1.5; 4.2.2	20
5.3	Quality System Documentation	V1M2 Secs. 4.1.5; 4.2.2; 4.2.5	4.2.2; 4.2.5	21
5.4	QA/QC Objectives For The Measurement Of Data	V1M2 Sec. 4.2.2	4.1.5; 4.2.2	22
5.5	Criteria For Quality Indicators			23
5.6	Statistical Quality Control			24
5.7	Quality System Metrics			24
6.0	DOCUMENT CONTROL	V1M2 Secs. 4.2.7; 4.3.1; 4.3.2.2 ; 4.3.3.3; 4.3.3.4	4.2.7; 4.3.1; 4.3.2.2; 4.3.3.3; 4.3.3.4	24
6.1	Overview			24
6.2	Document Approval And Issue	V1M2 Secs. 4.3.2; 4.3.2.1-4.3.2.3; 4.3.3.1	4.3.2.1; 4.3.2.2; 4.3.2.3; 4.3.3.1	25

Sec. No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005 (E) Reference	Page No.
6.3	Procedures For Document Control Policy	V1M2 Secs. 4.3.2.1–4.3.2.2; 4.3.3.1	4.3.2.1; 4.3.2.2; 4.3.3.1	25
6.4	Obsolete Documents	V1M2 Secs. 4.3.2.1–4.3.2.2	4.3.2.1; 4.3.2.2	26
7.0	SERVICE TO THE CLIENT	V1M2 Secs. 4.4.1 - 4.4.4	4.4.1; 4.4.2; 4.4.3; 4.4.4	26
7.1	Overview	V1M2 Secs. 4.4.5; 4.5.5; 5.7.1	4.4.5; 5.7.1	26
7.2	Review Sequence And Key Personnel	V1M2 Sec. 4.4.5	4.4.5	27
7.3	Documentation	V1M2 Sec. 5.7.1	5.7.1	28
7.4	Special Services	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	29
7.5	Client Communication	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	29
7.6	Reporting	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	29
7.7	Client Surveys	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	29
8.0	SUBCONTRACTING OF TESTS	V1M2 Secs. 4.4.3; 4.5.4	4.4.3; 4.5.4	30
8.1	Overview	V1M2 Secs. 4.5.1 - 4.5.3; 4.5.5; 5.3.1	4.5.1; 4.5.2; 4.5.3; 5.3.1	30
8.2	Qualifying And Monitoring Subcontracators	V1M2 Secs. 4.5.1; 4.5.2; 4.5.3; 4.5.5	4.5.1; 4.5.2; 4.5.3	30
8.3	Oversight And Reporting	V1M2 Sec. 4.5.5		32
8.4	Contingency Planning			32
9.0	PURCHASING SERVICES AND SUPPLIES	V1M2 Sec. 4.6.1	4.6.1	35
9.1	Overview	V1M2 Secs. 4.6.2; 4.6.3; 4.6.4	4.6.2; 4.6.3; 4.6.4	35
9.2	Glassware	V1M2 Sec. 5.5.13.1		35
9.3	Reagents, Standards & Supplies	V1M2 Secs. 4.6.2; 4.6.3; 4.6.4	4.6.2; 4.6.3; 4.6.4	35
9.4	Purchase Of Equipment / Instruments / Software			37
9.5	Services			38
9.6	Suppliers			38
10.0	COMPLAINTS	V1M2 Sec. 4.8	4.8	39
10.1	Overview			39
10.2	External Complaints			39
10.3	Internal Complaints			40
10.4	Management Review			40
11.0	CONTROL OF NON-CONFORMING WORK	V1M2 Secs. 4.9.1; 5.10.5	4.9.1; 5.10.5	40
11.1	Overview	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5	4.9.1; 4.11.3; 4.11.5	40

Sec. No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005 (E) Reference	Page No.
11.2	Responsibilities And Authorities	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5; 5.2.7	4.9.1; 4.11.3; 4.11.5	40
11.3	Evaluation Of Significance And Actions Taken	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5	4.9.1; 4.11.3; 4.11.5	41
11.4	Prevention Of Nonconforming Work	V1M2 Secs. 4.9.4; 4.11.2	4.9.2; 4.11.2	41
11.5	Method Suspension / Restriction (Stop Work Procedures)	V1M2 Secs. 4.9.1; 4.9.2; 4.11.5	4.9.1; 4.9.2; 4.11.5	42
12.0	CORRECTIVE ACTION	V1M2 Sec. 4.11		42
12.1	Overview	V1M2 Secs. 4.9.2; 4.11.1; 4.11.2	4.9.2; 4.11.1; 4.11.2	42
12.2	General	V1M2 Sec. 4.11.2; 4.11.3	4.11.2; 4.11.3	43
12.3	Closed Loop Corrective Action Process	V1M2 Sec. 4.11.2; 4.11.3; 4.11.4; 4.11.6; 4.11.7; 4.12.2	4.11.2; 4.11.3; 4.11.4; 4.12.2	43
12.4	Technical Corrective Actions	V1M2 Sec. 4.11.6		45
12.5	Basic Corrections	V1M2 Secs. 4.11.1; 4.13.2.3	4.11.1; 4.13.2.3	46
13.0	PREVENTIVE ACTION / IMPROVEMENT	V1M2 Secs. 4.10; 4.12.1; 4.12.2	4.10; 4.12.1; 4.12.2	50
13.1	Overview	V1M2 Secs. 4.15.1; 4.15.2	4.15.1; 4.15.2	50
13.2	Management Of Change			51
14.0	CONTROL OF RECORDS	V1M2 Secs. 4.2.7; 4.13.1.1; 4.13.3	4.2.7; 4.13.1.1	52
14.1	Overview	V1M2 Secs. 4.13.1.1; 4.13.1.2; 4.13.1.3; 4.13.1.4; 4.13.2.1; 4.13.2.2; 4.13.2.3; 4.13.3	4.13.1.1; 4.13.1.2; 4.13.1.3; 4.13.1.4; 4.13.2.1; 4.13.2.2; 4.13.2.3	52
14.2	Technical And Analytical Records	V1M2 Sec. 4.13.2.2 - 4.13.2.3	4.13.2.2; 4.13.2.3	55
14.3	Laboratory Support Activities			56
14.4	Administrative Records			57
14.5	Records Management, Storage And Disposal	V1M2 Sec. 4.13.3		57
15.0	AUDITS			58
15.1	Internal Audits	V1M2 Sec. 4.2.8.1; 4.14; 4.14.1; 4.14.2 ; 4.14.3; 4.14.5; 5.9.1; 5.9.2	4.14.1; 4.14.2; 4.14.3; 5.9.1; 5.9.2	58
15.2	External Audits	V1M2 Secs.4.14.2; 4.14.3	4.14.2; 4.14.3; 4.14.4	59

Sec. No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005 (E) Reference	Page No.
15.3	Audit Findings	V1M2 Secs. 4.14.2; 4.14.3; 4.14.5		60
16.0	MANAGEMENT REVIEWS	V1M2 Sec. 4.1.6; 4.15; 4.15.1; 4.15.2	4.1.6; 4.15.1; 4.15.2	61
16.1	Quality Assurance Report			61
16.2	Annual Management Review	V1M2 Sec. 4.2.2; 4.15.3	4.2.2	61
16.3	Potential Integrity Related Managerial Reviews			62
17.0	PERSONNEL	V1M2 Secs. 5.2; 5.2.1	5.2.1	62
17.1	Overview	V1M2 Secs. 5.2.2; 5.2.3; 5.2.5	5.2.2; 5.2.3; 5.2.5	62
17.2	Education And Experience Requirements For Technical Personnel	V1M2 Secs. 5.2.1; 5.2.3; 5.2.4	5.2.1; 5.2.3; 5.2.4	63
17.3	Training	V1M2 Sec. 5.2.5	5.2.5	64
17.4	Data Integrity And Ethics Training Program	V1M2 Sec. 4.2.8.1; 5.2.7		65
18.0	ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS	V1M2 Sec. 5.3		66
18.1	Overview	V1M2 Secs. 5.3.1; 5.3.3; 5.3.4; 5.3.5	5.3.1; 5.3.3; 5.3.4; 5.3.5	66
18.2	Environment	V1M2 Secs. 5.3.1; 5.3.2; 5.3.3; 5.3.4; 5.3.5	5.3.1; 5.3.2; 5.3.3; 5.3.4; 5.3.5	67
18.3	Work Areas	V1M2 Secs. 5.3.3; 5.3.4; 5.3.5	5.3.3; 5.3.4; 5.3.5	67
18.4	Floor Plan			67
18.5	Building Security	V1M2 Sec. 5.3.4	5.3.4	68
19.0	TEST METHODS AND METHOD VALIDATION	V1M2 Sec. 5.4.1	5.4.1	58
19.1	Overview	V1M2 Sec. 5.4.1	5.4.1; 5.4.5.1	68
19.2	Standard Operating Procedures (Sops)	V1M2 Secs. 4.2.8.5; 4.3.3.1; 5.4.2	4.3.3.1; 5.4.2	68
19.3	Laboratory Methods Manual	V1M2 Sec. 4.2.8.5		68

Sec. No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005 (E) Reference	Page No.
19.4	Selection Of Methods	V1M2 Secs. 4.13.3; 5.4.1; 5.4.2; 5.4.3. V1M4 Secs. 1.4; 1.5.1; 1.6.1; 1.6.2; 1.6.2.1; 1.6.2.2	5.4.1; 5.4.2; 5.4.3; 5.4.4; 5.4.5.1; 5.4.5.2; 5.4.5.3	69
19.5	Laboratory Developed Methods And Non-Standard Methods	V1M2 Sec. 5.4.2. V1M4 Sec. 1.5.1	5.4.2; 5.4.4; 5.4.5.2; 5.4.5.3	72
19.6	Validation Of Methods	V1M2 Sec. 5.4.2. V1M4 Secs. 1.5.1; 1.5.2; 1.5.2.1; 1.5.2.2; 1.5.3	5.4.2; 5.4.4; 5.4.5.2; 5.4.5.3	72
19.7	Method Detection Limits (mdl) / Limits Of Detection (LOD)	V1M2 Sec. 5.9.3. V1M4 Secs. 1.5.2; 1.5.2.1; 1.5.2.2	5.4.5.3	74
19.8	Instrument Detection Limits (Idl)	V1M2 Sec. 5.9.3		74
19.9	Verification Of Detection And Reporting Limits	V1M2 Sec. 5.9.3. V1M4 Sec. 1.5.2.1		74
19.10	Retention Time Windows	V1M2 Sec. 5.9.3		75
19.11	Evaluation Of Selectivity	V1M2 Sec. 5.9.3. V1M4 Sec. 1.5.4; 1.7.3.6		75
19.12	Estimation Of Uncertainty Of Measurement	V1M2 Sec. 5.1.1; 5.1.2; 5.4.6	5.1.1; 5.1.2; 5.4.6.1; 5.4.6.2; 5.4.6.3	75
19.13	Sample Reanalysis Guidelines	V1M2 Sec 5.9.1	5.9.1	76
19.14	Control Of Data	V1M2 Secs. 5.4.7.1; 5.4.7.2; 5.9.1	5.4.7.1; 5.4.7.2; 5.9.1	77
20.0	EQUIPMENT and CALIBRATIONS	V1M2 Secs. 5.5.4; 5.5.5; 5.5.6	5.5.4; 5.5.5; 5.5.6; 5.6.1	83
20.1	Overview	V1M2 Secs. 5.5.1; 5.5.2; 5.5.3; 5.5.5; 5.5.10	5.5.1; 5.5.2; 5.5.3; 5.5.5; 5.5.10; 5.6.1	83
20.2	Preventive Maintenance	V1M2 Secs. 5.5.1; 5.5.3; 5.5.7; 5.5.9	5.5.1; 5.5.3; 5.5.7; 5.5.9; 5.6.1	83
20.3	Support Equipment	V1M2 Secs. 5.5.10; 5.5.11; 5.5.13.1	5.5.10; 5.5.11; 5.6.2.1.2; 5.6.2.2.1; 5.6.2.2.2	84
20.4	Instrument Calibrations	V1M2 Secs. 5.5.8; 5.5.10; 5.6.3.1. V1M4 Sec. 1.7.1.1; 1.7.2	5.5.8; 5.5.9; 5.5.10; 5.6.1; 5.6.2; 5.6.3.1	86
20.5	Tentatively Identified Compounds (TICS) – GC/MS Analysis			89

Sec. No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005 (E) Reference	Page No.
20.6	Gc/Ms Tuning			90
21.0	MEASUREMENT TRACEABILITY			96
21.1	Overview	V1M2 Sec. 5.6.3.1	5.6.2.1.2; 5.6.2.2.2; 5.6.3.1	96
21.2	NIST-Traceable Weights And Thermometers	V1M2 Secs. 5.5.13.1; 5.6.3.1; 5.6.3.2	5.6.3.1; 5.6.3.2	96
21.3	Reference Standards / Materials	V1M2 Secs. 5.6.3.1; 5.6.3.2; 5.6.3.3; 5.6.3.4; 5.6.4.1; 5.6.4.2; 5.9.1; 5.9.3	5.6.3.1; 5.6.3.2; 5.6.3.3; 5.6.3.4; 5.9.1	96
21.4	Documentation And Labeling Of Standards, Reagents, And Reference Materials	V1M2 Secs. 5.6.4.2; 5.9.3		97
22.0	SAMPLING			99
22.1	Overview	V1M2 Secs. 5.7.1; 5.7.3	5.7.1; 5.7.3	99
22.2	Sampling Containers			99
22.3	Definition Of Holding Time			99
22.4	Sampling Containers, Preservation Requirements, Holding Times			99
22.5	Sample Aliquots / Subsampling	V1M2 Sec. 5.7.1	5.7.1	100
23.0	HANDLING OF SAMPLES	V1M2 Sec. 5.8.1	5.8.1	100
23.1	Chain Of Custody (COC)	V1M2 Secs. 5.7.2; 5.7.4; 5.8.4; 5.8.7.5; 5.8.8; 5.9.1	5.7.2; 5.8.4; 5.9.1	100
23.2	Sample Receipt	V1M2 Secs. 5.8.1; 5.8.2; 5.8.3; 5.8.5; 5.8.7.3; 5.8.7.4; 5.8.7.5	5.8.2; 5.8.3	101
23.3	Sample Acceptance Policy	V1M2 Secs. 5.8.6; 5.8.7.2		103
23.4	Sample Storage	V1M2 Secs. 5.7.4; 5.8.4	5.8.4	103
23.5	Hazardous Samples And Foreign Soils			104
23.6	Sample Shipping	V1M2 Sec. 5.8.2	5.8.2	104
23.7	Sample Disposal			105
24.0	ASSURING THE QUALITY OF TEST RESULTS			109
24.1	Overview	V1M2 Secs. 5.9.2; 5.9.3	5.9.2	109
24.2	Controls	V1M2 Secs. 5.9.2; 5.9.3	5.9.2	109

Sec. No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005 (E) Reference	Page No.
24.3	Negative Controls	V1M2 Secs. 5.9.2; 5.9.3 V1M4 Secs. 1.7.3; 1.7.3.1; 1.7.4.1	5.9.2	109
24.4	Positive Controls	V1M2 Secs 5.9.2; 5.9.3. V1M4 Secs. 1.7.3; 1.7.3.2; 1.7.3.2.1; 1.7.3.2.2; 1.7.3.2.3	5.9.2	110
24.5	Sample Matrix Controls	V1M2 Secs. 5.9.2; 5.9.3. V1M4 Secs. 1.7.3 ; 1.7.3.3; 1.7.3.3.1; 1.7.3.3.2; 1.7.3.3.3	5.9.2	111
24.6	Acceptance Criteria (Control Limits)	V1M2 Sec. 5.9.3. V1M4 Secs. 1.7.4.2; 1.7.4.3		112
24.7	Additonal Procedures To Assure Quality Control	V1M2 Sec. 5.9.3. V1M4 Sec. 1.7.3.4		114
25.0	REPORTING RESULTS			114
25.1	Overview	-V1M2 Secs. 5.10.1; 5.10.2; 5.10.8	5.10.1; 5.10.2; 5.10.8	114
25.2	Test Reports	V1M2 Secs. 5.10.1; 5.10.2; 5.10.3.1; 5.10.3.2; 5.10.5; 5.10.6; 5.10.7; 5.10.8; 5.10.10; 5.10.11	5.10.1; 5.10.2; 5.10.3.1; 5.10.3.2; 5.10.5; 5.10.6; 5.10.7; 5.10.8	114
25.3	Reporting Level Or Report Type	V1M2 Secs. 5.10.1; 5.10.7; 5.10.8	5.10.1; 5.10.7; 5.10.8	116
25.4	Supplemental Information For Test	V1M2 Secs. 5.10.1; 5.10.3.1; 5.10.5	5.10.1; 5.10.3.1; 5.10.5	117
25.5	Environmental Testing Obtained From Subcontractors	V1M2 Secs. 4.5.5; 5.10.1; 5.10.6	5.10.1; 5.10.6	117
25.6	Client Confidentiality	V1M2 Secs. 4.1.5; 5.10.7	4.1.5; 5.10.7	118
25.7	Format Of Reports	V1M2 Sec. 5.10.8	5.10.8	118
25.8	Amendments To Test Reports	V1M2 Sec. 5.10.9	5.10.1; 5.10.9	118
25.9	Policies On Client Requests For Amendments	V1M2 Secs. 5.9.1; 5.10.9	5.9.1; 5.10.1; 5.10.5; 5.10.9	119

LIST OF TABLES

Table No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005 (E) Reference	Page No.
12-1	Example – General Corrective Action Procedures	V1M2 Sec. 4.11.6. V1M4 Sec. 1.7.4.1	4.11.2	48
14-1	Record Index		4.13.1.1	52
14-2	Example: Special Record Retention Requirements			54
15-1	Types Of Internal Audits And Frequency		4.14.1	58
20-1	Example: Instrumentation List		5.5.4; 5.5.5	91
20-2	Example: Schedule Of Routine Maintenance			94
24-1	Example – Negative Controls			109
24-2	Sample Matrix Control			111

LIST OF FIGURES

Figure No.	Title	2009 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	Page No.
4-1	Corporate And Laboratory Organization Charts	V1M2 Sec. 4.1.5	4.1.3; 4.1.5; 4.2.6	17
8-1	Example - Subcontracted Sample Form			34
12-1	Example - Corrective Action Report			47
19-1	Example - Demonstration Of Capability Documentation			82
23-1	Example: Chain Of Custody (COC)			106
23-2	Example: Sample Acceptance Policy	V1M2 Sec. 5.8.6; 5.8.7.1. V1M4 Sec. 1.7.5		107
23-3	Example: Cooler Receipt Form		5.8.3	108

LIST OF APPENDICES

Appendix No.	Title	Page No.
1	Laboratory Floor Plan	120
2	Glossary / Acronyms	121
3	Laboratory Certifications, Accreditations, Validations	129

REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-004	Method Compliance & Data Authenticity Audits
CA-Q-S-006	Detection Limits
CA-Q-S-008	Management Systems Review
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-L-S-002	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-S-002	Subcontracting Procedures
CW-L-P-004	Ethics Policy
CA-L-P-002	Contract Compliance Policy
CW-F-P-002	Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CA-C-S-001	Work Sharing Process
CA-T-P-001	Qualified Products List
CW-F-S-007	Controlled Purchases Policy
CW-F-S-018	Vendor Selection
CA-Q-M-002	Corporate Quality Management Plan
CW-E-M-001	Corporate Environmental Health & Safety Manual

REFERENCED LABORATORY SOPs

SOP Reference	Title
BR-QA-003	Document Control
BR-QA-004	Complaint Resolution
BR-QA-011	Employee Training and Demonstration of Proficiency
BR-QA-005	Detection Limits, Limit of Detection and Limit of Quantitation
BR-QA-006	Manual Integration
BR-QA-020	Sample Homogenization and Subsampling
BR-SM-001	Sample Management

SECTION 3. INTRODUCTION, SCOPE AND APPLICABILITY

3.1 Introduction and Compliance References

TestAmerica Burlington's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025:2005(E). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *U.S. Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 4.2, October 2010.*
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005) (DW labs only)*
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th, 21st, and on-line Editions.
- *U.S. Department of Energy* Order 414.1B, *Quality Assurance*, Approved April 29, 2004.
- *U.S. Department of Energy* Order 414.1C, *Quality Assurance*, June 17, 2005.
- *U.S. Department of Energy*, *Quality Systems for Analytical Services*, Revision 3.6, November 2010.
- U.S. Department of Defense, *Air Force Center for Environmental Excellence Quality Assurance Project Plan (QAPP),* Version 4.0.02, May 2006.
- Nuclear Regulatory Commission (NRC) Quality Assurance Requirements.
- Marine Protection, Research, and Sanctuaries Act (MPRSA).
- Toxic Substances Control Act (TSCA).

3.2 Terms and Definitions

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 Scope / Fields of Testing

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge, soils, sediments, tissue and other biological matrices. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods performed by the laboratory can be found on the company's data portal, Total Access, or from a representative of the laboratory. The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 Management of the Manual

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. The manual itself is reviewed annually by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be

reviewed and approved by the senior laboratory management staff according to the laboratory's Document Control procedure (SOP No. BR-QA-003).

SECTION 4. MANAGEMENT REQUIREMENTS

4.1 Overview

TestAmerica Burlington is a local operating unit of TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President, Chief Operating Officer, Corporate Quality etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Burlington is presented in Figure 4-1.

4.2 Roles and Responsibilities

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Burlington laboratory.

4.2.2 Quality Assurance (QA) Manager or Designee

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system.

The QA Manager reports directly to the Laboratory Director and has access to Corporate QA for advice and resources. This position is able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of QA staff to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.

- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems and the technical operation.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action database and the corrective and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Review a percentage of all final data reports for internal consistency. Review of Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, 5% of calculations, format, holding time, sensibility and completeness of the project file contents.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Captains the QA team to enable communication and to distribute duties and responsibilities.
- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.
- Evaluation of the thoroughness and effectiveness of training.
- Compliance with ISO 17025. (where applicable)

4.2.3 Technical Manager (AKA Technical Director) & Department Manager (DM)

The Technical Director report(s) directly to the Laboratory Director. The Technical Director along with the Laboratory Director, the QA Manager and each Department Manager is accountable for compliance with the ISO 17025 Standard. The Technical Director works with QA and the Department Managers to solve day to day technical issues, provide technical training and guidance to laboratory staff, project managers, and clients, and assists with method development and validation.

The Department Managers report to the Laboratory Directory. The DMs maintain overall responsibility for a defined portion of the laboratory. These responsibilities include but are not limited to:

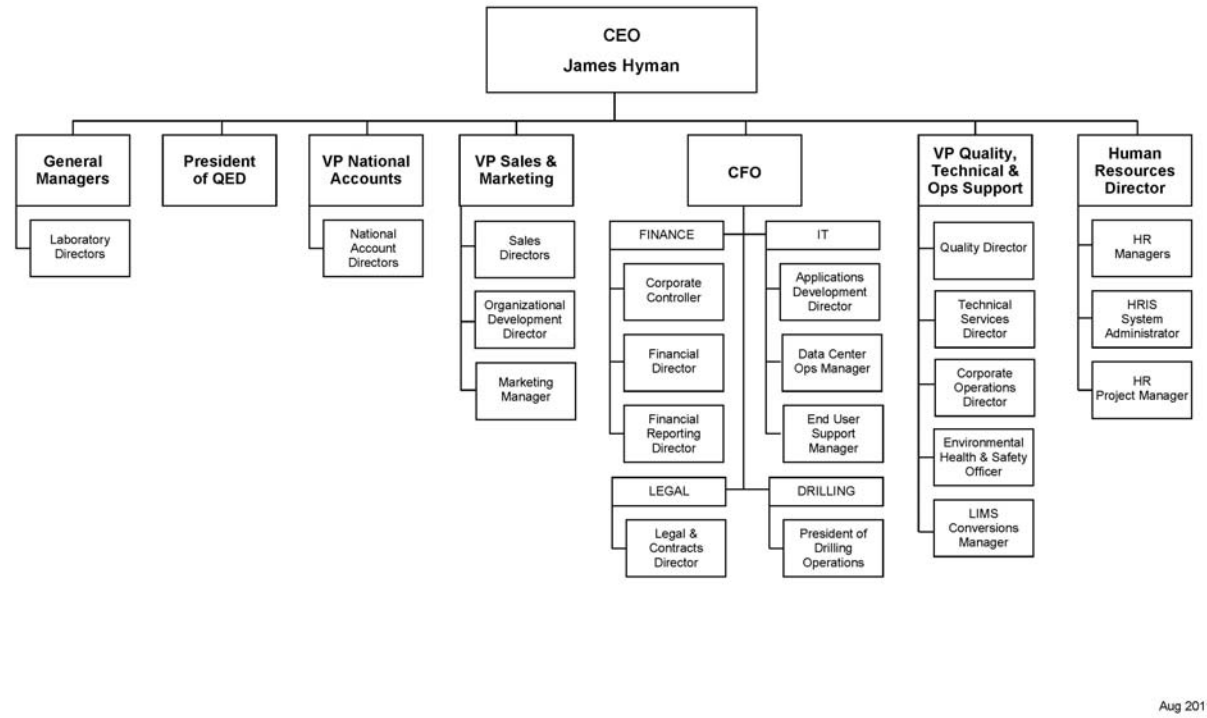
- Day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Working with the QA Manager to coordinate preparation of test method SOPs and performs subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples.
- Reviews and approves proposals from marketing, in accordance with the established procedure for the review of requests and contracts.
- Monitoring the validity of the analyses performed and data generated in the laboratory.
- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Working with the QA Manager to scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc.
- Captains department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.

4.3 Deputies

The following table defines who assumes the responsibilities of key personnel in their absence:

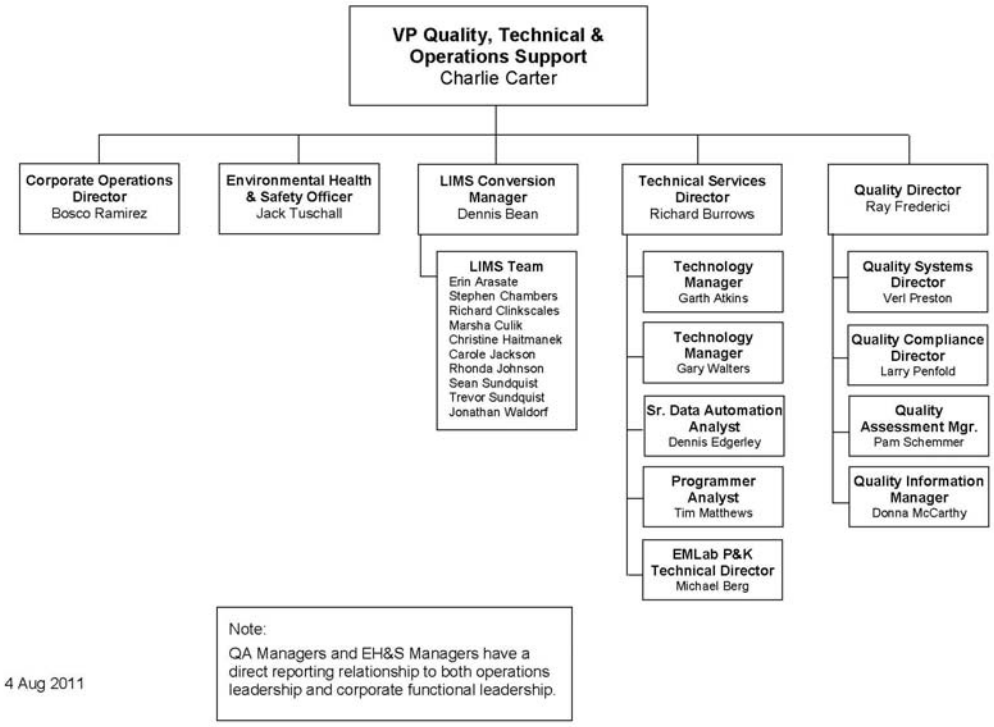
Key Personnel	Deputy
William S. Cicero Laboratory Director	Bryce E. Stearns, Technical Director Kirstin L. Daigle, QA Manager
Kirstin L. Daigle QA Manager	William S. Cicero, Laboratory Director Bryce E. Stearns, Technical Director Frances S. Bertsch, QA Assistant
Bryce E. Stearns Technical Director	William S. Cicero, Laboratory Director Kirstin L. Daigle, QA Manager
Dan E. Helfrich EHS Coordinator	William S. Cicero, Laboratory Director

Figure 4-1. Corporate and Laboratory Organization Charts



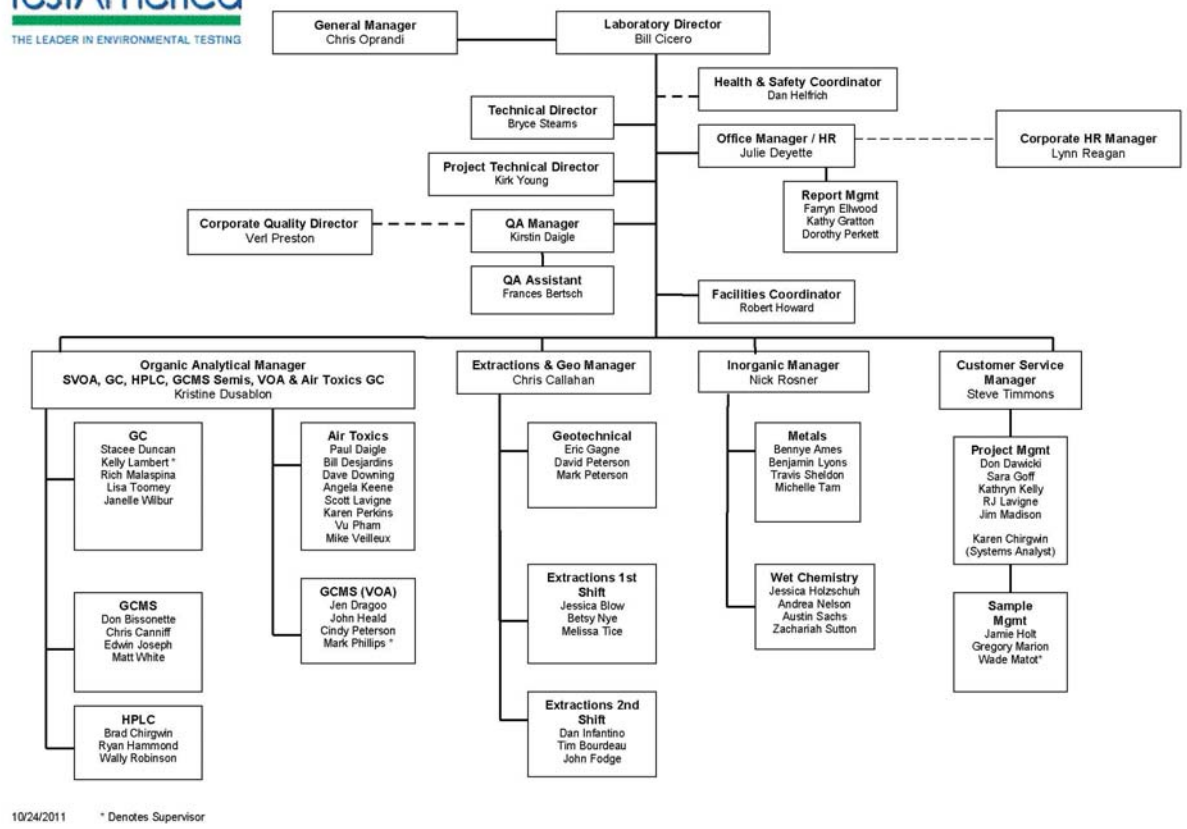
TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Quality, Technical & Operations Support



4 Aug 2011

Burlington Laboratory Organization



SECTION 5. QUALITY SYSTEM

5.1 Quality Policy Statement

It is TestAmerica's Policy to:

- ❖ Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- ❖ Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- ❖ Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- ❖ Provide clients with the highest level of professionalism and the best service practices in the industry.
- ❖ To comply with the ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 Ethics and Data Integrity

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CW-L-S-002).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.

- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 Quality System Documentation

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab-specific quality assurance manual.
- Corporate SOPs and Policies – Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions – A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC Objectives for the Measurement of Data

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing their project QAPPs. The laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before it is finalized.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise

identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data as specified for a particular project, is expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Detection Limit, Limit of Detection) or quantified (Limit of Quantiation or Reporting Limit).

5.5 Criteria for Quality Indicators

The laboratory limits used quality control are stored in the LIMS database and may also be published in laboratory SOPs. Limits for accuracy and precision are laboratory generated or are

derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. The laboratory procedure for establishment of control limits is described in laboratory SOP BR-QA-013.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and by program. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. If a method requires the generation of limits from historical data the lab develops such limits from data stored in the LIMS database following the procedure specified in laboratory SOP BR-QA-013.

For each job analysts are instructed to use the current limits that are entered as reference data data in the Laboratory Information Management System (LIMS) On occasion, a client requests contract-specified limits for a specific project in which case project specific limits are entered into each LIMS job by the PM handling the project.

As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The laboratory's procedures for the creation of control charts are described in laboratory SOP BR-QA-013. Control charts are created from data stored in the LIMS. The charts are evaluated by QA or technical staff to determine if limits need to be updated or to assess the need for corrective actions to improve method performance.

5.7 Quality System Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6. DOCUMENT CONTROL

6.1 Overview

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies

- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP BR-QA-003.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory records for supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports are kept by the QA department. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports are retained electronically, by each analytical section or by the QA department.

6.2 Document Approval and Issue

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item or an 'end of document' page, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. To develop a new document, the department manager or any employee with approval from the department manager submits an electronic draft to the QA Department for suggestions and approval before use. Upon approval QA personnel add the identifying version information to the document and retains a copy of the document as the official document on file. The document is then provided to all applicable operational units (may include electronic access) by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed annually and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 Procedures for Document Control Policy

For changes to the QA Manual, refer to SOP BR-QA-003. Uncontrolled copies must not be used within the laboratory. Previous revisions are stored by the QA department. The current revision is located in the public controlled document folder accessible to all employees.

For changes to SOPs, refer to SOP No. CW-Q-S-002, Writing a Standard Operating Procedure SOP.

Forms, worksheets, work instructions and information are organized by the QA department in accordance with the procedures specified in laboratory SOP BR-QA-003.

6.4 Obsolete Documents

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to SOP BR-QA-003.

SECTION 7. SERVICE TO THE CLIENT

7.1 Overview

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.
The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 Review Sequence and Key Personnel

Work requests are reviewed by appropriate personnel at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Sales Directors, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002**,** Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above. Appropriate personnel include but are not limited to:

- Legal & Contracts Director
- General Manager
- Laboratory Director
- Laboratory Project Manager
- Laboratory Technical Manager/Director
- Laboratory Department Manager
- Laboratory Customer Service Manager
- Information Technology Manager

- Account Executives
- Laboratory and/or Corporate Quality Managers
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements. The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility. The Project Manager, Sales Director, Legal Contracts Director, Account Executive or Proposal Coordinator then submits the final proposal to the client. The Legal & Contracts Director and facility Customer Service Manager maintains copies of all signed contracts.

7.3 Documentation

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. Records of review are organized and kept by the designated project manager (PM).

The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. These records are retained by the laboratory PM.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties. Such changes are also communicated to laboratory staff.

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 Special Services

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

Note: ISO/IEC 17025 states that a laboratory "shall afford clients or their representatives cooperation to clarify the client's request". This topic is discussed in Section 7.

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 Client Communication

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers and the Quality Assurance Manager are available to discuss any technical questions or concerns that the client may have.

7.6 Reporting

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 Client Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8. SUBCONTRACTING OF TESTS

8.1 Overview

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOP's on Subcontracting Procedures (CA-L-S-002) and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-NELAC accredited work where required.

Project Managers (PMs), Customer Service Managers (CSM), or Account Executives (AE) for the Export Lab are responsible for obtaining client approval prior to outsourcing any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder.

Note: In addition to the client, some regulating agencies (e.g, USDA) or contracts (e.g, certain USACE projects) may require notification prior to placing such work**.**

8.2 Qualifying and Monitoring Subcontracators

Whenever a PM, Account Executive (AE) or Customer Service Manager becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task. (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be as simple as placing a copy of an e-mail from the client in the project folder);
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica: A listing of all approved subcontracting laboratories is available on the TestAmerica intranet site. Supporting documentation is maintained by corporate offices and by the TestAmerica laboratory originally requesting approval of the subcontract lab.

- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- NELAC or A2LA accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

When the potential sub-contract laboratory has not been previously approved, management staff may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the QA Manager begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to Corporate Contracts for formal contracting with the laboratory. They will add the lab to the approved list on the intranet site and notify the finance group for JD Edwards.

8.2.2 The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.3 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Quality Departments. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all Laboratory Directors, QA Managers and Sales Personnel.

8.3 Oversight and Reporting

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and the Legal & Contracts Director can tailor the document or assist with negotiations, if needed. The PM responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented and in the project folder. An example form that may be used for documentation is provided as Figure 8-1. For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

The Sample Control department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must also be included with all samples workshared within TestAmerica. Client CoCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client CoCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-NELAC accredited work must be identified in the subcontractor's report as appropriate. If NELAC accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 Contingency Planning

The Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs; however, this decision & justification must be documented in the

project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and Chain-of-Custody. In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time. The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

Figure 8-1.

Example - Subcontracted Sample Form

Date/Time: _____

Subcontracted Laboratory Information:

- Subcontractor's Name: _____
- Subcontractor Point of Contact: _____
- Subcontractor's Address: _____
- Subcontractor's Phone: _____
- Analyte/Method: _____
- Certified for State of Origin: _____
- NELAC Certified: Yes_____No_____
- **USDA Permit (__Domestic __ Foreign)** **Yes**_____**No**_____
- ISO 17025 Certified: Yes_____No_____
- CLP-like Required: Yes_____No_____
  (Full doc required)
- Requested Sample Due Date: _____
  (Must be put on COC)
- **Client POC Approval on-file to Subcontract Samples to Sub Laboratory:** **Yes**_____**No**_____

Project Manager: _____

Laboratory Sample # Range: _____
(Only of Subcontracted Samples)

Laboratory Project Number (Billing Control #): _____

All subcontracted samples are to be sent via bonded carrier and Priority Overnight. Please attach tracking number below and maintain these records in the project files.

PM Signature_____**Date**_____

SECTION 9. PURCHASING SERVICES AND SUPPLIES

9.1 Overview

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Corporate Controlled Purchases Procedure, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Corporate Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 Glassware

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 Reagents, Standards & Supplies

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP.

9.3.2 Receiving

It is the responsibility of the manager that placed the order to receive the shipment. It is the responsibility of the manager or their designee who ordered the materials to document the date

materials where received. Once the ordered reagents or materials are received the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. Material Safety Data Sheets (MSDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.
- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained in each laboratory section.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. The minimum total pressure must be 120 psig for Helium, 100 psig for liquid Argon and 30 psig for Nitrogen or the tank must be replaced. To prevent a tank from going to dryness, close observation of the tank gauge must take place as pressure decreases towards the minimum psig, or the tank must be replaced. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- µmhom/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25^{o}C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Technical Managers must be notified

immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technical Manager, Technical Director or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 Purchase of Equipment / Instruments / Software

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Laboratory Director. If they agree with the request, the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by IT or the QA Department. Software certificates supplied by the vendors are kept by IT. The manufacturer's operation manual is retained at the bench.

9.5 Services

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Technical Managers. If an external contractor is selected to perform service, the service providers that perform the services are approved by the Technical Manager.

9.6 Suppliers

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Corporate Finance documents on Vendor Selection (SOP No. CW-F-S-018) and Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.
As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technology Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10. COMPLAINTS

10.1 Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following laboratory SOP BR-QA-004.

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to laboratory SOP BR-QA-004.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11. CONTROL OF NON-CONFORMING WORK

11.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. Any modifications to the routine procedure are documented in the project record and described in the case narrative submitted with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Any project specific modifications to the procedure are documented in the project record.

11.2 Responsibilities and Authorities

TestAmerica's Corporate SOP entitled *Internal Investigation of Potential Data Discrepancies and Determination for Data Recall* (SOP No. CW-L-S-002) outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

The Laboratory Director, a Technical Manager or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of

procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be documented. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Technical Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), Director of Quality & Client Advocacy and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, Corporate Quality, the COO, General Managers and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 Evaluation of Significance and Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

TestAmerica's Corporate Data Investigation & Recall Procedure (SOP No. CW-L-S-002) distinguishes between situations when it would be appropriate for laboratory management to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECO's and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-L-S-002.

11.4 Prevention of NonConforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. Periodically as defined by the laboratory's preventive action schedule, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 Method Suspension / Restriction (Stop Work Procedures)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.
The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate General Manager and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc…). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Manager/Director, QA Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12. CORRECTIVE ACTION

12.1 Overview

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are

documented using Non-Conformance Reports (NCR) and Corrective Action Reports (CAR) (refer to Figure 12-1).

12.2 General

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc..

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Report (NCR) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)
- Isolated reporting / calculation errors
- Client complaints
- Discrepancies in materials / goods received vs. manufacturer packing slips.

12.2.2 **Corrective Action Report (CAR)** - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCRs.
- Issues found while reviewing NCRs that warrant further investigation.
- Failed or unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic reporting / calculation errors
- Client complaints
- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 Closed Loop Corrective Action Process

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis,

Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An NCM or CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Technical Manager, Laboratory Director, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCM or CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness.

To perform root cause analysis, systematically analyze and document the root causes of the more significant problems reported then identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Technical Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technical Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Corrective actions are tracked by the QA department.
- The QA Manager reviews NCMs and CARs monthly for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 15.1.4, Special Audits.)

12.4 Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of an NCM or CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to specific method SOPs.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in method SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with

an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCM and appropriate corrective action (e.g., reanalysis) is taken and documented**.**

12.5 Basic Corrections

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original “uncorrected” file must be maintained intact and a second “corrected” file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 12-1.
Example - Corrective Action Report

CORRECTIVE ACTION REPORT (CAR)			Tracking Number:
Initiated By:		Assigned To:	
Initiation Date:		CC:	
Due Date:			
Section 1: Describe Problem & Attach Supporting Documentation As Needed			
Corrective Action Prompted By:			
Recurring NCR	Internal Audit	External Audit	Complaint / Other
Section 2: Root Cause Analysis			
Section 3: Describe Actions Required to Correct & Prevent Problem			
Section 4: QA Review and Close Out			
Action Taken Was:	Acceptable	Not Acceptable	Other
Comments:			
Close Out Date:		Closed By:	
Section 5: Follow Up (From Close-Out Date)			
Time Frame:	Performed By:	Date:	Is action taken preventing recurrence?
1 Month			
3 Month			
6 Month			
Comments:			

FQA018:03.29.07:2
TestAmerica Burlington

Table 12-1. Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank (Analyst)	See details in Method SOP	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards (Analyst, Technical Manager(s))	See details in Method SOP	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) (Analyst, Technical Manager(s))	% Recovery within limits in TALS	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards (Analyst, Data Reviewer)	- See details in Method SOP	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) (Analyst, Data Reviewer)	% Recovery within limits in TALS	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) (Analyst, Data Reviewer)	% Recovery within limits in TALS	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) when the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates (Analyst, Data Reviewer)	- % Recovery within limits in TALS.	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) (Analyst, Data Reviewer)	< Reporting Limit or as specified by regulatory program.	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples (QA Manager, Technical Manager(s)	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits (QA Manager, Technical Manager(s) Laboratory Director)	- Defined in Quality System documentation such as SOPs, QAM, etc..	- Non-conformances must be investigated through CAR system and necessary corrections must be made.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Technical Managers, QA Manager, Corporate QA, Corporate Management)	- SOP CW-L-S-002Internal Investigation of Potential Data Discrepancies and Determination for Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CW-L-S-002 or your lab's CA SOP.
Client Complaints (Project Managers, Lab Director/Manager, Sales and Marketing)	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 16 for an example) (QA Manager, Lab Director/Manager, Technical Manager(s)	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation (Safety Officer, Lab Director/Manager, Technical Manager(s)	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through CAR system.

SECTION 13. PREVENTIVE ACTION / IMPROVEMENT

13.1 Overview

The laboratory's preventive action programs improve~~,~~ or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and client satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the monthly QA Metrics Report, evaluation of internal or external audits, results & evaluation of proficiency testing (PT) performance, data analysis & review processing operations, client complaints, staff observation, etc.

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action system:

- Identification of an opportunity for preventive action.
- Process for the preventive action.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action. Documentation of Preventive Action is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 Management of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory such as the addition of new equipment or personnel.

Procedures for minimization of potential risks inherent with a new event or change are described in various laboratory standard operating procedures.

SECTION 14. CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued.

14.1 Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the QA department. Records are of two types; electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by each laboratory section.

Table 14-1. Record Index[1]

	Record Types [1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals	5 Years from document retirement date*
QA Records	- Internal & External Audits/Responses - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*

	Record Types [1]:	Retention Time:
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits	7 years
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	7 Years (HR Personnel Files must be maintained indefinitely)
	Administrative Policies Technical Training Records	7 years

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or an offsite location that provides a suitable environment to prevent damage or deterioration and to prevent loss**.** All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log**.** Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2. Example: Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	**5 years (project records)** **10 years - Radiochemistry (project records)**
Drinking Water Lead and Copper Rule	12 years (project records)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
NY Potable Water NYCRR Part 55-2	10 years
Ohio VAP	10 years and State contacted prior to disposal
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.14.1 for more information.

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purpose. Instrument data is stored by instrument. Run logs

are maintained for each instrument. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in logbooks or entered into the LIMS for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as “sampled by,” “prepared by,” “reviewed by”, or “analyzed by”.

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory’s ability to retrieve the information prior to the destruction of the hard copy that was scanned.

- Also refer to Section 19.14.1 ‘Computer and Electronic Data Related Requirements’**.**

14.2 Technical and Analytical Records

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code**;**
- Date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.
- Instrumentation identification and instrument operating conditions/parameters.
- analysis type**;**
- all manual calculations and manual integrations**;**
- analyst's or operator's initials/signature**;**

- sample preparation
- test results**;**
- standard and reagent origin, receipt, preparation, and use**;**
- calibration criteria, frequency and acceptance criteria**;**
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions**;**
- quality control protocols and assessment**;**
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements.

14.3 Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records)**;**
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value**;**
- copies of final reports**;**
- archived SOPs**;**
- correspondence relating to laboratory activities for a specific project**;**
- all corrective action reports, audits and audit responses**;**
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to

protect the integrity of samples.

14.4 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 Records Management, Storage and Disposal

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access**.**

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. The procedures for document are described in laboratory SOP BR-QA-003.

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15. AUDITS

15.1 Internal Audits

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and, when requested, to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CA-Q-S-004. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
Method Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CA-Q-S-004)	Methods Audits Frequency: 50% of methods annually 100% of methods annually (DoD Labs)
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI field of proficiency testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, the TNI quality systems requirements, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., MintMiner and Chrom AuditMiner) used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Quality Assurance Manager or qualified designee at least every two years.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: water, soil, air.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 External Audits

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time

allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 Audit Findings

Audit findings are documented in audit reports and tracked by the QA department. The laboratory's corrective action responses for internal and external audits include action plans and date for completion. If a completion date cannot be met, a new a completion date must be set and agreed to by the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Department Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16. MANAGEMENT REVIEWS

16.1 Quality Assurance Report

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, their Quality Director as well as the General Manager. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and General Managers.

16.2 Annual Management Review

The senior lab management team (Laboratory Director, Technical Manager, Department Manger and QA Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, & objectives and action items that feed into the laboratory planning system. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that can not be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CA-Q-S-008 & Work Instruction No. CA-Q-WI-020) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
    - Adequacy of staff, equipment and facility resources.
    - Adequacy of policies and procedures.
    - Future plans for resources and testing capability and capacity.
- The annual internal double blind PT program sample performance (if performed),

- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Data Investigation/Recall SOP shall be followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's COO, VP of Client & Technical Services, General Managers and Quality Directors receive a monthly report from the Director of Quality & Client Advocacy summarizing any current data integrity or data recall investigations. The General Manager's are also made aware of progress on these issues for their specific labs.

SECTION 17. PERSONNEL

17.1 Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular

area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 Education and Experience Requirements for Technical Personnel

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page.

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience

Specialty	Education	Experience
Technical Manager / Department Manager– **General**	Bachelors Degree in an applied science or engineering. The Technical Manager must also have 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified peer or supervisors and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.

- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the laboratory's training program are described in the Laboratory Training SOP BR-QA-011.

17.4 Data Integrity and Ethics Training Program

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy (Policy No. CW-L-P-004) and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.
Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.

- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 22,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, and administrative functions.

18.2 Environment

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 Work Areas

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 Floor Plan

A floor plan can be found in Appendix 1.

18.5 Building Security

Building cards are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook. Signs are posted in the laboratory designating employee only areas - "Authorized employees beyond this point".

SECTION 19. TEST METHODS AND METHOD VALIDATION

19.1 Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 Standard Operating Procedures (SOPS)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure', No. CW-Q-S-002.
- SOPs are reviewed at a minimum of every 2 years except for SOPs for Drinking Water and DoD SOPs which are reviewed annually. Whenever necessary, SOPs may be revised to ensure continuing suitability and compliance with applicable requirements.

19.3 Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 Selection of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*

- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *NIOSH Manual of Analytical Methods, 4th ed., August 1994.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC) is performed whenever there is a change in instrument type (e.g., new instrumentation), method or personnel (e.g., analyst hasn't performed the test within the last 12 months).

The initial demonstration of capability must be thoroughly documented and approved by the Technical Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

19.4.3.1 The spiking standard used should be prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

19.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance

criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (refer to Figure 19-1 as an example) shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

19.5 Laboratory Developed Methods and Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 Validation of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 Method Detection Limits (MDL) / Limits of Detection (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL.

Refer to the laboratory SOP No. BR-QA-005 for details on the laboratory's MDL process, including detection limit procedures specific to the CLP SOWs for ISM and SOM.

19.8 Instrument Detection Limits (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.9 Verification of Detection and Reporting Limits

Once the MDL is determined, it must be verified on each instrument used for the given method. TestAmerica defines the DoD QSM Detection Limit (DL) as being equal to the MDL. TestAmerica also defines the DoD QSM Limit of Detection (LOD) as being equal to the lowest concentration standard that successfully verifies the MDL, also referred to as the MDLV standard. MDL and MDLV standards are extracted/digested and analyzed through the entire analytical process. The MDL and MDLV determinations do not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDLV standard is not successful, then the laboratory will redevelop their MDL or perform and pass two consecutive MDLVs at a higher concentration and set the LOD at the higher concentration. Initial and quarterly verification is required for all methods listed in the laboratory's DoD ELAP

Scope of Accreditation. Refer to the laboratory SOP BR-QA-005 Method Detection Limits (MDLs/DLs) for further details.

The laboratory quantitation limit is equivalent to the DoD Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The DoD QSM requires the laboratory to perform an initial characterization of the bias and precision at the LOQ and quarterly LOQ verifications thereafter. If the quarterly verification results are not consistent with three-standard deviation confidence limits established initially, then the bias and precision will be reevaluated and clients contacted for any on-going projects. For DoD projects, TestAmerica makes a distinction between the Reporting Limit (RL) and the LOQ. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher.

19.10 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. Complete details are available in the laboratory SOPs.

19.11 Evaluation of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

19.12 Estimation of Uncertainty of Measurement

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly,

and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent a 99%-certain range for the reported result. As an example, suppose that the result reported is 1.0 mg/l, and the LCS percent recovery range is 50 to 150%. The uncertainty range would be 0.5 to 1.5 mg/l, which could also be written as 1.0 +/- 0.5 mg/l.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., 524.2, 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. Client specific or Contractual Terms & Conditions for reanalysis protocols may supersede the following items.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and may reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

19.14 Control of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. More detail is outlined in corporate IT procedure and policies. The laboratory is currently running TALS which is a custom in-house developed LIMS system has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes an SQL database which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 Maintain the Database Integrity: Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 Ensure Information Availability: Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 Maintain Confidentiality: Ensure data confidentiality through physical access controls such as password protextion or website access approval when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices* and laboratory SOP BR-QA-006.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it

should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained in the worklist folder, computer file (if appropriate), and/or runlog. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1**%.** Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to the number of significant figured programmed in the LIMS formatter selected by the PM.

19.14.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored in a monthly folder on the instrument computer; periodically, this file is transferred to the server and, eventually, to a tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.

- Worksheets are created with the approval of the QA Manager at the facility. The QA department controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are out lined in several SOP BR-QA-019 to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP for manual integration, BR-QA-005. The general review concepts are discussed below, more specific information can be found in the SOPs.

19.14.4.1 The data review process at the laboratory starts at the Sample Control level. Sample Control personnel review chain-of-custody forms and input the sample information and required analyses into a computer LIMS. The Sample Control Supervisor reviews the transaction of the chain-of-custody forms and the inputted information. The Project Managers perform final review of the chain-of-custody forms and inputted information.

19.14.4.2 The next level of data review occurs with the Analysts. As results are generated, analysts review their work to ensure that the results generated meet QC requirements and relevant EPA methodologies. The Analysts transfer the data into the LIMS and add data qualifiers if applicable. To ensure data compliance, a different analyst performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blank runs, QA/QC check results, initial and continuing calibration results, laboratory control samples, sample data, qualifiers and spike information are evaluated. Where calibration is not required on a daily basis, secondary review of the initial calibration results may be conducted at the time of calibration. Approximately 15% of all sample data from manual methods and from automated methods, all GC/MS spectra and all manual integrations are reviewed. Manual integrations are also electronically reviewed utilizing auditing software to help ensure compliance to ethics and manual integration policies. Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

19.14.4.3 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Department Manager, Project Manager,

QA Manager or Technical Director, as necessary. Corrective action is initiated whenever necessary.

19.14.4.4 The results are then entered or directly transferred into the computer database and a report is prepared for the client.

19.14.4.5 As a final review prior to the release of the report, the Project Manager reviews the report for completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

19.14.4.6 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. The accounting personnel also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP (CA-Q-S-002) as the guideline for our internal SOP BR-QA-006.

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas ~~to~~ for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principals and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale “after” chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale “before” chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1. Example - Demonstration of Capability Documentation

Analyst Demonstration of Capability

TestAmerica Burlington

Michelle Tam

10/12/2011

Preparation Method(s):	3010A
Analytical Method(s):	6020
Matrix:	Water
Method Description:	Metals (ICP/MS)
Preparation SOP No:	BR-ME-009R16
Analytical SOP No:	BR-ME-003R7

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method with the specifications in the cited SOP, which is in use at this facility for the analysis of samples under the laboratory's Quality Assurance Plan, has completed the Demonstration of Capability(DOC).
2. The test method(s) was performed by the analyst identified on this certificate.
3. A copy of test method(s) and laboratory SOPs are available for all personnel on-site. **These documents have been reviewed by the analyst as part of this DOC.**
4. The data associated with the demonstration of capability are true, accurate, complete and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility. The associated information is organized and available for review.

Michelle Tam — M. Chadkin Tam — 10/12/11
Analyst **Signature** **Date**

Bruce Stearns — — 10/12/11
Technical Director **Signature** **Date**

Kirstin Daigle — Kirstin Daigle — 10/13/11
Quality Assurance Officer **Signature** **Date**

Page 1 of 7

SECTION 20. EQUIPMENT and CALIBRATIONS

20.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturers instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may be / are also outlined in analytical SOPs or instrument manuals.

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.

- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and verified (including new initial MDL study) prior to return to lab operations.

20.3 Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains “calibration only” ASTM type 1 weights).
All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly.

The mercury/digital NIST thermometer is recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in support equipment logbooks.

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each day.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and ≤ 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in logbooks designated for this purpose.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.

For those dispensers that are not used for analytical measurements, a label is / can be applied to the device stating that it is not calibrated. Any device not regularly verified can not be used for any quantitative measurements.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

20.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated during initial instrument set up and as needed after that based on the instrument performance checks as specified in each test method. If instrument performance checks continue to indicate the calibration is valid over a time-frame that exceeds one calendar year; the company requires that the instrument be recalibrated at least annually.

Note: The following sections describe general requirements for instrument calibration and provide guidance for when the method does not specify a procedure or the procedure in the method is vague. These requirements may not be applicable to all test methods. The calibration procedure used for each test method is always specified in the laboratory's SOP for the test method.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i.e., RPD, per 2009 TNI Std. EL-V1M4 Sec. 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable based upon discussion and approval of the client:

a). when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b). when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

20.6 GC/MS Tuning

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Example: Instrumentation List

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Analytical Balance	Mettler	AT200	113081164	UNKNOWN	UNKNOWN
Analytical Balance	Mettler	ML204	1123452701	2010	NEW
Analytical Balance	Metler	ML204	1123452699	2010	NEW
Analytical Balance	Sartorius	XM1000P	40090006	UNKNOWN	UNKNOWN
Automated Distillation Apparatus	Westco	Easy Dist	1090	2002	NEW
Automated Distillation Apparatus	Westco	Easy Dist	1091	2002	NEW
COD	HACH	45600-00	11000022452	UNKNOWN	UNKNOWN
Conductivity Meter	Oaklon	CON110	35607-85	2001	
CVAA	Leeman (CV3)	HydraAA112-0064-1	2031	2003	NEW
CVAA	Leeman (CV4)	HydraAA112-0064-1	8015	2008	NEW
GC/ECD/ECD	Agilent (7424)	6890N	US10332093	2003	NEW
GC/ECD/ECD	Agilent (3283)	6890N	US10805001	2008	NEW
GC/ECD/ECD	Hewlett-Packard (2618)Screen	5890II	3203A41055	1987	UNKNOWN
GC/ECD/ECD	Agilent (7227)	6890N	CN10602095	2006	NEW
GC/ECD/ECD	Agilent (0825)	6890N	US10202136	2002	NEW
GC/ECD/ECD	Agilent (1031)	7890A	CN10301031	2010	NEW
GC/ECD/ECD	Agilent (5253)	6890N	CN10723008	2007	NEW
GC/ECD/ECD	Agilent (0911)	6890N	US10230082	2002	NEW
GC/ECD/ECD	Agilent (5005)	6890N	CN10615005	2009	USED
GC/FID/ECD	Hewlett-Packard (Screen)	5890	GC 2415A01109	UNKNOWN	UNKNOWN
GC/FID/FID	Hewlett-Packard (3012)	5890II	3235A45259	1984	UNKNOWN
GC/FID/FID/TCD	Varian (CP3800)	CP-3800	S/N 10328	2003	NEW
GC/FID/TCD	Varian (2866)	VR-3600	2866	1998	UNKNOWN
GC/FPD/FPD	Hewlett-Packard (2860)	5890II	2950A27078	1990	UNKNOWN
GC/MS	Hewlett-Packard (N)	5890II / 5971	3203A40979	1998	NEW
GC/MS	Hewlett Packard (V)	5890II / 5972	3336A61485	1998	NEW
GC/MS	Agilent (B)	6890N/ 5973	CN10317006	2003	NEW
GC/MS	Agilent (C)	6890N / 5973	CN10424016	UNKNOWN	NEW

GC/MS	Agilent (G)	6890N / 5973	CN10437065	UNKNOWN	USED
GC/MS	Agilent (E)	6890N / 5973	CN10453004	2005	NEW
GC/MS	Agilent (F)	6890N/ 5973	CN10531065	2005	NEW
GC/MS	Agilent (S)	7890A/5975	CN10211095	2010	NEW
GC/MS	Agilent (T)	7890A/5975	CN10211037	2010	USED
GC/MS	Hewlett-Packard (L)	5890II / 5971	3203A40982	1998	NEW
GC/MS	Hewlett-Packard (M)	5890II / 5971	3203A40980	1998	NEW
GC/MS	Agilent (D)	6890N / 5973	CN10439015	2004	NEW
GC/MS	Hewlett-Packard (P)	5890II / 5971	3203A40985	1992	USED
GC/MS	Hewlett-Packard (Q)	5890II / 5971	3203A40983	1992	NEW
GC/MS	Hewlett-Packard (R)	5890II / 5971	3203A40984	1992	NEW
GC/MS	Hewlett-Packard (U)	5890II Plus/ 5972	3336A61535	1997	NEW
GC/MS	Agilent (H)	6890N / 5975	CN10608102	2006	NEW
GC/MS	Agilent (Z)	6890A/ 5973	US00036343	2000	NEW
GC/MS	Agilent (J)	6890N / 5973	CN10430052	2009	USED
GC/FID	Hewlett-Packard (6453-K) Screen	5890 II	3203A41768	UNKNOWN	UNKNOWN
GPC	J2 Scientific (I)	Autoinject 110	02D-1030-2.1	2002	NEW
GPC	J2 Scientific (H)	Autoinject 110	02D-1031-2.1	2001	NEW
GPC	J2 Scientific (J)	AccuPrep	03G1076-3.0	2003	NEW
HPLC/UV	Dionex (1488)	P680	1680407	1991	UNKNOWN
HPLC/UV/PDA	Waters (1208)	600	60004790RP	1988	NEW
Hydrogen Generator	Parker Hannafin	H2-800	h2-800081C	2006	NEW
Hydrogen Generator	Parker Hannafin	H2-800	h2-800099C	2006	NEW
ICP-MS	Thermo Elemental (2)	X7	X0288	2003	NEW
ICP-OES	Thermo Electron Corp (7)	iCAP 6000	ICP20063302	2006	NEW
LC/MS/MS	Waters (1111)	Acquity/Quattro micro	QAA929	2005	NEW
LC	Waters (3062)	616	MX5NM6829M	UNKNOWN	NEW
pH Meter	Denver Instruments	UB-5	UB503B365	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXA)	SE3AS306A	4012396	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXB)	SE3AS306A	4022047	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXC)	SE3AS306A	4022046	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXD)	SE3AS306A	4022045	UNKNOWN	UNKNOWN

Soxtherm	Gerhardt (SOXE)	SE3AS306A	4022030	UNKNOWN	UNKNOWN
Soxtherm	Gerhardt (SOXF)	SE3AS306A	4012397	UNKNOWN	UNKNOWN
TKN Digestion System	Aim Lab	AIM600 Block	5048A23014	2011	NEW
TOC	Carlo Erba	NA 1500	220465	1991	UNKNOWN
TOC	Carlo Erba	EA1108	249146	1991	UNKNOWN
TOC	Costech	4010	231009973	2005	UNKNOWN
TOC	Shimadzu	TOC-V CPH	H5131480032AE	2011	NEW
Turbidimeter	HF Scientific	Micro 100	208463	2001	UNKNOWN
UV/VIS	Genesys	Spectronic 20	3SGEO38002	1999	UNKNOWN
UV/VIS	Genesys	Spectronic 20	3SGE165024	2002	UNKNOWN
UV/VIS	Lachat	Quick Chem 8000	A83000-2167	2000	UNKNOWN

Table 20-2. Example: Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Leeman Mercury Analyzer	Check Peristaltic Pump tubing	As required
	Lubricate Autosampler rods	Monthly
	Clean Autosampler	Weekly
	Check and fill Rinse Vessel	As required
	Check and fill Stannous Chloride	As required
	Check Waste Vessel	Daily
	Empty Waste Vessel	As required
ICP	Check Peristaltic Pump tubing	As required
	Clean Torch	Daily
	Replace Torch	As required
	Check and fill Rinse Vessel	As required
	Check and fill IS Vessel	As required
	Fill Standards Cup	Daily
	Check Waste Vessel	Daily
	Empty Waste Vessel	As required
	Check and clean Cones	As required
	Perform Auto Peak Adjustment	As required
ICP MS	Check Peristaltic Pump tubing	As required
	Clean Torch	As required
	Check and fill Rinse Vessel	As required
	Check and fill IS Vessel	As required
	Fill standards cup	Daily
	Check Waste Vessel	Daily
	Empty Waste Vessel	As required
	Check and clean Cones	As required
UV-Vis Spectrophotometer	Clean ambient flow cell	As required
	Wavelength verification check	As required
	Clean Cuvette with Cuvette Cleaning Solution	As required
Hewlett Packard GC/MS (VOA)	Clean Injection Port and Liner	As required
	Change Septa	As required
	Cut 2-3 inches from GC Column	As required
	Fill Autosampler rinse vials	As required
	Clean Purge and Trap mount and purge vessel	As required
	Check Purge Flow	As required
Hewlett Packard GC/MS (SVOA)	Clean Injection Port and Liner	Daily
	Change Septa	Daily
	Replace or clip Guard Column	Daily
	Replace or clip Analytical Column	Daily
	Fill Autosampler rinse vials	Daily
Hewlett Packard GC/MS (Air)	Check GC / Entech Column Interface	As required
	Check Nitrogen Tank Volume	As required
	Check Nitrogen Valves Software and Valves	As required
	Cut 2-3 inches from GC Column	As required
Gas Chromatograph	Replace Septa	As required
	Clean and replace Injection Port Liner	As required
	Replace or clip Guard Column	As required
	Replace or clip Analytical Column	As required
	Bake, Re-foil, Refurbish Detector	As required

Instrument	Procedure	Frequency
Zero Air Generator	Change pre-filter cartridge Replace catalyst module Check Indicator Beads in Moisture Filters Bake and Refill Mol Sieve Dry Rite Beads	Annually Indicator Light Blinks Daily As required
Hydrogen Generator	Fill Water Reservoir Replace Water in Water Reservoir Replace Ionic Bags in Water Reservoir	Daily Semi-Annually Semi-Annually
HPLC	Change Transfer Lines Replace Guard Column Replace Analytical Column Replace or clean Pump Head Check Valves Change Plunger Seals Change Suppressor Change Eluent Generator Cartridge and CR-ATC	As required As required As required As required As required As required As required
LC/MS/MS	Replace Guard Column Replace Analytical Column Replace or clean Pump Head Check Valves Change Plunger Seals Change In Line Filter Clean or Change Sample Cone Clean Source	As required As required As required As required As required As required As required
Balances	Class “1” traceable weight check Clean pan and check if level Field service	Daily, when used Daily Annually
Latchat	Change Tubing Replace Bulb	As required As required
Conductivity Meter	Calibrate	Daily
Turbidimeter	Calibrate Check light bulb	As required Daily, when used
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
pH/Specific Ion Meter	Calibrate Clean electrode	Daily As required
Centrifuge	Check brushes and bearings	Every 6 months or as needed
Water baths	Temperature monitoring Water replaced	Daily, when used Monthly or as needed

SECTION 21. MEASUREMENT TRACEABILITY

21.1 Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-Traceable Weights and Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), APLAC (Asia-Pacific Laboratory Accreditation Cooperation), or EA (European Cooperation for Accreditation). A certificate and scope of accreditation is kept on file at the laboratory.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the ‘true’ value does not exceed method requirements. The accuracy of calibration

standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 Documentation and Labeling of Standards, Reagents, and Reference Materials

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. [Refer to TestAmerica's Corporate SOP (CA-Q-S-001), Solvent and Acid Lot Testing and Approval.]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained **in each lab section.** Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to method specific SOPs.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Preparer's name

- Final volume
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained on the company's intranet and in test method SOPs.

21.4.3 In addition, the following information may be helpful:

- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and raw data.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

SECTION 22. SAMPLING

22.1 Overview

The laboratory does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory

22.2 Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Any certificates of cleanliness that are provided by the supplier are maintained at the laboratory.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 Definition of Holding Time

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in "days" (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling. Holding times for analysis include any necessary reanalysis. However, there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines on taking sample aliquots & subsampling are located in test method SOPs.

SECTION 23. HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 Chain of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form should include information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification

- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory personnel. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in log-in by date; it lists all receipts each date.

23.1.2 Legal / Evidentiary Chain-of-Custody

If the client requests legal COC sample management personnel will initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

23.2.1 Laboratory Receipt

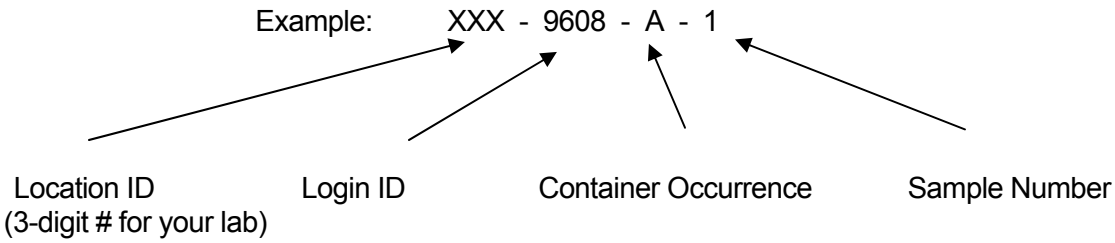
When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance,

irregularity, or compromised sample receipt must be documented*]* and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica <location> Laboratory (Location XXX). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: ~~XXX - 9608 -~~ A - 1 - **A**

Secondary Container Occurrence

Example: 220-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a complete COC;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to (Sampling Guide);
- the project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined. A copy of the sample acceptance policy is provided to each client prior to shipment of samples.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or

- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according to laboratory SOP BR-SM-001.

23.4 Sample Storage

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed weekly.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated refrigerator and place them on carts, analyze the sample, and return the remaining sample or empty container to the refrigerator from which it originally came. All unused portions of samples, including empty sample containers, are returned to the secure sample control area until disposal.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 Hazardous Samples and Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous and foreign soil samples are stored in an isolated area designated for hazardous waste only. For any sample that is known to be hazardous at the time of receipt or, if after completion of analysis the result exceeds the acceptable regulatory levels, a Hazardous Sample Notice must be completed by the analyst. This form may be completed by Sample Control, Project Managers, or analysts and must be attached to the report. The sample itself is clearly marked with a red stamp, stamped on the sample label reading “HAZARDOUS” or “FOREIGN SOIL” and placed in a colored and/or marked bag to easily identify the sample. The date, log number, lab sample number, and the result or brief description of the hazard are all written on the Hazardous & Foreign Soil Sample Notice. A copy of the form must be included with the original COC and Work Order and the original must be given to the Sample Control Custodian. Analysts will notify Sample Control of any sample determined to be hazardous after completion of analysis by completing a Hazardous Sample Notice. All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm that lab-packs all hazardous samples and removes them from the laboratory.

23.6 Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses (see Note). The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

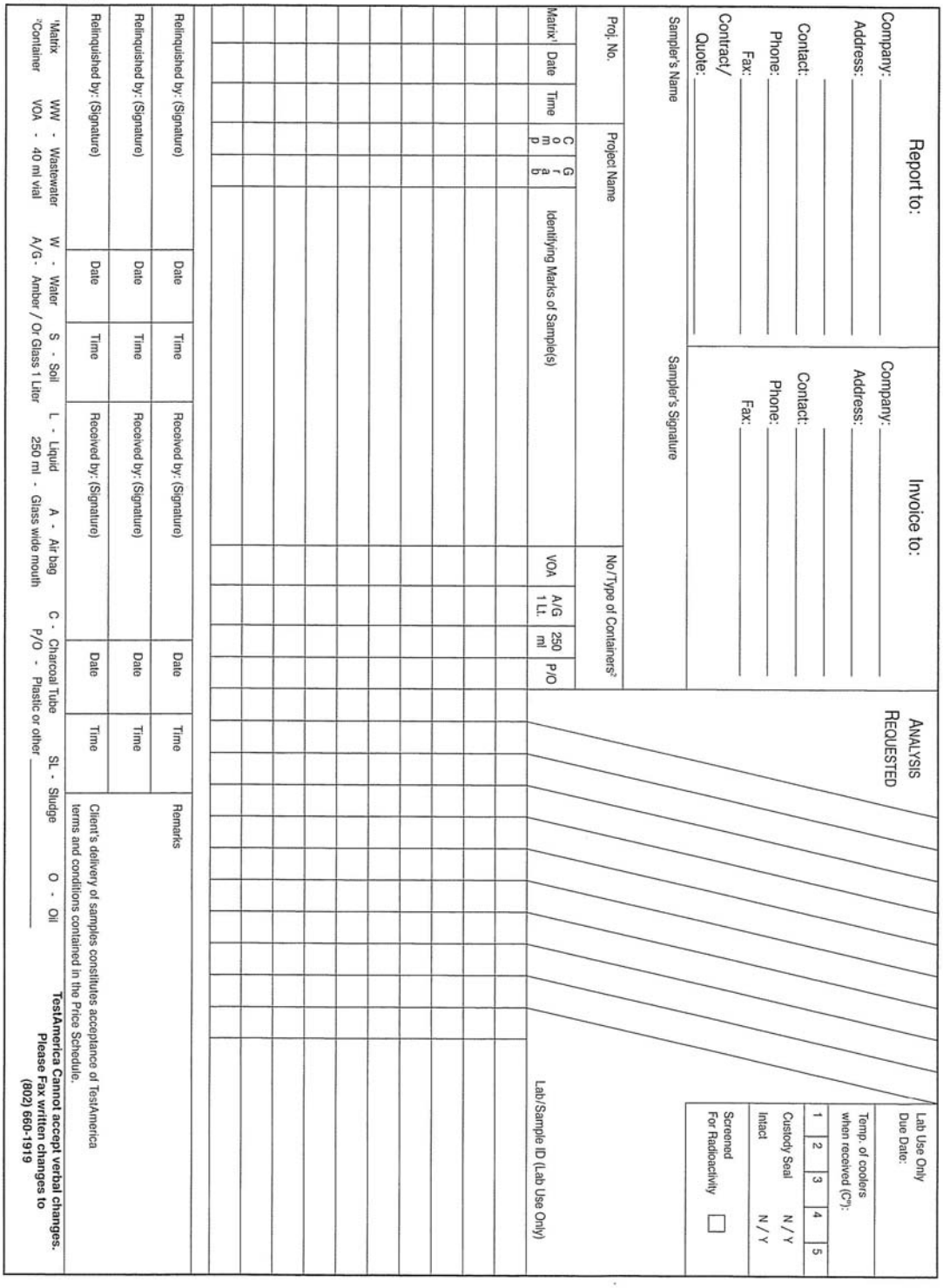
Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP: BR-EH-001) All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record should be completed.

Figure 23-1. Example: Chain of Custody (COC)



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Burlington
30 Community Drive, Suite 11
South Burlington, VT 05403 Tel: 802 660 1990

CHAIN OF CUSTODY RECORD

TAL-8234(1007)

Report to: Company: Address: Contact: Phone: Fax: Contract/ Quote: Sampler's Name

Invoice to: Company: Address: Contact: Phone: Fax: Sampler's Signature

Analysis Requested

Lab Use Only Due Date:

Temp. of coolers when received (C°): 1 2 3 4 5

Custody Seal N / Y
Intact N / Y

Screened For Radioactivity ☐

Proj. No. Project Name

No./Type of Containers²

Matrix¹	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O	Lab/Sample ID (Lab Use Only)

Relinquished by: (Signature) Date Time Received by: (Signature) Date Time Remarks

Relinquished by: (Signature) Date Time Received by: (Signature) Date Time

Relinquished by: (Signature) Date Time Received by: (Signature) Date Time

Client's delivery of samples constitutes acceptance of TestAmerica terms and conditions contained in the Price Schedule.

TestAmerica Cannot accept verbal changes. Please Fax written changes to (802) 660-1919

¹Matrix: WW - Wastewater, W - Water, S - Soil, L - Liquid, A - Air bag, C - Charcoal Tube, SL - Sludge, O - Oil
²Container: VOA - 40 ml vial, A/G - Amber / Or Glass 1 Liter, 250 ml - Glass wide mouth, P/O - Plastic or other ____

Figure 23-2. Example: Sample Acceptance Policy

The receipt of samples is acknowledged on the chain of custody (COC) form with the signature and date/time of the sample custodian. The condition of samples upon receipt is documented on checklists designated for this purpose. Any deficiencies identified during sample receipt are recorded and communicated to the laboratory project manager (PM), who will contact the client and fully document any decision to proceed with analysis in the project record. Consultation with the client should be immediate and timely (next business day or as specified in the project plan). Correspondence records and/or records of conversations concerning the decision to proceed with analysis and/or the disposition of rejected samples is maintained in the project record, and should be maintained in association with the sample receipt checklist. All data associated with samples that did not meet the sample acceptance criteria must be qualified with a Non-Conformance Report (NCR) and/or noted in the project narrative that accompanies the final test report.

Sample receipt is considered deficient when the following conditions are observed:

- Shipping cooler and/or samples are received outside the temperature specification
- Sample bottles are received broken or leaking
- Samples are received beyond holding time
- Samples are received without the appropriate preservation
- Samples are not received in appropriate containers
- Chain of Custody does not match the samples received
- Chain of Custody was not received or is incomplete*
- Custody seals are broken
- Evidence of tampering with the cooler and/or samples
- Headspace in 40mL or 22 mL VOA vials
- Seepage of extraneous water or other material into the samples
- Inadequate sample volume
- Illegible, impermanent ink, or non-unique sample labeling
- One or more coolers missing from a multi parcel shipment
- Shipping container is damaged

**Complete documentation shall include sample identification, the location date/time of collection, collector's name, preservation type, sample type and any special remarks concerning the sample.*

Figure 23-3. Example: Cooler Receipt Form

TestAmerica Burlington
SAMPLE RECEIPT & LOG IN CHECKLIST

Client:	**Date Received:**	**Job #:**
Project #:	**Time Received:**	
PM:	**Received By:**	**Login#:**
Login Date:	**# Coolers Received:**	
	Samples Delivered By:	**ICOC Required? Y/N**
Initials:	⊐ Shipping Service	*If "Y", attach copy(s) of ICOC*
Signature:	⊐ Courier	
	⊐ Hand	

Receipt Info	**YES**	**NO**	**NA**	**COMMENTS**
There is *no* evidence to indicate tampering				
Custody seals are present and intact				
Custody seal numbers are present				
If yes, list custody seal numbers:				

IR Gun ID: **Correction Factor:** ° C

Thermal Preservation Type: ⊐ Wet Ice ⊐ Blue Ice ⊐ None ⊐ Other (specify)
Packing Material: ⊐ Bubble Wrap ⊐ Cardboard ⊐ Corrugated Paper ⊐ Shredded Paper ⊐ Styrofoam ⊐ Vermiculite ⊐ None

Cooler 1:	°C	Cooler 6	°C	Cooler 11	°C	Cooler 16	°C
Cooler 2:	°C	Cooler 7	°C	Cooler 12	°C	Cooler 17	°C
Cooler 3:	°C	Cooler 8	°C	Cooler 13	°C	Cooler 18	°C
Cooler 4:	°C	Cooler 9	°C	Cooler 14	°C	Cooler 19	°C
Cooler 5	°C	Cooler 10	°C	Cooler 15	°C	Cooler 20	°C

Unless otherwise documented, the recorded temperature readings are adjusted readings to account for the CF of the IR Gun
EPA Criteria: 0-6°C, except for air and geo samples which should be at ambient temperature and tissue samples, which may be frozen.
Some clients require thermal preservation criteria of 2-4°C or other such criteria. The PM must notify SM when alternate criteria is specified.
Comments:

Report Management-*Workshare (TALS Labs)*	**YES**	**NA**	**Initials**	**Date**
Workshare (TALS Labs)-Shipping and Receiving Documents scanned and attached to job.				
Email notification sent to job contact				
Report Management-*Login Review*	**YES**	**NA**	**Initials**	**Date**
Shipping and Receiving Documents: Scanned and attached to deliverable job folders.				
Project Manager-*Login Review*	**YES**		**Initials**	**Date**
Login Review Performed				
EDD Questions	**YES**	**NA**	**Initials**	**Date**
Applicable login/job questions answered				
Report Management-*Preliminary Deliverables*	**YES**	**NA**	**Initials**	**Date**
Lab Documents-Scanned and attached to appropriate job deliverables folder.				
Subcontract Data (if applicable)- Non-TALS Labs, 3rd Party Labs Scanned and attached to appropriate job deliverables folders				
Narrative-NCMs added, if present				
Preliminary Reports-run and assembled				
EDD(s)-run and created				
Project Manager	**YES**		**Initials**	**Date**
Final review and release completed				
Report Management-*Final Deliverables*	**YES**	**NA**	**Initials**	**Date**
Reports-Hardcopy printed (if requested), CD(s) burned				
Invoice-Approved in Invoice Desktop and printed (if hardcopy requested)				
Email-Report(s), EDD(s), and invoice (as requested)				
Delivery confirmed for report(s), EDD(s) and Invoice in TALS				

BR-FSR002:09.19.11:4
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SECTION 24. ASSURING THE QUALITY OF TEST RESULTS

24.1 Overview

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 Negative Controls

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blanks	are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

Table 24-1. Example – Negative Controls

Control Type	Details
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous

volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.
- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.5 Sample Matrix Controls

Table 24-2. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;

Table 24-2. Sample Matrix Control

Control Type	Details	
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects.If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.

[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated when necessary unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking ± 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.

- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client).

24.7 Additonal Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 9 and 21.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 18.
- The laboratories sample acceptance policy is included in Section 23.

SECTION 25. REPORTING RESULTS

25.1 Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

The format of each report type is specific to the client or regulatory program and is therefore not included in the QAM. The reporting specifications for CLP contract samples must comply with the specifications for CSF organization, preparation and review as specified in the SOW. Procedures for preparation of the CSF are provided in laboratory SOP BR-RM-001.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report For Samples) with a "sample results" column header.

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Practical quantitation limits or reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda).

25.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.18 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.

25.2.19 When NELAC accreditation is required, the lab shall certify that the test results meet all requirements of TNI Standard or provide reasons and/or justification if they do not.

25.2.20 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.21 When soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.

25.2.22 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.23 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report, or how your lab identifies it). A complete report must be sent once all of the work has been completed.

25.2.24 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.28 A clear statement notifying the client that non-accredited tests were performed and directing the client to the laboratory's accreditation certificates of approval shall be provided when non-accredited tests are included in the report.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002) for details on internally applying electronic signatures of approval.

25.3 Reporting Level or Report Type

The laboratory routinely offers four levels of quality control reporting.

- Level I is a report with the features described in Section 25.2 above except QC summary information is not included.
- Level II is a Level I report plus QC summary information.
- Level III contains all the information supplied in Level II, but presented on CLP-like summary forms, and relevant calibration information. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

The format of each report type is specific to the client or regulatory program and is therefore not included in the QAM. The reporting specifications for CLP contract samples must comply with the specifications for CSF organization, preparation and review as specified in the SOW. Procedures for preparation of the CSF are provided in laboratory SOP BR-RM-001.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services. TestAmerica Burlington offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific

electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 Supplemental Information for Test

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP No. CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 Client Confidentiality

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

This material is intended only for the use of the individual(s) or entity to whom it is addressed, and may contain information that is privileged and confidential. If you are not the intended recipient, or the employee or agent responsible for delivering this material to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify us immediately by telephone at the 1-800-765-0980 (or for e-mails: please notify us immediately by e-mail or by phone (1-800-765-0980) and delete this material from any computer).

25.7 Format of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 Amendments to Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the Archive data server, as is the original report. The revised report is stored in the Archive data server under the sample number followed by "R" ***[indicate your naming scheme]***. The revised report will have the word "revised" or "amended" next to the date rather than the word "reported".

When the report is re-issued, a notation of "report re-issue "is placed on the cover/signature page of the report *or at the top of the narrative page* with a brief explanation of reason for the re-issue and a reference back to the last final report generated. *For Example*: *Report was revised on 11/3/08 to include toluene in sample NQA1504 per client's request. This final report replaces the final report generated on 10/27/08 at 10:47am.*

25.9 Policies on Client Requests for Amendments

25.9.1 Policy on Data Omissions or Reporting Limit Increases

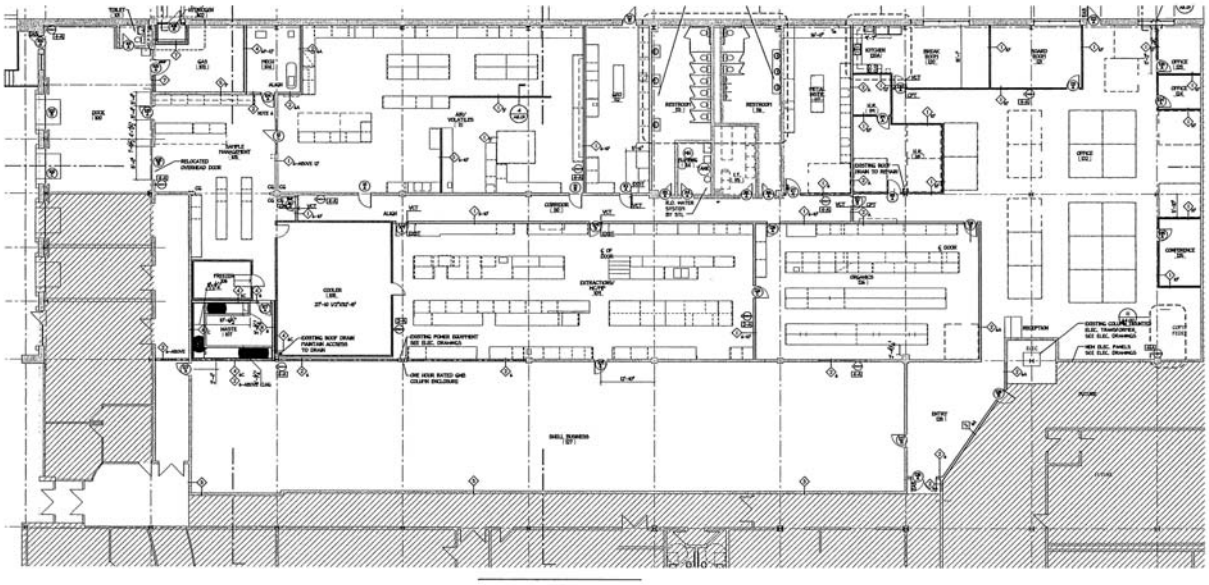
Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan



Appendix 2. Glossary/Acronyms (EL-V1M2 Sec. 3.1)

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical ~~r~~relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material~~,~~ accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to Second Column Confirmation; Alternate wavelength; Derivatization; Mass spectral interpretation; Alternative detectors or Additional Cleanup procedures. (TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis**.** No significant action is taken to change behavior, process or procedure.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.
External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: hose matrix, technology/method, and analyte combinations for which the NELAP accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ± 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as

total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater~~,~~ effluents, and TCLP or other extracts.

Drinking Water: Any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-Aqueous Liquid: Any organic liquid with <15% settleable solids.

Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test

result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the aboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, ~~product~~ or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank: A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
MSDS - Material Safety Data Sheet
NELAC - National Environmental Laboratory Accreditation Conference
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
TNI – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP – Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Burlington maintains accreditation, certifications and approvals with numerous state and national entities. At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

Lab ID	Program	Program Type	Authority
NA	Delaware DNREC		Delaware
ADE-1492	DoD ELAP	DoD	ACLASS
200610	NELAC	Secondary AB	New Hampshire
VT972	NELAC	Primary AB	New Jersey
10391	NELAC	Secondary AB	New York
68-00489	NELAC	Secondary AB	Pennsylvania
E87467	NELAC	Secondary AB	Florida
176292	NELAC	Secondary AB	Louisiana
PH-0751	State Program		Connecticut
VT00008	State Program		Maine
050-999-436	State Program		Minnesota
LAO00298	State Program		Rhode Island
VT-4000	State Program		Vermont
P330-11-00093	USDA		USDA

The certificates and parameter lists are available upon request from a laboratory representative. A complete list of analytical capabilities may be found on the company's web site, the laboratory's public server or from a representative of the laboratory.

Title: Gasoline Range Organics – Total Area Quantification [Method No. 8015B/D]

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):

8/30/13
Gary S. Rudz Date
GC Manager

8/30/13
Brad Prinzi Date
Quality Assurance Manager

8/30/13
Christopher Spencer Date
Laboratory Director

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1.0 Scope and Application

1.1 This method is used to qualify and quantify Gasoline Range Organics by purge & trap techniques into a capillary column equipped gas chromatograph. This method is restricted to use by or under the supervision of analysts experienced in the use of a gas chromatograph and the integration of gas chromatograms.

1.2 Analytes, Matrix(s), and Reporting Limits

1.3 All soils and waters

1.4 Routine laboratory reporting limits are 50 ug/l for aqueous samples and 250 ug/kg for soil samples.

1.5 Method detection limits are established for each compound by analyzing seven replicate spiked samples and using the following equation. This is done on an annual basis.

$$MDL = (3.14)(S_c)$$

Where:

S_c = standard deviation of concentration for seven replicate samples

The MDL is determined annually and is on file with the QA dept.

On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in the Quality Assurance Manual.

2.0 Summary of Method

2.1 The Gasoline Range Organics Method provides gas chromatographic conditions for the detection of various aromatic volatile compounds using purge and trap techniques. An inert gas is bubbled through a 5ml water sample contained in a specifically designed purging chamber at ambient temperature. The aromatics are transferred efficiently from the aqueous phase to the vapor phase and swept through a sorbent trap where the aromatics are trapped. After purging is complete, the trap is flash-heated and flushed with the inert gas to desorb the aromatics onto the gas chromatographic column. The gas chromatograph is temperature programmed to separate the aromatics which are then detected by a flame ionization detector (FID).

3.0 Definitions

All abbreviations are explained in the text of this SOP, and additional definitions may be found in the Test America Buffalo LQM.

4.0 Interferences

4.1 Samples can be contaminated by diffusion of volatile organics through the sample container septum during shipment and storage. A field blank, a trip blank and a holding blank prepared from reagent water and carried through the sampling and/or subsequent storage and handling can serve as a check on such contamination.

4.2 Contamination by carryover can occur whenever a sample with high levels is analyzed. To reduce carryover the purging device, syringe and lines are flushed between every analysis. The trap is baked at 270°C between each analysis.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Safety Manual and this document.

This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

None

5.2 Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Methanol	Flammable Poison Irritant	200 ppm-TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Gasoline	Flammable	N/A	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
2-Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

Gas chromatograph suitable for on-column injection and all required materials, i.e., syringes, columns, gases, detector and a data processing system capable of measuring peak areas and heights.

Hewlett Packard 5890 gas chromatograph
Tekmar, Dynatech, Purge & Trap
Archon Auto Sampler
Capillary columns as described in sections 9.2
Flame Ionization Detector
PE Nelson Totalchrom data system
Carrier Gas – Helium
Syringes - various

6.1 Instrumentation

Hewlett Packard 5890 gas chromatograph
Tekmar, Dynatech, Purge & Trap
Archon Auto Sampler

Columns - three different capillary columns are used in TestAmerica's 8015B/D (GRO) analysis:

Column analytical system
Column or equivalent
30 m x 0.53 mm ID RTX-VMS (Restek).
60 m x 0.53 mm ID RTX-VGC (Restek).
60 m x 0.53 mm ID ZB-624 (Phenomenex)

Sample introduction apparatus:
Purge – and – trap – See Method 5030

6.2 Supplies

Volumetric flasks - various sizes

Micro syringes - various sizes

Carbon treated tap water for volatile-free source of water

7.0 Reagents and Standards

7.1 All standards are stored in the freezer at a maximum of (-2°C).

7.2 Volatile standards are prepared covering a concentration range expected to be found in real samples. All standards are to be properly recorded in a given standard log.

Separate Standard Operating Procedures address standard preparation and standards recordkeeping.

7.3 Stock Standards
- **7.3.1** Unleaded Gasoline Standard purchased from Ultra Scientific at 5000 ng/ul in methanol.
- **7.3.2** Commercial grade gasoline – used as second source material (ICV)

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 Aqueous samples should be collected in (2) 40 ml Level I VOA vials. Soil samples should be collected in (1) 4 oz Level I glass wide-mouth jar. All samples should be maintained with zero headspace.

8.2 Both aqueous and soil samples should be shipped with ice.

8.3 Both aqueous and soil samples must be stored and maintained at the lab at 4°C, ±2, until the analyst is prepared for the analytical process.

8.4 Both aqueous and soil samples are to be analyzed within 14 days of sample date.

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time	Reference
Waters	Level 1 VOA vial	50 mLs	Cool 4 ± 2°C	14 Days	40 CFR Part 136.3
Soils	Glass	3 grams	Cool 4 ± 2°C	14 Days	N/A

9.0 Quality Control

9.1 ICAL: Analysis can not begin without an acceptable calibration. Instrument maintenance may be required. Refer to TestAmerica Corporate Policy P-T-001, R3 for information on the proper selection of calibration points.

9.2 ICV: Reanalyze calibration curve if unacceptable ICV is obtained (<15%)

9.3 CCV: (%D<15%)
- **9.3.1** Reanalyze the CCV
  - **9.3.1.1** If the 2nd analysis is acceptable, analytical sequence may continue, however the previous 10 samples must be re-analyzed.
  - **9.3.1.2** If the 2nd analysis is unacceptable, analyze a new ICAL

9.3.2 If the CCV is out high and there are no positives in the samples, the results may be reported. This situation must however be noted in the logbook and on the Job Summary.

9.4 GVOA Decision Tree – running 2 consecutive CCVs
- **9.4.1** Run: CCV1
- **9.4.2** Run: CCV2
  - **9.4.2.1** CCV 1 Passes & CCV2 Passes
  - **9.4.2.2** Continue as Normal Routine

  - **9.4.2.3** CCV1 Passes & CCV2 Fails
  - **9.4.2.4** Rerun all runs after failed CCV

  - **9.4.2.5** CCV1 Fails & CCV2 Passes
  - **9.4.2.6** Rerun all runs before CCV1 and last Compliant CCV.

  - **9.4.2.7** CCV1 Fails & CCV2 Fails
  - **9.4.2.8** Rerun all samples before and after CCVs after Maintenance and/or Recalibration

9.5 Method Blank: Reanalyze all samples associated with an unacceptable method blank.

9.6 LCS:
- **9.6.1** If below limits: Reanalyze all samples associated with an unacceptable LCS
- **9.6.2** If above limits: Reanalyze all samples with detections. Reanalysis is *not required* if samples are ND.

9.7 MS/MSD:
- **9.7.1** Matrix interference can be assumed and corrective action is not required if both of the following conditions are met:
  - **9.7.1.1** LCS recovery is acceptable
  - **9.7.1.2** Recoveries in both the MS and MSD are consistent (RPD<30%)

    9.7.1.2.1 If sample appearance indicates that the MS/MSD pair may not provide reproducible results, the poor results may be accepted but this should be noted in the job summary and case narrative.

- **9.7.2** If LCS is unacceptable – reanalysis of batch is required.

- **9.7.3** If recoveries in MS/MSD are different (i.e.: one high, one low) further evaluation should be made. Matrix interference can not be assumed in this case. Discussion with the department supervisor, operations manager or QA manager should be included in the final decision process prior to releasing data.

9.8 Surrogate:

9.8.1 If below limits – reanalyze samples

9.8.2 If above limits – reanalyze sample if detections obtained. Reanalysis is *not required* if sample is ND.

CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

A Job Exception Form must be completed and filed with the Project Manager and QA Manager for any of the following conditions:

Holding times exceeded
Insufficient sample volume for re-analysis
Re-analysis required due to method blank, surrogate or LCS failure

In the event of unknown positives or sample matrix which present the analyst with questionable data, the project manager shall be notified so the client may be contacted and involved in the decision process and course of action

9.9 **Sample QC** - The following quality control samples are prepared with each batch of samples.

9.10 The reader is referred to TestAmerica's Laboratory Quality Manual (LQM) for general information and more specific detail. Often project specific quality assurance documents will provide overriding criteria to that presented below. Those criteria depending on project-specific data quality objectives may be more or less stringent than TestAmerica's LQM or the following criteria. The following criteria are subsequently presented as minimum criteria on those criteria deemed applicable in the absence of project-specific Data Quality Objectives.

9.11 Surrogates - All standards and samples are fortified with a surrogate material in order to monitor both system and method performance. The surrogate material routinely used by TestAmerica is A,A,A-Trifluorotoluene and is added to all samples at prescribed levels (usually 150ng/ul). Please refer to Laboratory GRO manual for specific recovery limits. Limits are client and state specific. Laboratory specific surrogate limits are calculated yearly by using the following equation:

Upper limit = p+3s
Lower limit = p-3s

where p=ave.% rec. and s=standard deviation

9.11.1 If the surrogate is out-of-control, re-analysis is required.

9.11.2 If upon re-analysis, surrogate recoveries are under control, report only the re-analysis.

9.11.3 If re-analysis again results in out-of-control surrogate recoveries, report both analyses and note matrix effects in the case narrative.

9.11.4 If initial surrogate failure is due to chromatographic interference which resulted in large portion bias, re-analysis may be inappropriate, but approval of the client, TestAmerica Program Manager and/or the Quality Manager is required.

9.12 Matrix Spike / Matrix Spike Duplicates - MS and MSD samples are to be prepared at a frequency of at least 5% (1 MS per 20 samples and 1 MSD per 20 samples) or with each analytical job/case. Batch MS/MSD (i.e., 1/20 over a number of jobs/cases) is an option to fulfilling the requirements, but at least one (1) set of MS/MSD should be run per day of instrument operation.

9.12.1 Both water and soil spikes should be at a level of 1000 total ng.

9.12.2 MS and MSD percent recoveries and Relative Percent Differences (RPDs) between MS and MSD recoveries are advisory, unless defined as mandatory by an applicable project-specific quality assurance plan. Advisory recovery limits are 50-150% and %RPD between MS/MSD recoveries $\leq$50%.

9.13 Laboratory Control Sample / Matrix Spike Blank - A minimum of one (1) matrix spike blank 12 hours (or batch) is required.

9.13.1 Spiking levels for LCS are the same as for MS/MSD. Please refer to Laboratory GRO manual for required recovery limits. Limits are client and state specific.

9.13.2 Inject 10.0ul of the unleaded gasoline standard (2000ug/ml) into 100 mls of volatile free water for a final concentration of 0.2 ug/ml. This concentration should yield 1000 ng on column.

9.13.3 To prepared soil sample add 100ul of the unleaded gasoline standard (500ug/mL) and 100ul of surrogate (75ug/mL).

9.13.4 In the event of LCS failure, re-analysis is required. If re-analysis continues to indicate LCS failure, all sample analyses completed relative to that LCS are subject to re-analysis.

9.14 Method Blank - A method blank must be analyzed once every 12 hours. If a method blank exhibits contamination above the Quantitation Limit all related sample results must be evaluated. Samples containing the same analytes found in the method blank must be re-analyzed.

9.15 Method Blank:
Detected concentrations < PQL or
Detected concentrations < 10X amount in associated samples

9.16 LCS (LCS):
Recovery within 50-150% (typical)

9.17 MS/MSD:
Recovery within 50-150% (typical)
%RSD <30%

9.18 Surrogate:
Recovery within lab historical limits. Typical limits are 55-140%.

Quality Controls	Frequency	Control Limit
Method Blank (MB)	1 in 20 or fewer samples	< Rpt. Limit
Laboratory Control Sample (LCS)[1]	1 in 20 or fewer samples	Statistical Limits [4]
Matrix Spike (MS)[2]	1 in 20 or fewer samples	Statistical Limits [4]
MS Duplicate (MSD)[2]	1 in 20 or fewer samples	Statistical Limits [4]
Surrogates	every sample[3]	Statistical Limits [4]

[1] LCS Duplicate (LCD) is performed only when insufficient sample is available for the MS/MSD or when requested by the client/project/contract.
[2] The sample selection for MS/MSD are randomly selected, unless specifically requested by a client….predetermined by the extraction lab.
[3] Analytical and QC samples (MB, LCS, MS/MSD)
[4] Statistical control limits are updated annually and are updated into LIMS.

9.19 Instrument QC

ICAL: %RSD < 20% or calibration factor >0.990

ICV (second source): Within ±15% of true value

CCV: %D < 15%

Step	*Standards*	*Type*	*Control Limit*	*Frequency*
Method # 8015B/D GRO				
1-5	*5 Point Cal*	*Linear or Ave Cal Factor*	*>0.995 or <20.0 RSD*	*When ICV criteria cannot be met with routine maintainence*
6	*Second Source*	*Midrange Cal*	*</= 15.0 %D*	*After ICAL prior to analysis*
7	*ICV*	*Single Point*	*</= 15.0 %D*	*Daily prior to analysis*
8	*VBLK*	*VOA-free Water*	*<RL for all Target Analytes*	*Daily prior to analysis*
9	*CCV*	*Single Point*	*</= 15.0 %D*	*Every 10 injections*

10.0 Procedure

10.1 Volatile compounds are introduced into the gas chromatograph by purge–and–trap (Method 5030). Method 5030 may be used directly on groundwater samples or low-level contaminated soils and sediments. For medium-level soils and sediments, aqueous extraction, in accordance with this SOP may be necessary prior to purge-and-trap. All method blanks and standards are treated in the same manner as the samples.

10.2 Sample Preparation
10.3 Sample Preparation - Water

10.3.1 Aqueous samples are removed from the storage incubator and allowed to warm to ambient temperature before analysis.

10.3.2 For matrix spike/matrix spike duplicate and matrix spike blank analyses, the sample aliquot is also fortified with the appropriate spike solution.

10.3.3 All appropriate information including sample designations, etc. are recorded in the instrument injection logbook and appropriately transferred to calculation forms/software. Copies of these original analyst observations are included in their entirety in the job/case files.

10.4 Sample Preparation - Soil/Sediment (Med Level)

10.4.1 The sample consists of the entire contents of the sample container. Any supernatant liquids are mixed in to the sample with a clean spatula. Care is taken to minimize time which the sample is exposed to the air.

10.4.2 Approximately 5 grams of sample is weighted into a tared 20 ml vial. Surrogate and/or spiking materials (if appropriate to the particular sample) are added along with 5.0 ml of methanol.

10.4.3 The vial is sealed and shaken for 2 minutes. The contents are allowed to settle or are centrifuged to obtain a clear (not necessarily colorless) aqueous supernatant. Using a clean 1.0 ml syringe, 1000ul of supernatant is drawn off and placed into a 50mls flask of volatile free water, capped and shaken. 44ml of this mixture is poured into a VOA vial, capped and inserted into the tray on the gas chromatograph for purge-and-trap analysis.

10.4.4 Dry weights for soil analysis are determined independently of the procedure but are used in order to report results on a dry weight basis.

10.4.5 All appropriate information including sample weights, and sample designations are recorded in the instrument injection logbook and transferred to calculation forms/software. Copies of these original analyst observations are included in their entirety in the job/case files.

10.5 Instrument Performance Specifications – The gas chromatograph is set up to reflect the following general operating conditions.

Injection B Temp.	250^{o}C
Detector B	250^{o}C
Oven Maximum	250^{o}C
Range 1	2
Range 2	0
Signal 1	Att. 0
Signal 2	Att. 0

10.6 Column conditions reflect the constituents of interest in a particular analysis.

GRO Analysis:

Initial Temperature	50°C
Initial Time	5 min
Rate	10°C/min
Final Temperature	210°C
Final Time	2.5 min
Rate A	20°C/min
Final temperature A	220°C
Final Time A	1.0 min
Equilibrium Time	1.0 min

10.7 Calibration

10.8 A five point calibration curve is established for each compound of interest. The method of continuing calibration verification on a daily basis is acceptable if QC criteria are met. A new initial calibration curve must be run whenever continuing calibration criteria can not be met.

Gasoline Component Standard and Concentrations

Level	2.0 Standard µls Injected	Ng on column
A	1100	250
B	2200	500
C	4400	1000
D	13200	2500
E	22000	5000

10.8.1 Using the unleaded gasoline standard, inject 20ul into 100 mls of volatile free water for a final concentration of 2.0 ng/ml.

10.8.2 For the initial calibration curve to be acceptable measurable response factors at all levels and the %Relative Standard Deviation (RSD) between response factors must be ≤20%.

10.9 For calibration verification (i.e. continuing calibration) of the analytical curve, a 2500 total ng standard must be analyzed every 12 hours sample analyses and at the end of each analysis sequence.

10.9.1 Inject 10.0ul of the unleaded gasoline standard (5000ng/mL) into 100 mls of volatile free water for a final concentration of 0.5. ug/mL. This concentration should yield 2500ng on column.

10.9.2 The continuing calibration verification standard response factor must agree with the initial calibration to within ±15% difference. Project-specific limits may be different from this criteria.

10.10 To obtain retention time windows, three levels from an initial calibration are used to calculate standard deviation and mean for all target compounds and surrogates. The width of the retention time window is + or – 3x the standard deviation of the mean absolute retention time from the 3 levels in the initial calibration. The retention times are updated daily with each ICV.

Before any instrument is used as a measurement device, the instrument response to known reference materials must be determined. The manner in which various instruments are calibrated depends on the particular type of instrument and its intended use. All sample measurements must be made within the calibration range of the instrument. Preparation of all reference materials used for calibration must be documented.

Calibration Controls	Sequence	Control Limit
Calibration Standards	5-point (minimum) linearity	≤20% RSD
Cont. Cal. Verif. (CCV)	Prior to / after every 10 injections	Prior to/after every 10 injections
RT Windows (RTW)	Init. CCV determines midpt. of RTW	±3X SD

10.11 Sample Analysis

10.12 Upon establishment of or verification of established instrumental operating conditions, the following instrument maintenance procedures are performed daily.

10.12.1 Check flows and column conditions

10.12.2 Analyze blank(s) before samples and determine system to be clean and free of interferences.

10.12.3 If interferences are present, (1) bake out column at 250°C, and/or (2) cut capillary column at injector end about 6-12 inches.

10.12.4 Log maintenance activities into the instrument maintenance log.

11.0 Calculations / Data Reduction

$$\text{Calibration factor} = \frac{\text{total area of peaks}}{\text{nanograms injected}}$$

$$\text{Percent Difference} = \frac{R1 - R2}{R1} \times 10$$

Where: R1 = Expected recovery in nanograms

R2 = Actual recovery in nanograms

Nanograms on column = $\frac{\text{total area minus surrogate's area}}{\text{Calibration factor}}$

Ug/L = $\frac{\text{nanograms on column}}{\text{ul injected (purged)}}$ X 1000

ug/Kg= medium level soils = $\frac{\text{(nanograms on column X final volume)}}{\text{(dry weight X ul injected)}}$ X 1000

low level soils = $\frac{\text{nanograms on column}}{\text{dry weight}}$

$R = \frac{Xs - Xu}{K} \times 100$

Where: Xs = measured value for spikes sample
Xu = measured value for unspiked sample
K = known value of spike in the sample

% dry weight = $\frac{\text{grams of dry sample}}{\text{grams of sample}}$ X 100

Rounding – for rounding off numbers to the appropriate level of precision, observe the following common rules:

If the figure following those to be retained is less than 5, round down.

If the figure is greater than 5, round up (increase the last digit by one).

If the figure following the last digit to be retained equals 5 (round up if the digit to be retained is odd, and down if that digit is even).

Organic Significant Figures – for volatile and semi volatile results, report analytical results to one significant figure if the value is less than 10, and two significant figures if the value is above 10.

Results must be defined as wet weight or dry weight.

12.0 Method Performance

12.1 The accuracy and precision obtained will be determined by the sample matrix, sample introduction technique, and by the calibration procedure used. Specific acceptance limits for both precision and accuracy are updated annually and are maintained in the TALs system.

12.2 Method Detection Limit Study (MDL)

12.3 Method detection limit studies are performed annually in accordance with 40 CFR, Part 136, Appendix B.

The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. The MDL is determined according to the laboratory's MDL procedure in the QA Manual. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method requirements require a greater frequency.

12.4 Demonstration of Capabilities

12.5 A minimum of 4 replicate QC check standards at 20ug/L will be performed by each analyst. The average recovery and standard deviation are keep in TALs and kept with each analyst's training file.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability).

14.0 Waste Management

14.1 All waste will be disposed of in accordance with Federal, State and Local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.2 Waste Streams Produced by the Method

14.2.1 The following waste streams are produced when this method is carried out. VOA vials containing extracted acidic water and small amounts of methanol. Waste is disposed of in appropriate waste containers, either labeled "A" for aqueous waste or "C" for any solvent other than water.

14.2.1 VOA vials containing extracted soil samples, which will contain small

amounts of methanol. The methanol is decanted off the soil into a "C" waste container. The soil is wrapped in tin foil and placed in the solid waste receptacle. Soils used for dry weight measurements are also disposed of in this manner.

14.2.2 Glass waste such as pipettes and vials are rinsed and disposed of in approved glass receptacles.

15.0 References / Cross-References

15.1 Method D 4128-89, "Standard Practice for Identification of Organic Compounds in Water by Combined Gas Chromatography and Electron Impact Mass Spectrometry", American Society for Testing and Materials.

15.2 Method 8015B, "Non-halogenated Volatile Organics by Gas Chromatography", Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, Revision 2, September 1994.

15.3 Method 8015D, "Non-Halogenated Organics Using GC/FID", Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Fourth Edition, Revision 4, June 2003.

15.4 "Test America's Laboratory Quality Manual", Current Revision

15.5 "Chemical Hygiene Plan", Current Revision

16.0 Method Modifications: N/A

17.0 Attachments NA

18.0 Revision History

Revision 3 dated August 30, 2013

- Changed QA Manager, signature updated
- Changed all references from 8015B to 8015B/D

Revision 2 dated March 29, 2012

- Removed all ELEMENT references
- Changed QA Manager, signature updated.
- Section 7.1 clarification
- Changed MSB references to LCS
- Section 10.4.3 updated soil procedure
- Section 9.13.3 Clarified soil spiking procedure

Revision 1 dated March 18, 2010

- Removed all AIMS references

Revision 0 dated June 9, 2008

- Integration of TestAmerica operations
- Quality Manager change, signature updated

Title: Method 5030C: Purge and Trap

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):

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1.0 Scope and Application

This method describes sample preparation and extraction for the analysis of volatile organics by a purge and trap procedure. The gas chromatographic determinative steps are found in Methods 8260C, 624, 524.2, NYSDEC Analytical Services Protocols, and USEPA OLMO4.3.

1.1 Analytes, Matrix(s), and Reporting Limits

On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in Section 7.3.1 in the Quality Assurance Manual.

2.0 Summary of Method

An inert gas, helium, is bubbled through a sample (solution) at ambient temperature or an elevated temperature depending on analytes and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are adsorbed. After sample purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column.

3.0 Definitions

Standard definitions are found in TestAmerica Buffalo's Laboratory Quality Manual.

4.0 Interferences

Purchasing high-quality helium minimizes impurities from the purge gas (helium). The purge and trap system is highly susceptible to carryover from high level samples. Sample lines are flushed with volatile free water after each sampling. The trap is baked at 260 degrees C for a minimum of eight minutes.

The laboratory analyzes weekly volatile holding blanks to ensure an environment free of volatile organic solvent vapors. Methylene chloride can permeate through a septum seal, a trip blank is carried through the sampling and handling protocols to serve as a check on such contamination.

The purge and trap system will also be demonstrated to be clean by the use of Method Blanks and IBLKs. Contamination by carryover can occur whenever high-concentration and low-concentration samples are analyzed sequentially. Unusually high-concentration samples should be followed by an analysis of organic-free reagent water to check for cross-contamination.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the

method to follow appropriate safety, waste disposal, and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats, and closed-toe, nonabsorbent shoes are a minimum.

Specific Safety Concerns or Requirements

Special precautions are taken when working with a purge and trap system. Due to the amount of gas utilized by the system, all employees are required to wear approved safety glasses. Parts of the system are under pressure, always allowing for the possibility of shattered glass.

Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Hydrochloric Acid	Corrosive Poison	5 ppm-Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Methanol	Flammable Poison Irritant	200 ppm-TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

Purge and trap device that consists of three parts.

Sample purge vessels are designed to accept 5ml samples and have a total volume of less than 15 mls. In low level drinking water methods, 25ml sample purge vessels are utilized.

A VOCARB 3000 trap (or similar manufacturers trap) ~30cm long containing the following materials is utilized for all methods:

10cm Carbopack B
6cm Carboxen 1000
1cm Carboxen 1001

The desorber rapidly pre-heats the trap to 245 degrees C and then desorbs at 250 degrees C. The trap is then baked at 260 degrees C.

7.0 Reagents and Standards

Volatile free water for making sample dilutions and method blanks.
Purge and trap grade methanol for standards.

8.0 Sample Collection, Preservation, Shipment and Storage

Samples should be collected in 40 ml capped vials with zero headspace and stored at 4°C +/-2° until time of analysis. Aqueous samples preserved with HCl must be analyzed within 14 days of collection. Aqueous samples not preserved with HCl must be analyzed within 7 days of collection. Soil samples must be analyzed within 14 days of collection. TCLP volatile samples must be tumbled with in 14 days of collection and then analyzed within 14 days of the TCLP extraction.

9.0 Quality Control

A standard, LCS, and MB is analyzed in each run as well as a MS/SD every 20 samples.

9.1 Instrument QC

Instrument Operating Conditions (Suggested)

Purge temperature	<35-40ºC
Desorb Temperature	250ºC
Line Temperature	110ºC
Purge Gas (Helium)	40mL/min.
Purge Total Time	11 min.
Desorb Time	2 min.

Instrument Maintenance

Upon verification of established operating conditions, the following is performed on a sequence basis:

- check purge flow;
- analyze blank to insure system is free of contamination (daily);
- vessel and lines are flushed with volatile free water after each analysis.

Note: System must be leak free. System can be checked by purging 5mL water in sample vessel and capping off vent on purge device. If purge flow stops system is leak free, if purge flow continues (within 2-3 minutes) this means there is a leak within the system. Leak must be located and corrected.

10.0 Procedure

Instrument Operating Conditions (Suggested)

Purge temperature	<35-40ºC
Desorb Temperature	250ºC
Line Temperature	110ºC
Purge Gas (Helium)	40ml/min.
Purge Total Time	11min.
Desorb Time	2min.

10.1 Calibration

See appropriate determinative method(s).

11.0 Calculations

NA

12.0 Method Performance

MDLs are performed yearly, per analytical method, and kept on file with the Quality Department. The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. The MDL is determined according to the laboratory's MDL procedure in Section 20.7 of the QA Manual. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix and may not be achievable in all environmental matrices. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method requirements require a greater frequency.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage, and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Environmental Health and Safety Manual (CW-E-M-001) for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed.

Waste disposal procedures are incorporated by reference to BF-WM-01. The following waste streams are produced when this method is carried out:

14.1 Acidic material from the auto-sampler: Waste stream must be collected in "A" waste receptacles and neutralized before discharge to a sewer system.

14.2 Methanol waste from rinses and standards: Collect in "C" waste receptacles. In the case of medium level soil extractions, the methanol is decanted off the soil and collected in the "C" receptacle. Waste receptacles are then taken to sample control where they are disposed of properly. Excess samples (acidic and non-acidic). Collect in "A" waste receptacles and are neutralize before disposal into drain/sewer.

14.3 Excess soil sample from medium level extraction: Place in solid waste receptacle. Soils for dry weight measurements are also disposed in this manner.

15.0 References

U.S. EPA 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule," October 26, 1984

U.S. EPA "Method 5030C, Purge and Trap for Aqueous Samples", Test Methods for Evaluating Solid Waste, Volume 1B, Revision 3, May 2003.

16.0 Tables, Diagrams, Flowcharts NA

17.0 Revision History

- Revision 0, July 30, 2013 initial release

Title: ULTRASONIC EXTRACTION (SW846 3550C)

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1.0 Scope and Application

This SOP describes the laboratory procedure for ultrasonic extraction of nonvolatile and semivolatile organic compounds from solids such as soils, sediments and waste. This SOP includes the procedure for concentration of extracts in preparation for cleanup and/or determinative analysis.

This procedure is not applicable to the medium/high concentration method (individual organic components of greater than 20 mg/kg) as described in the referenced method.

1.1 Analytes, Matrix(s), and Reporting Limits

Refer to analytical methods for analyte lists and reporting limits.

2.0 Summary of Method

A measured amount of sample, usually 30 g, is mixed with anhydrous sodium sulfate to create a free-flowing mixture that is solvent extracted three times using ultrasonic extraction. The extract is dried, concentrated, and relinquished to the analytical department(s) or if necessary, exchanged into a solvent compatible for extract cleanup procedures.

This SOP is based on the following reference method:

SW-846 Method 3550C, Ultrasonic Extraction, Revision 3, February 2007.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

Method interference may be caused by contaminants in solvents, reagents, glassware and other sample processing equipment that can cause interference and/or elevated baselines in chromatography. All reagents and solvents used during this procedure should be reagent grade or high purity in order to minimize interference. All glassware must be cleaned in accordance with laboratory SOP BR-EX-017 *Glassware Cleaning Procedure*, and rinsed with acetone and methylene chloride prior to use.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

Nitrile gloves should be used when performing this extraction. Latex and vinyl gloves provide no significant protection against the organic solvents used in this SOP and should not be used.

Ultrasonic disrupters can produce high intensity noise and must be used in an area with adequate noise protection.

During Kuderna-Danish (KD) concentration, do not allow the extract to boil to dryness. The solvent vapors remaining in the KD apparatus may superheat and create an explosion or fire hazard.

The KD apparatus has ground glass joints which may become stuck. Technicians must use Kevlar or other cut/puncture resistant gloves when separating stuck joints.

Proper hearing protection is recommended when working with sonicators. Proper hearing protection must be worn if the Decibel value of the sonicators exceeds the regulatory limit. Closing the fume hood sash is recommended to reduce the cavitation sound.

The following analytes have been tentatively classified as known or suspected, human or mammalian carcinogens: benzo(a)anthracene, benzidine, 3,3'dichlorobenzindine, benzo(a)pyrene, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, dibenz(a,h)anthracene, N-nitrosodimethylamine, 4,4'-DDT, and polychlorinated biphenyl compounds. Primary standards of these toxic compounds should be prepared in hood.

5.2 Primary Materials Used

Table 1 lists those materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Extraction Equipment

- Ultrasonic Disrupter: Vibra Cell 750-watt Model Dual Output with pulsing capability, 3/4" standard disrupter horn for low level extractions. Sonics and Materials Model Number VC750 or equivalent.
- Sonabox
- 400 mL Glass Beaker: Fisher Scientific or equivalent.
- Filter Funnels: 100mm diameter for filtration/drying, Fisher Scientific or equivalent.
- Filter Paper: No. 54 Whatman 18.5 cm or equivalent

6.2 Extract Concentration (KD Apparatus)

- Concentrator Tube: 10 mL graduated, ChemGlass Catalog Number CG-1316-11 or equivalent.
- Snyder Column: Three ball macro AMK Catalog Number SC2-01 or equivalent.
- Snyder Column: Two ball micro AMK Catalog Number SC3-01 or equivalent.
- Evaporation Flask: 500 mL attached to concentrator tube with clip, AMK Catalog Number KDF-500 or equivalent.
- Boiling Chips: silicon carbide, approximately 10/40 mesh, solvent extracted in methylene chloride, Troemner Catalog Number 133B or equivalent.
- Heating mantle rheostat controlled for water bath capable of temperature control (± 5℃). ChemGlass Catalog Number PL3122 or equivalent.
- Water Bath: capable of temperature control to ±5℃ , Barnstead Corporation Catalog Number HM0500-HS1 or equivalent.
- Solvent Vapor Recovery System: Kontes K-54000-1006, K-547300-000, Ace Glass Catalog Number 6614-30 or equivalent.

6.3 Miscellaneous

- Disposable Glass Pasteur Pipette and Bulb: Fisher Scientific or equivalent.
- Top Loading Balance: Capable of measuring to 0.01 gram accuracy, Mettler Model Number PM4800 or equivalent.
- Teflon and Stainless Steel Spatulas: Fisher Scientific or equivalent.
- 0.5 mL – 2.0 mL Syringes: Hamilton Gastight® Syringes or equivalent.
- 2, 4, 8 & 16 mL vials with PTFE-lined screw caps.

7.0 Reagents and Standards

7.1 Reagents

- Sodium Sulfate, granular anhydrous (Na_2SO_4): J.T. Baker or equivalent. Purify by heating at 400℃ for at least 4 hours.
- Methylene Chloride (CH_2Cl_2): Pesticide Quality, J.T. Baker or equivalent.
- Hexane, (C_6H_{14}): Pesticide Quality, J.T. Baker or equivalent.
- Acetone, ($(CH_3)_2CO$): Pesticide Quality, J.T. Baker or equivalent.
- Nitrogen, Ultra High Purity, Linde or equivalent.

7.1.1 Prepared Reagents

Methylene Chloride/Acetone (1:1): In a 4 L amber glass bottle mix 2 L methylene chloride with 2 L acetone. Store the solution in a fume hood. Assign an expiration date of 6 months from date of preparation unless the parent material expires earlier, in which case, use the earliest expiration date.

Hexane /Acetone (1:1): In a 4 L amber glass bottle mix 2 L hexane with 2 L acetone. Store the solution in a fume hood. Assign an expiration date of 6 months from date of preparation unless the parent material expires earlier, in which case, use the earliest expiration date.

7.2 Standards

Purchase stock standards as certified solutions from commercial vendors. Prepare surrogate and spiking solutions in the laboratory by diluting a known volume of the stock standard solutions in an appropriate solvent. Record the preparation of standard in the LIMS (TALS) module established for this purpose. The recommended formulation for each standard used in this procedure is provided in the analytical method along with the recommended source materials, expiration dates and storage conditions.

Store prepared standard solutions in glass containers at 4℃ or below. Unless otherwise specified, assign an expiration date of 6 months from the date of preparation or in accordance with the expiration date of the parent standard, whichever is sooner.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method.

Listed below are minimum sample size, preservation and holding time requirements:

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time[1]	Reference
Soil	Clear or Amber Glass	50 g	≤6℃	14 Days	SW-846

[1]Extraction holding time is determined from sampling date.

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Analytical SOP
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Analytical SOP
Matrix Spike(s) MS/MSD	Client Request	See Analytical SOP
Sample Duplicate (SD)	Client Request	See Analytical SOP

9.2 Instrument QC

Refer to the analytical SOP for the determinative test method.

10.0 Procedure

10.1 Instrument Calibration

Check the calibration of the pH meter and the balance each day of use prior to use and record these checks in the logbook designated for this purpose.

Check the tune of the non-self-calibrating sonicator horns prior to use and inspect the horn tip for excessive wear. Attach the converter to the bottom connector. Set the pulsar switch to the off position, the output control to 10 (full power) and the % duty cycle to 50 (energy on 50% of time and off 50% of time). Briefly depress the tune switch and rotate the tuning control clockwise or counterclockwise until a minimum reading of less than 20% is achieved on the power meter. Re-attach the upper converter if using both converters and record the tune calibration in the logbook designated for this purpose.

10.2 Equipment Preparation

Prepare glassware using the procedures described in laboratory SOP BR-EX-017 and rinse with acetone and methylene chloride prior to use. Label the glassware for each field and QC sample clearly and unambiguously during each step of the extraction procedure. Solvent will erase grease pens and “sharpie ink”; so use caution to ensure labels are not obliterated during the procedure.

Assemble a drying funnel for each field and QC sample by placing filter in a 75mm glass funnel then add a sufficient amount of purified granular sodium sulfate to fill the funnel ¾ full. Rinse the funnel with ~30 mL of acetone and ~ 30 mL of methylene chloride each and discard the solvent rinse.

Assemble a KD setup for each field and QC sample by attaching a 10 mL concentrator tube to a 500 mL evaporation flask and attach this to the drying funnel.

10.3 Extraction

Mix sediment samples thoroughly and discard any foreign objects such as sticks, leaves and rocks. Homogenize the sample following the procedures given in laboratory SOP BR-QA-020 Sample Homogenization.

NOTE: The percent dry weight of solid samples is determined by the wet chemistry department following SOP BR-WC-006 Percent Solids Determination.

Label and place a 400 mL beaker on the balance and tare the balance. Weigh out approximately 30 g ±1 g of sample into the beaker and record sample weight to the nearest 0.01 g in the TALS worksheet tab. Use 30 g of purified sodium sulfate for the MB and LCS.

Add the proper type and volume of surrogate solution to each field and QC sample and add the proper type and volume of spike solution to the LCS and MS/MSD. (Refer to the Extraction Condition Spreadsheet for details).

Add a sufficient amount of anhydrous granular sodium sulfate to each sample and mix to create a free-flowing mixture.

Add 100 mL of the extraction solvent mixture to each field and QC sample. For GC Methods (8081 & 8082), use the 1:1 Acetone/Hexane solution as the extraction solvent. For GC/MS and 8015M-DRO, use the 1:1 Methylene Chloride/Acetone solution as the extraction solvent.

Check to ensure the extraction horn is appropriate for the extraction protocol.

Clean the tip of the sonicator horn using a lint-free cloth wetted with acetone. Place the bottom tip of the sonicator horn ~1/2 inch below the solvent, but above the sediment/sodium sulfate mixture layer. Close the hood sash to reduce noise produced by the sonicator.

Set the control knob set at 10 (full power) and with mode switch on Pulse (pulsing energy rather than continuous energy) and percent duty cycle knob set at 50% (energy on 50% of time and off 50% of time) extract ultrasonically for 3 minutes. Watch the extraction to ensure there is very active mixing of the sample and the solvent when the ultrasonic pulse occurs.

Decant the extract into the drying funnel. Repeat the extraction two more times with two additional 100 mL portions of extraction solvent. Decant the solvent between each extraction into the drying funnel/K-D setup. After the final extraction, pour the entire sample into the funnel and rinse with ~30 mL of extraction solvent. Allow the solvent to completely drain through the funnel into the K-D apparatus. Remove the funnel and discard the contents.

Concentrate the extract using K-D technique and when necessary, nitrogen blowdown.

10.4 Extract Concentration (KD Technique)

The following sections describe the procedures for the concentration of extracts. Any of the three techniques described may be used. However some techniques are more efficient than others to achieve the final extract volume. Use the following guidelines to select the concentration technique: For the concentration of volumes greater than 5 mL, use Macro Concentration. To concentrate extract volumes between 5 and 1 mL use Micro Concentration. To concentrate extract volumes below 1 mL, use Nitrogen Blowdown.

10.4.1 Macro Concentration

Macro Snyder Column (K-D)

Add one or two clean boiling chips to the K-D evaporation flask and attach a three-ball Snyder column to the flask. Add ~1 mL of methylene chloride to the top of the column then place the K-D apparatus in a hot water bath (60-70℃) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed in hot water vapor.

Attach the solvent vapor recovery glassware to the Snyder column. Adjust the vertical position of the apparatus and check the water bath temperature. The water bath temperature should be between 54.8 – 74.8℃ when methylene chloride is the extraction solvent and 84-89℃ when hexane is the extraction solvent. Higher water bath temperatures may be used so long as the recovery of target analytes is not impacted. The boiling point of each solvent is provided in the following table:

Solvent	Boiling Point	Water Bath Temperature
Hexane	69℃	84 – 89℃
Methylene Chloride	39.8℃	54.8 – 74.8℃

Monitor the concentration and do not let the extract evaporate to dryness. At the proper rate of distillation the balls of the column will actively chatter but the chambers will not flood with solvent.

When the apparent volume of the extract reaches desired amount remove the K-D apparatus from the water bath and allow it to drain and cool for at least 10 minutes.

10.4.2 Micro Concentration

Add one or two clean boiling chips to the concentrator tube and attach a two ball micro-Snyder column to the tube. Place the concentrator tube into the water bath so that the concentrator tube is partially immersed in hot water. Adjust the vertical position of the concentrator tube and check the temperature of the water bath to ensure the proper temperature for the extract solvent.

Continuously monitor the distillation process to ensure sample extracts do not evaporate to dryness. At the proper rate of distillation, the balls of the column will actively chatter, but the chambers will not flood with solvent. Remove setup when desired sample volume is reached.

10.4.3 Nitrogen Blowdown

Nitrogen blow down may be used to concentrate extracts as needed.

Place the concentrator tube in a warm water bath maintained at a temperature of 35℃. Apply a steady stream of nitrogen until the desired final extract volume is achieved. Rinse the internal wall of the concentrator tube several times with the appropriate solvent during the evaporation and ensure the solvent level in the concentrator is positioned such to prevent water condensations. Monitor the concentration carefully and do not allow the extract to evaporate to dryness.

10.5 Extract Preparation & Handling

Transfer the extract to labeled Teflon lined screw cap via and store refrigerated. Complete the batch worksheet and perform primary review.

If the TALS log-in does not include cleanup methods in the method chain and there is reason to believe the extract may require cleanup (color, odor, viscosity, etc.) notify the PM of the situation so he/she can determine if cleanup should be performed prior to analysis.

11.0 Calculations / Data Reduction

11.1 Calculations

Calculations are provided in the analytical SOP for each method parameter.

11.2 Data Review

11.2.1 Primary Review

Review the batch worksheet for correctness and completeness. Record any problems encountered during the extraction process with a nonconformance memo (NCM) and complete the data review checklist.

11.2.2 Secondary Review

Review the batch worksheet for correctness and completeness and to ensure the extraction performed is consistent the SOP and project specifications. Complete the data review checklist.

Print the output worksheets and release extracts and output worksheet to the analytical department or to the next step in the method chain such as extract cleanup.

If the TALS log-in does not include cleanup methods in the method chain and there is reason to believe the extract may require cleanup (color, odor, viscosity, etc.) notify the PM of the situation so he/she can determine if cleanup should be performed prior to analysis.

For additional guidance regarding the laboratory's protocol and required elements for data review refer to laboratory SOP BR-QA-019.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

A Method Detection Limit (MDL) Study must be determined for each test method associated with this extraction procedure during initial method set-up or prior to the analysis of field samples. The MDLs are verified annually or after major instrument maintenance. The procedure for the determination of MDLs is described in laboratory SOP BR-QA-005.

12.2 Demonstration of Capabilities (DOC)

Each analyst must complete an Initial Demonstration of Capability prior to unsupervised performance of this method.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001 *Hazardous Waste*. The following waste streams are produced when this method is carried out.

- Organic Solvents - Satellite container: 55 Gallon Covered and Vented Drum.
- Extracted water samples - Satellite Container: 55 Gallon Covered and Vented Drum.

- Vials containing extracts - Satellite Container: 5 Gallon Covered Bucket (inside fume hood).
- Solid Waste - Satellite Container: Solid Waste 5 Gallon Plastic Bucket (inside fume hood).

15.0 References / Cross-References

- SW-846 Method 3550C, Revision 3, February 2007.
- Laboratory SOP BR-EX-017
- Laboratory SOP BR-QA-019
- Laboratory SOP BR-QA-005
- Laboratory SOP BR-QA-020
- Laboratory SOP BR-EH-001
- Corporate Environmental Health and Safety Manual

16.0 Method Modifications

There are no modifications of the referenced method.

17.0 Attachments

- Table 1: Primary Materials Used
- Appendix A: Terms and Definitions

18.0 Revision History

BR-EX-008, Revision 10.1

- Title Page: Updated approval signatures and copyright date.
- Section 6.1: Added Ultra High Purity Nitrogen to equipment list.
- Section 10.4: Added guidance for how to select concentration technique.

BR-EX-008, Revision 10

- Title Page: Updated approval signatures and copyright date.
- Section 7.1: Corrected methylene chloride formula to CH_2CI_2

BR-EX-008, Revision 9:

- Title Page: Updated approval signatures and copyright date.
- Section 6.3: Removed mechanical pipette from list.
- Section 10.1: Removed procedure to verify calibration of mechanical pipette.
- Section 10.3: Removed reference to Kimwipe and replaced with lint-free cloth.

BR-EX-008, Revision 8:

- Title Page: Updated method reference and approval signatures
- Section 2.0: Updated method reference to SW-846 3550C.
- Section 10.3: Changed the timing of the addition of surrogate and spike solutions from after the addition of sodium sulfate to before the addition of sodium sulfate.
- Section 15.0: Updated method reference to SW-846 3550C.

BR-EX-008, Revision 7:

- All Sections: Changed references from legacy system to TALS
- All Sections: Changed references from benchsheets to EX conditions spreadsheet
- All Sections: Fixed typographical errors
- Section 5.1: Removed vacuum system paragraph
- Section 6.1: Removed sonicator box
- Section 10.1 Addition of self calibrating sonicator note
- Section 10.3: Replaced sonicator box with fume hood sash

BR-EX-008, Revision 6:

- Section 6.3: Added vials.

Table 1: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and symptoms of exposure
Acetone	Flammable	1000 ppm-TWA	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.
Hexane	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Material[1]	**Hazards**	**Exposure Limit[2]**	**Signs and symptoms of exposure**
Acetone	Flammable	1000 ppm-TWA	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.

[1] *Always add acid to water to prevent violent reactions.*
[2] *Exposure limit refers to the OSHA regulatory exposure limit.*

Appendix A: Terms and Definitions

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Title: Diesel Range Organics by GC/FID (SW-846 8015B)

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1.0 Scope and Application

This SOP describes the analytical procedure used to determine the concentration of diesel range organics (DRO) in non-potable water, soil, sediment and waste. In the context of this SOP, DRO corresponds to the range of alkanes from C_{10} to C_{28}.

This SOP is applicable to the analytical procedure and does not include instructions for sample preparation or extraction. Sample preparation and extraction procedures are described in laboratory SOPs specific to the extraction technique employed.

This SOP describes the laboratory's routine analytical procedure and QC requirements for the test method.

Program or state specific requirements are not included in the SOP because these requirements do not apply to all jobs, vary between programs, are subject to frequent change, and/or may be mutually exclusive. Project specific or program specific QC requirements may be used in place of, or in addition to the requirements specified in this SOP when necessary.

Certain program requirements, such as Department of Defense (DOD) QSM or state specific requirements may be described in Program Requirement Summary (PRS). The PRS supplements and/or replaces procedures and/or QC requirements specified in this SOP when required. PRS are prepared by the QA department and issued to laboratory staff under controlled distribution to the electronic controlled distribution folder located in QA_Public folder.

The need to comply with the PRS shall be communicated by the PM with a method note or job comment in the TALS backlog. Analysts shall follow the instructions of the PRS when the requirement is specified for a job.

1.1 Analytes, Matrices, and Reporting Limits

This procedure may be used for a variety of matrices including: water, soil, sediment and waste.

The list of target compounds that can be determined from this method along with the associated reporting limits (RL) is provided in Table 1.

2.0 Summary of Method

Following solvent extraction a 2 uL aliquot of extract is injected onto a GC system equipped with a fused silica capillary column and a Flame Ionization Detector (FID). The GC system separates the organic compounds and detection is achieved by the FID.
This SOP is based on the following reference method:

- SW-846 Method 8015B Nonhalogenated Organics using GC/FID as applicable to the analysis of petroleum hydrocarbons including Diesel Range Organics (DRO), Revision 2, December 1996.

If the laboratory procedure is modified from the above reference method, a list of modifications will be provided in Section 16.0 of this SOP.

3.0 Definitions

A list of terms and definitions is provided in Appendix A.

4.0 Interferences

- Contaminated solvents, reagents or equipment can cause interferences. To reduce the occurrence of this type of interference, glassware used during the extraction process must be cleaned thoroughly before use following the procedure given in laboratory SOP BR-EX-017.

- Contamination by carryover is possible whenever high and low concentration samples are analyzed in sequence. To reduce the potential for contamination, set the syringe to rinse several times between injections. Samples are screened prior to analysis so that the proper dilution analysis is performed. Re-analysis is performed if carryover is suspected. Cleaning blanks may also be analyzed between samples at the discretion of the analyst.

- The FID is a non-selective detector, so there is a potential for interference from many non-target compounds.

- The chromatographic conditions in this method can result in significant column bleed and a resulting baseline rise. Baseline subtraction of the column bleed is employed by using the column compensation program on the GC.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

The gas chromatograph contains zones that have elevated temperatures. The analyst must be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

There are areas of high voltage in the gas chromatograph. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

5.2 Primary Materials Used

Table 2 lists those materials used in this procedure that have a serious or significant hazard rating along with the exposure limits and primary hazards associated with that material as identified in the MSDS. **NOTE: This list does not include all materials used in the method.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are instructed to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- Zero Air Generator
- Autosampler Vials, National Scientific or equivalent.
- Hydrogen Generator: Parker Balston
- Volumetric Syringes, Class "A" (10µl, 25µl, 50µl, 100µl, 250µl and 500µl), Hamilton or equivalent.
- Volumetric Flasks, Class "A" – appropriate sizes with ground glass stoppers.
- Helium

6.2 Analytical System

- Computer Hardware/Software: GC Acquisition Platform - VAX 4505 (GVAX) Multichrom V2.11. Data Processing - Hewlett-Packard 9000-series computers, an HP 9000 K200 (Chemsvr5)/ HP-UX 10.20 and Target V3.5 or higher.

- Hewlett Packard 5890 GC equipped with Flame Ionization Detector (FID) and an Auto-Sampler capable of a 2-µl injection split or equivalent.

- GC Column: RXI-5ms (30m x 0.25 mm ID x 0.25µm) or equivalent.

- Equivalent columns may be used so long as elution orders are documented and compound separations are maintained.

7.0 Reagents and Standards

7.1 Reagents

- Acetone, Ultra-Resi Analyzed: J.T. Baker or equivalent.

- Methylene Chloride, Ultra-Resi Analyzed: J.T. Baker or equivalent.

7.2 Standards

Purchase stock standard solutions from commercial vendors and from these prepare calibration and working standards by diluting a known volume of stock standard in an appropriate solvent to the final volume needed to achieve the desired concentration. The recommended formulation for each standard used in this procedure is provided in Appendix B along with the recommended source materials, expiration dates and storage conditions.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method.

Listed below are recommendations for minimum sample size, preservation and the method specified holding time requirement:

Matrix	Sample Container	Minimum Sample Size	Preservation	Extract Holding Time	Reference
Water	Glass	1 L	Chilled to 4°C	40 Days	SW-846 8015B
Solid	Glass	50 g	Chilled to 4°C	40 Days	SW-846 8015B

Analytical holding time is determined from date of initiation of extraction.

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 3
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 3
Matrix Spike(s) MS/MSD	Per Client Request	See Table 3
Sample Duplicate (SD)	Per Client Request	See Table 3

NOTE: Matrix spikes and sample duplicates indicate the effect of the sample matrix on precision and accuracy of results using the test method. Information from these QC are relevant only to the client's whose sample was used because matrix effects are sample and site-specific. These QC samples are performed when requested by the client and when the client provides sufficient sample volume. These QC samples are not used to judge laboratory performance. The method blank and LCS serve as the positive and negative controls for method performance by the laboratory. The laboratory does not perform LCS duplicates in lieu of MS/MSD because LCSD does not provide any information regarding matrix effects on precision or accuracy. Precision and bias of the test method in relation to laboratory performance is evaluated through demonstration of capability (DOC) and/or control charts.

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Table 3
Second Source Calibration Verification (ICV)	Once, after each ICAL	See Table 3
Continuing Calibration Verification (CCV)	every 10 samples	See Table 3
Retention Time Windows	As Needed	See Table 3

10.0 Procedure

10.1 Instrument Operating Conditions

Install a five meter deactivated guard column into the injection port and connect the guard column to the analytical column using a glass connector. Attach the analytical column to the FID.

The recommended instrument operating conditions are as follows:

Temperature Program:

Initial Temperature	50°C hold for 4 minutes
Program	50°C to 300°C at 20°C/min for 11 minutes
Final Temperature	300°C to 320°C, at 5°C/min, hold for 9.5 minutes
Carrier Gas:	Helium
Injector Temperature:	320°C
Detector Temperature:	330°C

10.2 Retention Time Window Establishment

DRO are distinguished on the basis of the retention time ranges for characteristic components in each type of fuel. The RT range for DRO is set during initial calibration based on retention times of the C_{10} to the C_{28} alkanes in the RT Standard.

The method recommends establishing retention time windows for $C_{10,}$ C_{28} and o-Terphenyl with the installation of each GC column by analysis of three standards over a 72-hour period. The mean RT and Standard Deviation (SD) are determined and the RT window is calculated as the mean RT $\pm$ 3SD. If the SD is <0.01 minutes, a default SD of 0.01 minutes may be used. If this procedure results in RT windows that are too narrow, favoring false negatives, the Technical Manager and the Department Manager may set a default RT window of $\pm$ 0.05 minutes centered around the C_{10} and C_{28} RT markers in the RT Standard and around the o-Terphenyl RT in the mid-level initial calibration standard.

10.3 Instrument Calibration

10.3.1 Initial Calibration (ICAL)

Initial Calibration

Prepare the calibration standards at a minimum of five different concentration levels using the formulations given in Appendix B.

Inject 2 µl of each of the calibration standards onto the system. The data processing system calculates the Calibration Factor (CF), mean CF, and Percent Relative Standard Deviation (%RSD).

The %RSD must be less than or equal to 20% in order to use the mean CF for quantification. If this criterion is not met, use an alternate quantification method for that analyte or correct the problem and repeat the calibration. Once a method of quantification is chosen, the same method of quantification must be used until a new calibration is performed.

Alternate Quantification Option:

Linear Regression: Generate a curve of concentration vs. response for each analyte and calculate the correlation coefficient. The calibration must have a correlation coefficient $r \geq 0.995$.

Non-Linear Regression (2nd Order): Generate a curve of concentration vs. response for each analyte and calculate the coefficient of determination (COD) r^2. The calibration model must have a COD $r^2 \geq 0.99$ and must include a minimum of 6 points.

10.3.2 Retention Time Standard (RT Standard)

Prepare the RT standard using the formulation in Appendix B. Analyze the RT standard to set the RT range.

10.3.3 Second Source Calibration Verification (ICV)

Verify the calibration with a second source standard. The second source standard must be prepared from a different manufacturer than the calibration standards unless only one manufacturer exists, in which case, the second source standard must be from a different lot than the lot used for the calibration standards.

Prepare the ICV using the formulation given in Appendix B. Inject 2 uL of standard onto the analytical system. The recovery of each analyte in the ICV must be within ± 20% of the expected value. The RT of the surrogate (o-Terphenyl) peak must be within the established RT window. If the criteria are not met, correct the problem and reanalyze the ICV. If reanalysis fails, repeat the calibration.

10.3.4 Continuing Calibration Verification (CCV)

Analyze the continuing calibration verification standard (CCV) at a concentration at or below the mid-range of the calibration each day before sample analysis, after every ten sample analyses, and at the end of each analytical sequence. The data system calculates the CF and percent difference for each analyte. The percent difference must be within ±15% and the RT of the surrogate (o-Terphenyl) peak must be within the established RT window.

NOTE: Use one of the mid-range calibration standards for the CCV.

If the results of the CCV are outside established acceptance criteria, a corrective action may be performed. If criteria are not met, stop work and recalibrate. Sample analysis may not proceed until the calibration has been verified.

Data with failing CCV may be usable and reportable under the following conditions:

- If the CCV result is biased high and there are no detections for the failing analytes in the sample, then the non-detects may be reported.

- If the CCV is biased low and the sample results for the failing analytes exceed a maximum regulatory limit or decision level, then the sample results may be reported.

Any sample result associated with a CCV failure must be qualified with a data flag.

NOTE: The conditions under which data may be reported may not be acceptable to all clients and/or regulatory programs and may only be used when not other requirement is specified. Always refer to the program requirements for which work is performed when making the decision to report data without corrective action.

10.3.5 Troubleshooting Guidance

- ICAL Failure: Perform injection port maintenance, install new guard column, check detector ends to see if detector jet has slipped. In extreme cases, install new columns, particularly if the chromatography has degraded as evidenced by peak shapes.

- CCV Failure: Perform Injection port maintenance. If injection port maintenance does not restore CCV, install a new guard column and remove one or more loops from each analytical column.

- Crushed Injection Needle: Replace the needle and check the injection port for obstructions and check the autosampler for misalignment.

- AutoSampler Failure: Reset the auto-sampler.

- Power Failure: Reset run and re-acquire or re-initiate run sequence.

10.4 Sample Preparation

Remove the sample extract from refrigerated storage and let it warm to room temperature.

Transfer ~100 uL of extract into an autosampler vial insert and cap the vial. Place the vials in the autosampler tray in order of the analytical sequence. See the next section for an example order.

Screen the extracts if they appear “dirty”, have a strong odor, or are suspected to contain high levels of DRO or other matrix interferences.

10.5 Sample Analysis

Scan the sample ID’s into the data acquisition program, place the samples on the autosampler in the order they were scanned and initiate the analytical sequence.

An example analytical sequence that includes initial calibration is provided in the following table:

Injection Number	Lab Description	
		Instrument Blank
		Instrument Blank
1	RT Standard	
2	ICAL Level 1	Diesel (100 ppm)
3	ICAL Level 2	Diesel (200 ppm)
4	ICAL Level 3	Diesel (500 ppm)
5	ICAL Level 4	Diesel (750 ppm)
6	ICAL Level 5	Diesel (1000 ppm)
7	ICV	
8-18	10 Samples	
19	CCV	
20-30	10 Injections	

31	CCV	
	Repeat	

11.0 Calculations / Data Reduction

11.1 Qualitative Identification

Target analytes are identified by the processing software using summed peak areas in the RT range established during the initial calibration sequence.

Manual integration of the hydrocarbon envelope is typically required to ensure a straight baseline from C_{10} to $C_{28.}$ The o-Terphenyl peak is skimmed out of the hydrocarbon envelope. All manual integration must be performed in accordance with laboratory SOP BR-QA-006 *Manual Integration*.

11.2 Quantitative Identification

The data system calculates the corrected concentration for each analyte from the calibration curve using the equations given in Appendix C. If sample interference is suspected, or if atypical patterns are observed, the observations are noted in the case narrative.

11.3 Calculations

Example calculations are provided in Appendix C. All calculations are performed by the laboratory's LIMS system, TALS, using equations embedded in the TALS software.

11.4 Data Review

11.4.1 Primary Review

Confirm qualitative and quantitative identification criteria using the criteria provided in Sections 11.1 and 11.2. If the data system does not properly integrate the peaks perform manual integration in accordance with laboratory SOP BR-QA-006.

Upload the data files from the data processing system to the laboratory information management system (TALS). Complete the batch information for standards and reagents and verify and set ICAL and QC sample associations. Review the results and set results to primary, secondary, acceptable or rejected as appropriate.

Dilute and reanalyze samples whose results exceed the calibration range. The dilution analysis should result in a determination within the calibration range, preferably in the upper half of the calibration range. A more concentrated analysis is not necessary unless the project requires it. Dilution analyses may also be performed to minimize matrix interference.

If a sample was analyzed immediately following a high concentration sample, review the results of the sample for any sign of carryover. If carryover is suspected, reanalyze the sample.

Review project documents to ensure requirements are met. If not, immediately notify the project manager (PM) to determine an appropriate course of action.

Create a non-conformance report (NCM) for any calibration, QC and sample data that is reported outside established acceptance criteria and/or schedule necessary corrective action. Set batch to 1st level review and complete the data review checklist.

11.4.2 Secondary Data Review

Verify quantitative and qualitative identification in the initial calibration standards and spot check such for ~15% of the remaining data in the batch.

If manual integrations were performed:

- Review each integration to verify that the integration meets the requirements for manual integration as specified in laboratory SOP BR-QA-006. If an error is suspected or found consult with the analyst that performed the integration and request correction or notify the Department Manager, Technical Manager or QA Manager. Do not "fix" the integration. Reintegration by a secondary data reviewer must not be performed except in limited circumstances as approved by the department supervisor or other laboratory management. If those instances where the secondary reviewer performs the integration, this person is now considered the primary analyst and each integration performed by the secondary reviewer must be subsequently reviewed by a peer analyst or the department supervisor to verify the integration is consistent and compliant with the requirements specified in laboratory SOP BR-QA-006.

- Check to ensure an appropriate technical reason code is provided for each manual integration. Acceptable technical reason codes are provided in laboratory SOP BR-QA-005.

- Print the Manual Integration Summary Report. Document your review of manual integrations on the summary report and obtain any review signatures of integrations performed during secondary review as required.

Review project documents such as the Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Verify that the acceptance criteria are met. If the results do not fall within the established limits verify the recommended corrective actions were performed. If not, initiate corrective actions and/or verify an NCM was created to document the criteria exception. Verify analytical results are qualified accordingly. Set samples to 2nd level review.

Run the LIMS QC Checker, investigate and correct any problems found. Run and review the deliverable. Fix any problems found then set the method chain to lab complete.

11.5 Data Reporting

The report deliverable and the application of data qualifiers is handled by TALS based on the TALS formatter set by the PM for each job.

The following default reporting scheme has been set for this method:

Results above the limit of quantitation (LOQ) or reporting limit (RL) are reported as the value found. Results between the limit of detection (LOD) and the LOQ or RL are reported as estimated. Results less than the LOQ and LOD are reported as non-detects to the LOQ or RL.

Electronic and hardcopy data are maintained as described in laboratory SOP BR-QA-014.

12.0 Method Performance

12.1 Limit of Detection (LOD) and Limit of Quantitation (LOQ)

Establish a LOD and LOQ at initial method set up following the procedures specified in laboratory SOP BR-QA-005. Verify the LOD and LOQ at the frequency established for the method using the procedures specified in same SOP. The frequency of LOD and LOQ verification depends on the frequency of the regulatory program for which the method supports. The frequency requirement is documented in a spreadsheet maintained by the QA Department.

12.2 Demonstration of Capabilities (DOC)

An IDOC is required when there is a change instrument type, personnel or method, and when the method has not been performed by the laboratory or analyst in a 12 month period. Each analyst that performs the test method must complete an IDOC prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter.

Refer to laboratory SOP BR-QA-011 for DOC requirements and procedures.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of the SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices conducted are consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001. The following waste streams are produced when this method is carried out.

- Vials containing sample extracts: Satellite container: 15 gallon bucket connected to a fume hood.
- Solvent Waste: Satellite container: 1 L glass bottle located in fume hood.

15.0 References / Cross-References

- SW-846 Method 8015B Nonhalogenated Organics using GC/FID as applicable to the analysis of petroleum hydrocarbons including Diesel Range Organics (DRO), Revision 2, December 1996.
- Laboratory SOP BR-QA-005
- Laboratory SOP BR-QA-011
- Laboratory SOP BR-EH-001
- Laboratory SOP BR-QA-014
- Laboratory SOP BR-QA-006
- Laboratory SOP BR-EX-017
- Laboratory Quality Assurance Manual BR-QAM
- Corporate Health and Safety Manual CW-E-M-001

16.0 Method Modifications

This laboratory procedure is modified from the reference method as follows:

Modification Number	Method Reference	Modification
1	8015B (7.6.5)	The method states that second column analysis is required when analytical interferences are indicated. The laboratory does not perform second column analyses for this method. If an analysis has an obvious interference or does not exhibit a typical fuel pattern, the observation is documented in the project narrative.
2	8015B (7.5.1)	The reference method states that calibration verification is performed by analyzing both the fuel standard and the RT standard. The laboratory does not analyze the RT standard with each CCV. The RT standard is only analyzed as part of the initial calibration sequence. RT drift is monitored by the surrogate RT in the CCV.

17.0 Attachments

- Table 1: Routine Target Analyte List & Reporting Limit (RL)
- Table 1A: Accuracy and Precision Limits
- Table 2: Primary Materials Used
- Table 3: QC Summary & Recommended Corrective Action
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: Equations

18.0 Revision History

BR-GC-004, Revision 14:

- Updated Title Page and Approval Signatures
- Section 9:0: Changed frequency for MS/MSD added explanatory NOTE.
- Section 10.0: Updated column type, temperature program and changed solvent. Changed CCV requirements to match TNI Standard. Clarified the analytical sequence.
- Section 11.0: Updated procedure to match TALS review process.

- Section 12.0: Updated DOC requirements to match TNI standard.
- Appendix B: Removed standard preparation tables and replaced with example formulary reports from TALS Reagent application.

BR-GC-004, Rev. 13

- Converted SOP to company format
- Updated approval signatures
- Added language on RT window establishment
- Removed all references to motor oil
- Updated standard information in Appendix B

Table 1: Routine Target Analyte List & Reporting Limit (RL)

Analyte	Routine Reporting Limit (RL)[1]	
	Water (mg/L)	Soil (mg/Kg)
C10-C28	0.10	6.7

[1]*The RL that can be achieved in a clean matrix assuming 100% solids for soils. Actual RL in sample will vary based on volume/mass extracted, extract final volume, dilution factor, percent moisture or other matrix interferences inherent to the sample.*

Table 1A: Routine Accuracy and Precision Limits[1]

	In-House Limits[2] (%R)		Precision (RPD) (≤)
	Water	Solid	
C10-C28	50-130	55-120	30
o-Terphenyl (Surrogate)	10-180	10-160	NA

[2] *In-House Control Limit Reference: 2012CC_Q2*

Table 2: Primary Materials Used

Material	Hazards	Exposure Limit[1]	Signs and symptoms of exposure
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.

[1] Exposure limit refers to the OSHA regulatory exposure limit.

Table 3: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action[1]
ICAL	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	CF: RSD $\leq$ 20% Linear Regression: r $\geq$ 0.995 ($r^2 \geq$ 0.99- 6 POINTS REQUIRED)	Correct problem, reanalyze, repeat calibration.
ICV	After each initial calibration	(% R) ± 20% from expected value o-Terphenyl RT must be within RT window	Correct problem and verify second source standard. If that fails, repeat initial calibration.
CCV	Daily before sample analysis, every 10 samples and at the end of the analytical sequence	% Difference or Drift ±15% o-Terphenyl RT must be within RT window	Re-analyze once, if still outside criteria perform corrective action, sequence can be re-started if two successive CCVs pass, otherwise repeat ICAL and all associated samples since last successful CCV. See Section 10.0
MB	One per extraction batch of 20 or fewer samples	Target Analyte < RL	Examine project DQO's and take appropriate corrective action, which may include re-analysis of MB, re-extraction of batch, and/or non-conformance report (NCR). Corrective action must be documented on NCR. If there are no detects in samples, or if all detects are > 10 X MB level, re-prep and reanalysis may not be required.
LCS	One per extraction batch of 20 or fewer samples	See Table 1A	Examine project DQO's and take appropriate corrective action, which may include re-analysis of LCS, re-extraction of batch, and/or non-conformance report (NCR). Corrective action must be documented on NCR. Flag all reported values outside of control limits.
MS/MSD SD	MS/MSD: Per extraction batch SD: Per client request	See Table 1A	Evaluate data and determine if a matrix effect or analytical error is indicated. If analytical error, re-analyze and/or re-extract. Flag all reported values outside of control limits.
Surrogate Spike	All field and QC samples	See Table 1A	Evaluate data and determine if a matrix effect or analytical error is indicated. If analytical error, re-analyze or re-extract. If matrix effect, review project DQOs to determine if a matrix effect must be confirmed by re-analysis. Flag all reported values outside of control limits.

[1]*The recommended corrective action may include some or all of the items listed in this column. The corrective action taken may be dependent on project data quality objectives and/or analyst judgment but must be sufficient to ensure that results will be valid. If corrective action is not taken or is not successful, data must be flagged with appropriate qualifiers.*

Appendix A: Terms and Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration Verification (ICV): solution prepared from a separate source from that which is used to prepare the calibration curve.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are only produced in this range and qualified with the proper data reporting flag when a project requires this type of data reporting.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Appendix B: Standard Preparation Information

Refer to the Formulary Reports appended to this SOP. The standard formulation reports are printed from the TALS Reagent Module and are attached to the SOP as PDF documents so they are not paginated.

Lab staff should use the formulary reports as the guide for standard preparation. The formulary report provides the name of the parent standard (source reagents); the vendor, the volume used, the solvent, solvent lot number, and the final concentration of the prepared standard. Keep in mind that if the concentration of the source reagents differ from those in the formulary report, the standard preparation procedure may need to be adjusted accordingly.

Prepare the standards using Class A volumetric glassware and glass syringes. Assign an expiration date of 6 months from date of preparation unless the parent standard expires sooner in which case use the earliest expiration date. Store the prepared solutions under refrigeration and protected from light at a temperature of 4ºC (±2). See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance.

Appendix C: Equations

Calibration Factor (CF_x)

$$CF_x = \frac{Peak\ Area_x}{Standard\ concentration_{\ mg/L}}$$

Mean Calibration Factor ($\overline{CF}$)

$$\overline{CF} = \frac{\sum_{i=1}^{n} CF_i}{n}$$

Where:
n = number of calibration levels

Standard Deviation of the Calibration Factor (SD)

$$SD = \sqrt{\frac{\sum_{i=1}^{n} \left(CF_i - \overline{CF}\right)2}{n-1}}$$

Where:
n = number of calibration levels

Percent Relative Standard Deviation (RSD) of the Calibration Factor

$$\text{Percent RSD} = \frac{SD}{\overline{CF}} \times 100\%$$

Where:
SD = Standard Deviation of the Calibration Factor
$\overline{CF}$ = Mean Calibration Factor

Percent Difference (%D)

$$\%D = \frac{CF_v - \overline{CF}}{\overline{CF}} \times 100\%$$

Where:
CF_v = Calibration Factor from the Continuing Calibration Verification (CCV)

Percent Drift

$$\text{Percent Drift} = \frac{\text{Calculated Concentration - Theoretical Concentration}}{\text{Theortical Concentration}} \text{ X } 100\%$$

Percent Recovery (%R)

$$\%R = \frac{C_s}{C_n} \times 100\%$$

Where:
C_s = Concentration of the Spiked Field or QC Sample
C_n = Nominal Concentration of Spike Added

Percent Recovery (%R) for MS/MSD

$$\%R \text{ for MS/MSD} = \frac{C_s - C_u}{C_n} \times 100\%$$

Where:
C_s = Concentration of the Spiked Sample
C_u = Concentration of the Unspiked Sample
C_n = Nominal Concentration of Spike Added

Relative Percent Difference (%RPD) - form 10

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100\%$$

Where:
C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Sample Concentration

Extract

$$C_{extract}\,(mg/L) = \frac{\text{Peak Area}}{\overline{CF}}$$

Water

$$C_{sample}\,(mg/L) = C_{extract}\,(mg/L) \times \frac{\text{extract volume (L)}}{\text{sample volume (L)}} \times DF$$

Soil

$$C_{sample}\,(mg/Kg) = C_{extract}\,(mg/L) \times \frac{\text{extract volume (L)}}{\text{sample volume (Kg)}} \times \frac{100}{\%\text{ solids}} \times DF$$

Where:
DF = Extract Dilution Factor. If no dilution was made, DF=1.

SOP Change in Progress Attachment (CIPA)

SOP Number	SOP Title	SOP Revision	SOP Effective Date	CIPA Effective Date
BR-MS-001	SVOCs by GC/MS (SW-846 8270D)	7	04/01/11	06/29/11

The following change(s) are made to this standard operating procedure (SOP). These changes are effective on the CIPA Effective Date. The change to this document is authorized and issued by the laboratory's QA Department.

Page 5 of 31: Section 9.0 Quality Control

Insert the following paragraphs:

Section 9.0 describes the requirements for routine sample and instrument QC. The acceptance criteria and recommended corrective actions specified in the SOP are the criteria used in the absence of project-specific criteria. If the project manager (PM) has specified the use of project specific criteria in the job's method or sample comment notes, use the criteria specified in the project for the evaluation of QC. Always check the method comments in your back log for any special project requirements.

Project-specific reporting limits and control limits for LCS/MS/MSD and ICV are entered into the TALS job by the PM and these limits are automatically used for the evaluation of QC in the TALS batch. Project specific criteria for initial calibrations (ICAL) and continuing calibrations (CCV), and blank evaluations or non-routine QC may not be set on a project-basis in the LIMS system. The LIMS will apply the routine criteria set in the SOP; therefore any time project criteria or frequency is specified for these QC; the evaluation must be performed at the bench. The PM is responsible for communication of any special project requirements to the bench and verification that project specifications were followed.

DoD: If the project is Department of Defense (DoD) and the project specifies use of the QSM acceptance criteria ("F" Tables); the PM will identify the need to follow the "F" tables in the job log-in. The "F" tables are posted to the controlled SOP directory which is accessed using the shortcut located on each laboratory PC or with the following pathway: QA_items\SOPS\SOPs_Controlled_Distribution\Program Summary\DOD.

The DoD program summary includes a copy of the DoD QSM, the "F" tables, which specify required QC, frequency, criteria and corrective actions, "Appendix G" which specifies control limits that are to be used when no other project limits are specified, a copy of the latest version of the QSM and other relevant information such as which methods the laboratory hold DoD ELAP accreditation, the corporate SOP for internal DoD approval, comparisons between different versions of the QSM, and frequently asked questions about the QSM.

Title: SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS (SW-846 8270D)

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1.0 Scope and Application

This standard operating procedure (SOP) describes the laboratory's analytical procedure used to determine the concentration of semivolatile organic compounds in extracts from a variety of matrices.

This SOP is applicable to the analytical procedure and does not include instructions for sample preparation or extraction. Sample preparation and extraction procedures are described in laboratory SOPs specific to the extraction technique employed.

1.1 Analytes, Matrix(s), and Reporting Limits

This procedure may be used for a variety of matrices including: water, soil, sediment, sludge, and tissue.

The list of target compounds that can be determined from this method along with the associated reporting limit (RL) is provided in Attachment 1.

NOTE: The following problems have been associated with compounds analyzed by this method: Benzidine, 3,3'-Dichlorobenzidine and 4-chloroaniline may be subject to oxidative losses during solvent concentration; hexachlorocyclopentadiene is subject to thermal decomposition in the inlet of the gas chromatograph, chemical reactions in acetone solution, and photochemical decomposition; and n-nitrosodiphenylamine decomposes in the gas chromatograph inlet forming diphenylamine and, consequently, is detected as diphenylamine. Likewise, 1,2-Diphenylhydrazine is detected as Azobenzene and surrogate Phenol-d6 is detected as Phenol-d5 due to decomposition during the GC/MS analysis.

2.0 Summary of Method

Following solvent extraction and extract cleanup as needed, 2 uL of extract is injected onto a GC system which uses a temperature program to separate the target compounds which are then detected by a mass spectrometer (MS). Target analytes are identified by comparison of their mass spectra with the electron impact (or electron impact-like) spectra of standards. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard using a five-point calibration curve.

This procedure is based on the following reference method:

- SW-846 Method 8270D, Revision 4, February 2007.

If the laboratory's procedure is modified from the reference method, a list of these modifications can be found in Section 16.0 of this SOP.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

- Contaminants in solvents, reagents, glassware, and other sample processing hardware may cause method interferences such as discrete artifacts and/or elevated baselines in the

extracted ion current profiles (EICPs). All of these materials must be routinely demonstrated to be free from interferences under the conditions of the analysis by running laboratory method blanks. Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source.

- Injection syringes should be adequately flushed with solvent between injections in order to remove all traces of the prior sample.

- Contamination by carryover is possible whenever high and low concentration samples are analyzed in sequence. Samples are screened prior to analysis so that the proper dilution analysis is performed. Re-analysis is performed if carryover is suspected.

- Co-extracted Interferences may include lipids, polymers, copolymers, proteins, natural resins, cellular components, viruses, steroids, and high-molecular weight compounds. GPC, which is size exclusion chromatography, is appropriate for cleanup of these types of polar and non-polar interferences.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

Latex and vinyl gloves provide no protection against the organic solvents used in this method. Nitrile or similar gloves must be used.

The gas chromatograph and mass spectrometer contain zones that have elevated temperatures. The analyst needs to be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

There are areas of high voltage in both the gas chromatograph and the mass spectrometer. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

5.2 Primary Materials Used

Table 1 lists those materials used in this procedure that have a serious or significant hazard rating along with the exposure limits and primary hazards associated with that material as identified in the MSDS. **NOTE: This list does not include all materials used in the method.** A complete list of materials used in the method can be found in the reagents and materials

section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

2 mL Autosampler vials with 200 uL inserts, PFTE crimp top, National Scientific or equivalent.
4 mL sample vials with PFTE lined screw top caps, National Scientific or equivalent
Volumetric Syringes, Class “A”, Assorted sizes, Hamilton or equivalent.

6.2 Computer Hardware/Software

- GCMS Acquisition Platform - Hewlett-Packard ChemStation.
- Data Processing - Hewlett-Packard 9000-series computers, HP 9000 K200 (Chemsvr6)/ HP-UX 10.20 and Target V3.5.

6.3 Instrumentation

- SVOA Autosampler: HP7673A™, CTC A200S™ or equivalent.
- Gas Chromatograph: Hewlett-Packard™ 5890 GC, 6890 GC or equivalent.
- Mass Spectrometer: Hewlett-Packard™ 5971 MSD, 5972 MSD, 5973 MSD and 5975 MSD or equivalent.
- Primary Column, Crossbonded, 5% diphenyl – 95% dimethyl polysiloxane, 30 m x 0.25 mmID x 0.25 um film thickness: Restek™ RXi-5ms or equivalent.
- Guard Column: Restek™ Deactivated 5m x 0.25 mm ID or equivalent.
- Column unions: Restek Press-Tights™ or equivalent.
- Injection port liners: Single Goose Neck, borosilicate glass. Restek™ 20799 or equivalent.
- Injection Port Septa: HP™, 11 mm Thermo Red or equivalent.
- Data System: Hewlett-Packard Chem server™, Target 3.5 processing software and Hewlett-Packard ChemStation software for instrument control and acquisition

7.0 Reagents and Standards

7.1 Reagents

- Acetone: Pesticide Residue Analysis Grade, JT Baker or equivalent.
- Methylene Chloride (CH_2Cl_2): Pesticide Quality, J.T. Baker or equivalent.
- Methanol (MeOH): Pesticide Quality, J.T. Baker or equivalent.
- Hexane (CH_3 $(CH_2)_4CH_3$): Pesticide Quality, J.T. Baker or equivalent.
- Toluene ($C_6H_5CH_3$): Pesticide Quality, J.T. Baker or equivalent.

7.2 Standards

Purchase stock standard solutions from commercial vendors. Prepare calibration and working standards by diluting a known volume of the purchased stock standard in an appropriate solvent to the final volume needed to achieve the desired concentration. The recommended formulation for each standard used in this procedure is provided in Appendix B along with the recommended source materials, expiration dates and storage conditions.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method. Listed below are the laboratory recommended minimum sample size, preservation and holding time requirements:

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time	Reference
Tissue	Amber glass jar	30 grams	Chilled to <4°C or frozen	Analytical: 40 days	SW-846 Chapter 4
Soil, Sludge, Sediment	Amber glass jar	50 grams	Chilled to <4°C	Analytical: 40 days	SW-846 Chapter 4
Water	Amber glass bottle	1 Liter	Chilled to <4°C	Analytical: 40 days	SW-846 Chapter 4

Analytical holding time is determined from date of initiation of extraction.

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 3
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 3
Matrix Spike(s) MS/MSD	Client Request	See Table 3
Sample Duplicate (SD)	Client Request	See Table 3

Surrogate spikes are added to all field and QC samples before preparation and/or analysis to assess the effect of the sample matrix on the accuracy of the method in the specific sample matrix.

Internal standards are added to all field and QC samples prior to analysis.

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
DFTPP	Daily	See Table 3
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Section 10.0
Second Source Calibration Verification (ICV)	Once, after each ICAL	See Table 3
Continuing Calibration Verification (CCV)	Daily, following a passing DFTPP	See Section 10.0

10.0 Procedure

10.1 Instrument Operating Conditions

Gas Chromatography/Mass Spectrometry: Set the instrument to acquire and store analytical data over the nominal mass range of 35-500 atomic mass units (amu) with a total cycle time (including scan overhead time) of one second per scan at 70 electron volts. Adjust the cycle time to measure five or more spectra during the elution of each GC peak.

A typical GC temperature program used by the laboratory is as follows:

Initial Temperature:	40°C for 2 minutes.
Temperature Program:	40°C to 320°C at 14°/min.
Final Temperature:	320°C for 5.6 min or until Benzo (g,h,i) perylene has eluted
Injector Temperature:	250°C
Transfer Line Temperature:	300°C
Injector:	Grob-like, splitless
Injection volume:	2 µL
Carrier Gas:	Helium

10.2 Tune Standard (DFTPP)

To initiate the analytical sequence inject a 2 µL aliquot of DFTPP (25 µg/mL) into the GC. The data processing system acquires and averages three scans (apex scan, scan prior, and scan following) and performs background subtraction of the single scan prior to the elution of the DFTPP. The results of the DFTPP must meet the tune criteria given in Table 2 before further analysis can proceed. If criteria are not met, retune the instrument.

The 12-hour analytical window begins at the time of injection of the tune standard. The injection of all samples and standards must be within 12 hours of the injection of the DFTPP. After 12 hours has elapsed initiate a new analytical window with analysis of another tune standard.

10.3 Column Performance and Injection Port Inertness Check

Evaluate the tune standard for GC column performance and injection port inertness. The degradation of DDT to DDE and DDD should not exceed 20 and benzidine and pentachlorophenol should be present at their normal responses and should not exceed a tailing factor of 2. If degradation is excessive and/or poor chromatography is noted perform instrument maintenance.

10.4 Instrument Calibration

10.4.1 Initial Calibration (ICAL)

Calibrate the instrument with a minimum of five calibration standards for each target analyte at concentrations that span the working range of the method. To accomplish this for the complete target analyte list, analyze eight ICAL standards at the recommended concentrations of 10, 25, 40, 50, 60, 70, 80, and 160 ng/uL. These values are equivalent to an on column concentration of 20, 50, 80, 100, 120, 140, 160, and 320 ng per 2 uL injection. Although eight standards are analyzed, not every standard is used for the calibration of each analyte. Each analyte has been assigned to an analyte group that includes a calibration range of at least five levels. The analyte group associations for each target analyte are provided in Table 1; the calibration range for each analyte group is as follows:

- Group A: This analyte group is associated with a seven point calibration curve. The calibration range is 10 to 80 ng/uL or 20 to 160 ng on column. The limit of quantitation (LOQ) for this group of analytes is 10 ng/uL (20 ng on column).

- Group B: This analyte group is associated with a six point calibration curve. The calibration range is 25 to 80 ng/uL or 50 to 160 ng on column. The limit of quantitation (LOQ) for this group of analytes is 25 ng/uL(50 ng on column).

- Group C: This analyte group is associated with a seven point calibration curve. The calibration range is 25 to 160 ng/uL or 50 to 320 ng on column. The limit of quantitation (LOQ) for this group of analytes is 25 ng/uL(50 ng on column).

Prepare each calibration standards in an autosampler vial using the formulations found in Appendix B. The final internal standard concentration in extract will be 20 ng/uL.

Inject 2 uL of each standard onto the instrument system. The data processing system acquires and calculates the mean Response Factor (RF), the Standard Deviation (SD) and the Percent Relative Standard Deviation (%RSD) for each analyte and surrogate compound. See Appendix C for the equations.

The following criteria must be met for a calibration to be considered acceptable. If criteria are not met, perform corrective action prior to further analysis. Recommended corrective actions are provided in Table 3.

- The minimum response factor (RF) must listed in the tables in Attachment 1 must be met for each analyte in each level of the ICAL. If the RSD is not met for any analyte, analyzed an RLCCV in each analytical batch to demonstrate sensitivity at the quantitation limit and a NCM is required to document the situation.

- The %RSD for each analyte must be less than 20%. If this criterion is not met for any analyte an alternative curve fit must be used for the analytes that fail criteria as follows:

  Use linear regression as the alternative curve fit. The regression coefficient (r^2) must be greater than 0.990 and the read back of the ICAL standard equal to the RL for each analyte must be within 30% of the expected value. To obtain the percent recovery, quant the low standard as a sample. If this criterion is not met, the curve may be evaluated using a quadratic curve or the compound may be quantitated using average response factor but if minimum RF is used the compound must be reported as estimated and the situation must

be documented with an NCM. If quadratic fit is used, the regression coefficient (r^2) must be greater than 0.990.

If an alternative curve fit is not performed; all sample results associated with the analyte that failed the %RSD criteria must be qualified and reported as estimated values.

- If more than 10% of the analytes in the calibration do not meet both %RSD criteria and the (r^2) criteria, the instrument must be recalibrated.

Note: SW-846 does not specify a cap for an individual analyte's %RSD. However, no individual analyte should exceed 60% RSD. If any analyte exceeds 60%RSD, the instrument should be recalibrated.

10.4.2 Second Source Calibration Verification (ICV)

Verify the calibration with a second source standard. The second source standard must be prepared from a different manufacturer than the calibration standards unless only one manufacturer exists, in which case, the second source standard must be from a different lot than the lot used for the calibration standards.

Prepare the ICV solution (50 ng/uL) using the formulations provided in found in Appendix B. The final internal standard concentration in extract will be 20 ng/uL. Inject 2 uL of the ICV onto the instrument system. Acquire the data and evaluate the results.

The percent recovery of the ICV must be ±30% of the expected value for each analyte. If this criterion is not met, correct the problem and reanalyze the ICV. If the reanalysis fails, remake the calibration standards and recalibrate.

NOTE: If after successful analysis of the ICV time remains in the 12-hour analytical window samples may be analyzed without analysis of a CCV; otherwise a CCV must be performed.

10.4.3 Continuing Calibration Verification (CCV)

Analyze a continuing calibration verification standard (CCV) immediately after the daily tune standard or the ICV. The concentration of the CCV should be at or near the mid-point of the calibration range for each analyte.

Inject 2 uL of the prepared CCV standard(s), acquire the data and evaluate the results. The data processing system calculates the RF and percent difference or drift for each target analyte and surrogate.

Evaluate the minimum RF against those listed in the table provided in Attachment 1. If criteria are not met, perform corrective action. Possible causes may include degradation of standards, injection port inlet contamination and/or active sites in the column or in the chromatographic system.

The %D must be <20% for 80% of the analytes included in the calibration. If more than 20% of anlaytes do not meet criteria, calibration verification fails and reanalysis is required. Note: the laboratory may set wider %D criteria for poor performing analytes but the number of analytes

with criteria greater than 20%D must not exceed 10% of the total number of analytes included in the calibration.

If less than 20% of analytes in the CCV exceed the %D criteria, analyze an RLCCV (CCV at the concentration of the RL). Analytes that do not meet the %D criteria may be reported if those anlaytes are qualitatively detected in the RLCCV. Report analytical results as follows:

If the analyte that does not meet criteria in the CCV is not detected in the field sample; report the analytical result for the analyte without qualification.

If the analyte that does not meet criteria in the CCV is detected in the filed, report the analytical result as an estimated value and document the exception with a NCM.

Troubleshooting:

Check the following items in case of calibration failures:

- Benzidine is subject to oxidative loss during extraction and chromatographs poorly, injection port and/or column maintenance may be required.
- Hexachlorocyclopentadiene is subject to thermal decomposition in the inlet, injection port and/or column maintenance may be required.
- N-nitrosodiphenylamine decomposes in the inlet and cannot be separated from diphenylamine. Compound is reported as N-nitrosodiphenylamine.
- 1,2-Diphenylhydrazine decomposes to Azobenzene in the analytical portion of the procedure and as such is reported as Azobenzene.
- Acid compounds are subject erratic chromatographic behavior, especially if the GC system is contaminated with high boiling material, injection port and/or column maintenance may be required.
- Loss of sensitivity for higher boiling compounds and internal standards may be indicative of a leak at the inlet. Replace septa and/or re-tighten lower inlet connection.
- Carryover contamination may indicate empty rinse vials.

10.5 Screen Procedure

At the discretion of the laboratory, sample extracts may be screened prior to analysis with a GC-FID or a GC/MS system. To calibrate the screen instrument: analyze an instrument blank, a surrogate standards that includes surrogates at a concentration of 5 ng/uL, and a standard that contains target analytes at a concentration of 8 ng/ uL.

10.6 Analysis

Remove the extracts from storage and let them warm to room temperature. Transfer 100 uL of extract to a 1 mL auto-sampler vial with insert. Add 4 uL of the internal standard solution to each vial and seal the vial with a PTFE lined crimp top cap. If a different extract volume is used (e.g. 50 uL), adjust the internal standard volume proportionately (2 uL of IS).

If the extract was screened and the screen results indicate a primary dilution is required, dilute the extract in methylene chloride. If the relative volumes needed for a single dilution step exceed the accuracy of the syringes, perform serial dilutions. For example, if a sample requires a 0.1% analysis in order to have target constituents within the upper half of the calibrated range, 0.1 uL of a 100 uL extract aliquot is needed to perform the dilution but the

gradations of the syringe are to 0.2 uL. In this instances, perform a serial dilution of 1:100 (1.0%) and 10:100 (10%) to achieve an analysis concentration of 0.1%.

Arrange the samples in a sequence that begins with the calibration standards followed by the analysis of QC samples, field samples, and continuing calibration verification standards (CCVs).

An example analytical sequence for our routine compound list that includes initial calibration (ICAL) is provided below.

Injection Number	Lab Description
1	DFTPP Tune Standard
2	ICAL 7 (SSTD 160)
3	ICAL 6 (SSTD 140)
4	ICAL 5 (SSTD 120)
5	ICAL 4 (SSTD 100)
6	ICAL 3 (SSTD 080)
7	ICAL 2 (SSTD 050)
8	ICAL 1 (SSTD 020)
9	ICAL 8 (SSTD 320)
10	ICV (SSTD 100 ICV)*
11	DFTPP Tune Standard
12	CCAL 3 (SSTD 080)
	12 hour window of samples
1	DFTPP Tune Standard
2	CCAL 3 (SSTD 080)
	12 hour window of samples
	Continue until a new calibration is needed.

*If additional analytes are requested, a separate calibration is analyzed after the initial calibration noted above and before ICV and sample analysis begins.

Enter the sample ID's into the data acquisition program in the order the samples were placed in the autosampler and initiate the analytical sequence.

11.0 Calculations / Data Reduction

11.1 Qualitative Identification

The data system tentatively identifies target analytes by comparing the retention time of the peaks to a window set around the daily calibration standard, and searches in that area for the primary and up to two secondary ions characteristic of the target analyte. Tentative identifications made by the computer are reviewed and either accepted or rejected by the analyst using the following criteria:

- The target analyte is identified by comparison of its background subtracted mass spectrum to a reference spectrum in the user-created database. In general, all ions that are present above 10% relative abundance in the mass spectrum of the standard should be present in the mass spectrum of the sample component and their relative abundances should agree within 20%. For example, if an ion has a relative abundance of 30% in the standard spectrum, its abundance in the sample spectrum should be in the range of 10-50%. Some

ions, particularly the molecular ion, are of special importance if a tentative identification is to be made, and should be evaluated even if they are below 10% relative abundance.

- The GC retention time for the target analyte should be within 0.06 RRT units of the daily standard.

Identification is hindered when components are not chromatographically resolved from interfering analyte peaks or non-target constituents (background). When chromatographic peaks obviously indicate contribution from more than one component (broadened peak with shoulder(s) or a valley between two or more maxima), examine the EICPs to select the appropriate analyte spectra over the entire peak and use selective background subtraction in order to positively identify target analytes and account for extraneous ions. For coeluting compounds, the identification criteria will be met, but the analyte spectrum will contain extraneous ions contributed by the coeluting compound.

Structural isomers that produce very similar mass spectra can be explicitly identified only if they have sufficiently different GC retention times. Acceptable resolution is achieved if the height of the valley between two peaks is less than 25% of the average height of the two peaks. Otherwise, structural isomers are identified as isomeric pairs.

Complex environmental matrices, baseline upsets, coelution and peak shape variation can complicate automatic data system integration causing inaccurate and/or missed identification that should be corrected with manual integration. To assure accurate qualitative identification, optimize the data system integration parameters to ensure consistency in integration between standards and sample and evaluate each chromatogram to verify the identification for each target analyte.

11.1.1 Tentatively Identified Compounds (TICs)

If TICs are requested, perform the library search, and visually compare the sample spectra with the nearest library search and assign a tentative identification. The library search should not include peaks that are <10% of the nearest internal standard, target analytes, or peaks that elute earlier than 30 seconds before the first target analyte.

Use the following criteria to qualitatively identify the TIC compounds:

- Relative intensities of ions greater than 10% of the most abundant ion in the reference spectrum should be present in the sample spectrum.

- The relative intensities of the major ions should agree within ± 20%.

- Molecular ions present in the reference spectrum should be present in the sample spectrum.

- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

TICs identified by the automated processing system with a quality match of 85% or greater may be left as identified by the system. TICs with matches less than 85% may be marked as “Unknown”. Further compound classification is <u>not</u> routinely performed.

11.2 Quantitative Identification

The data system quantifies the concentration of the target compound based on the integrated abundance of the characteristic ion from the EICP using the equations given in Appendix C. If there is matrix interference with the primary ion, a secondary ion may be used for quantification by calculating a mean RF factor for that ion and using that ion to quantify the analyte in the sample. When secondary ion calculations are performed, initiate a nonconformance memo (NCM) to ensure the quantitation approach is reported in the project narrative.
The data system calculates TIC concentrations using an RF of 1.00 and the equations given in Appendix C.

11.3 Calculations

See Appendix C.

11.4 Data Review

11.4.1 Primary Review

Review project documents to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Confirm qualitative and quantitative identification criteria using the criteria provided in Sections 11.1 and 11.2. If the data system does not properly integrate the peaks perform and document manual integration in accordance with laboratory SOP BR-QA-006.

Upload the data files from the data processing system to the laboratory information management system (TALS). Complete the batch information for standards and reagents and verify ICAL and QC sample associations. Review the results and set results to primary, secondary, acceptable or rejected as appropriate. Dilute and reanalyze samples whose results exceed the calibration range. The dilution analysis should result in a determination within the calibration range, preferably in the upper half of the calibration range. A more concentrated analysis is not necessary unless the project requires it. Dilution analyses may be performed to minimize matrix interference.

If a sample was analyzed immediately following a high concentration sample, review the results of the sample for any sign of carryover. If carryover is suspected, reanalyze the sample.

Create a non-conformance report (NCM) for any calibration, QC and sample data that is reported outside established acceptance criteria and/or schedule necessary corrective action. Set batch to 1st level review and complete the data review checklist.

The following analytes have been identified as poor performing analytes in some matrices based on statistical data. Consequently corrective action will not be taken when LCS or MS/MSD recovery is not within established limits for these analytes. Initiate a NCM to document the exceedance and indicate poor performing analyte as the justification for not taking corrective action.

Poor Performing Analytes

Analyte	
Water	**Soil**

4-Nitrophenol	3,3'-Dichlorobenzidine
Benzoic Acid	4-Chloroaniline
Phenol	Benzoic Acid
Phenol-d5	Aniline
Benzidine	Benzidine
2-Chlorobenzoic Acid	2-Chlorobenzaldehyde
Hexachlorocyclopentadiene	2-Chlorobenzoic Acid
Pyridine	3-Chlorobenzaldehyde
	4-Chlorobenzaldehyde
	Pyridine

11.4.2 Secondary Data Review

Verify quantitative and qualitative identification in the initial calibration standards and spot check such for ~15% of the remaining data in the batch.

If manual integrations were performed:

- Review each integration to verify that the integration meets the requirements for manual integration as specified in laboratory SOP BR-QA-006. If an error is suspected or found consult with the analyst that performed the integration analyst and request correction or notify the Department Manager, Technical Director or QA Manager. Do not "fix" the integration. Reintegration by a secondary data reviewer must not be performed except in limited circumstances as approved by the department supervisor or other laboratory management. If those instances where the secondary reviewer performs the integration, this person is now considered the primary analyst and each integration performed by the secondary reviewer must be subsequently reviewed by a peer analyst or the department supervisor to verify the integration is consistent and compliant with the requirements specified in laboratory SOP BR-QA-006.

- Check to ensure an appropriate technical reason code is provided for each manual integration. Acceptable technical reason codes are provided in laboratory SOP BR-QA-005.

Review project documents to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Verify that the acceptance criteria for the calibration and QC items listed in Table 1 were met. If the results do not fall within the established limits verify the recommended corrective actions were performed. If not, initiate corrective actions and/or verify an NCM was created to document the criteria exception. Verify analytical results are qualified accordingly. Set batch to 2nd level review and complete the data review checklist.

11.5 Data Reporting

The report format, application of data qualifiers and creation of the data deliverable is performed by the LIMS using the formatter set by the project manager during log-in.

Records of electronic and hardcopy data are maintained as described in laboratory SOP BR-QA-014.

12.0 Method Performance

12.1 Limit of Detection (LOD) and Limit of Quantitation

Establish a LOD and LOQ at initial method set up following the procedures specified in laboratory SOP BR-QA-005. Verify the LOD and LOQ at the frequency established for the method using the procedures specified in same SOP. The frequency of LOD and LOQ verification depends on the strictest frequency of the regulatory program for which the method supports. The frequency requirement is documented in a spreadsheet maintained by the QA Department.

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when time there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in the laboratory SOP BR-QA-011.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001 *Hazardous Waste*. The following waste streams are produced when this method is carried out.

- Vials containing sample extracts - Satellite Container: 30 gallon waste drum
- Methylene Chloride solvent waste - Satellite Container: 40mL vials and 4L bottle.

15.0 References / Cross-References

- Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (Method 8270D), Revision 4, February 2007
- Laboratory SOP BR-QA-005
- Laboratory SOP BR-QA-011
- Laboratory SOP BR-EH-001
- Laboratory SOP BR-QA-014
- Laboratory SOP BR-QA-006 Manual Integration Requirements
- Laboratory Quality Assurance Manual (QAM)
- DoD QSM

16.0 Method Modifications

Modification Number	Method Reference	Modification
1	8270D Sec. 7.4.2 and 7.7.2	The laboratory does not store standards at 6 °C (–10 °C recommended). All standards are stored at the recommendations of the manufacturer prior to initial use and then at 4 °C once prepared.
2	8270D Sec. 8.2	The laboratory does not store sample extracts at 6 °C. All extracts are stored at 4 °C once prepared.
3	8270D Sec. 11.5.2	4uL of internal standard is added to 100uL of sample extract just prior to analysis.

17.0 Attachments

- Table 1: Primary Materials Used
- Table 2: Tune Standard Criteria
- Table 3: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action
- Appendix A: Standard Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: Equations
- Attachment 1: SW-846 8270D Method Information

18.0 Revision History

BR-MS-001, Revision 7:

Title Page: Updated method reference and approval signatures
Section 1: Updated method reference
Section 10.0: Updated criteria for ICAL and CCV to conform to 8270D requirements.
Section 15.0: Updated method reference.
Section 16.0: Updated method reference.
Section 18.0: Removed tables to Attachment 1
Table 3: Updated acceptance criteria or ICAL and CCV

Table 1: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and Symptoms of Exposure
Toluene	Flammable Poison Irritant	200 ppm-TWA 300 ppm-Ceiling	Inhalation may cause irritation of the upper respiratory tract. Symptoms of overexposure may include fatigue, confusion, headache, dizziness and drowsiness. Peculiar skin sensations (e. g. pins and needles) or numbness may be produced. Causes severe eye and skin irritation with redness and pain. May be absorbed through the skin.
Methanol	Flammable Poison Irritant	200 ppm-TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Hexane	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Acetone	Flammable	1000 ppm-TWA	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.

[1] Always add acid to water to prevent violent reactions.
[2] Exposure limit refers to the OSHA regulatory exposure limit.

Table 2: DFTPP Key Ions and Abundance Criteria

Mass	Ion Abundance Criteria
51	10-80% of Base Peak
68	<2% of mass 69
69	Present
70	<2% of mass 69
127	10-80% of Base Peak
197	<2% of mass 198
198	Base peak, or >50% of mass 442
199	5-9% of mass 198
275	10-60% of Base Peak
365	>1% of mass 198
441	Present but less than 24% of mass 442
442	Base peak, or >50% of mass 198
443	15-24% of mass 442

Table 3: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action

QC	Minimum Frequency	Acceptance Criteria	Recommended Corrective Action[1]
Tune Standard	Prior to initial calibration and every 12 hours	See Table 4	Reanalyze, retune mass spectrometer; no samples may be analyzed without a valid tune.
Breakdown Check	Daily prior to sample analysis	Degradation of DDT should not exceed 20%	If degradation is excessive and/or poor chromatography is noted, the injection port may require cleaning. It may also be necessary to break of the first 6 to 12 in. of the capillary column. The use of a guard column between the injection port and the analytical column may help prolong analytical column performance life.
ICAL	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	See Section 10.0	Correct problem then repeat calibration, no samples may be analyzed until criteria are met.
ICV	Immediately after each initial calibration	% Recovery within ±30% of expected value	Correct problem and verify second source standard. Reanalyze. If that fails, repeat initial calibration; no samples should be analyzed without an acceptable ICV.
CCV	Beginning of each 12-hour window after the tune standard	See Section 10.0	Correct problem then repeat CCV, no samples may be analyzed until criteria are met. If problem cannot be corrected by other measures, a new calibration must be generated.
MB	One per extraction batch of 20 or fewer samples	Routine: < RL (See Attachment 1)	Examine project DQO's and take appropriate corrective action, which may include re-analysis of MB, re-extraction of batch, and/or non-conformance report (NCR). Corrective action must be documented on NCR. If there are no detects in samples, or if all detects are > 10 X MB level, re-prep and reanalysis may not be required.
LCS	One per extraction batch of 20 or fewer samples	%R within limits (See Attachment 1)	Examine project DQO's and take appropriate corrective action, which may include re-analysis of LCS, re-extraction of batch, and/or non-conformance report (NCR). Corrective action must be documented on NCR. Flag all reported values outside of control limits.
MS/MSD	One per extraction batch of 20 or less samples.	%R within limits (See Attachment 1)	Evaluate data and determine if a matrix effect or analytical error is indicated. If analytical error, re-analyze and/or re-extract. Flag all reported values outside of control limits.
Surrogate Standard	All field and QC samples	%R within limits (See Attachment 1)	Evaluate data and determine if a matrix effect or analytical error is indicated. If analytical error, re-analyze or re-extract. If matrix effect, review project DQOs to determine if a matrix effect must be confirmed by re-analysis. Flag all reported values outside of control limits.
Internal Standard	All field and QC samples	EICP area between -50% to +100% of area of daily calibration internal standard area. RT ± 30 seconds from RT of midpoint of ICAL.	Inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

Appendix A: Terms and Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Internal Standard: a known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are not produced in this range.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Appendix B: Standard Preparation Tables

The standard formulations contained in this Appendix are recommended and are subject to change. If the concentration of the stock standard is different than those noted in this table, adjust the standard preparation formulation accordingly. Unless otherwise specified, prepare the standard solutions in methylene chloride using Class A volumetric glassware and Hamilton syringes. Unless otherwise specified for a standard solution, assign an expiration date of 6 months from date of preparation unless the parent standard expires sooner in which case use the earliest expiration date. Record the preparation of the solutions in the LIMS reagent module.
See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance.

ISTD Mix

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Conc. (ug/mL)
SV Internal Standard Mix	Restek (31006)	4000	1000	8.0	500

Decafluorotriphenylphosphine (DFTPP) Solution

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (ug/mL)
SV GC/MS Tuning Standard	Ultra Scientific (GCM-150)	1000	400	16.0	25

8270 Calibration Stock Solution

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (mL)	Final Volume (uL)	Final Concentration (ug/mL)
8270 MegaMix	Restek (31850)	1000	1240	7440	167
Custom Rev. AP9 Adds w/ Benzoic Acid	Restek (564928)	1000	1240		

Benzidines Added Solution

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (ug/mL)
8270 Benzidines Mixture	Restek (31852)	2000	1000	2.0	1000

OLM04 Added Solution

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (ug/mL)
CLP SOW OLM 04 Semi-volatiles Mix	Supelco/Sigma-Aldrich (47514-U)	2000	1250	2.5	1000

320 Acid Solution

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/L)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
Custom 2-Chlorobenzoic Acid	Restek (562264)	5000	800	2.0	2000
Benzoic Acid	Restek (31879)	2000	1000		1000

MASOGD Added Solution

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/L)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
Custom 2-Chlorobenzoic Acid	Restek (562264)	5000	128	4.0	160
Custom MMR 1	Restek (562265)	1000	320		80
Custom MMR 2	Restek (562266)	1000	320		

Appendix IX Mix A

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (ug/mL)
Acid Surrogate Standard Mix (3/90)	Restek (31073)	7500	42.67	4.0	80
8270 Calibration Mix #1	Restek (31618)	2000	160		
8270 Calibration Mix #3	Restek (31620)	2000	160		
8270 Calibration Mix #4	Restek (31621)	2000	160		
8270 Calibration Mix #6	Restek (31623)	2000	160		
Custom AP9 Mix A	Restek (565078)	2000	160		

Appendix IX Mix B

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (ug/mL)
B/N Surrogate Standard Mix (3/90)	Restek (31072)	5000	64	4.0	80
8270 Calibration Mix #2	Restek (31619)	2000	160		
8270 Calibration Mix #5	Restek (31622)	2000	160		
Appendix IX Mix #1	Restek (31625)	2000	160		
Ethyl Methacrylate	Restek (30289)	2000	160		
CLP SOW OLM 04 Semi-volatiles Mix	Supelco/Sigma-Aldrich (47514-U)	2000	160		

8270 ICV Solution

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (ug/mL)
BNA Mix	NSI Solutions (C-701)	1000	400	4.0	100
Benzoic Acid	NSI Solutions (541)	5000	80		
Benzo(e)pyrene	Absolute (71016)	1000	400		
Perylene	Absolute (70471)	1000	400		

Benzidines Added ICV Solution

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (uL)	Final Concentration (ug/mL)
Benzidines Mix	NSI Solutions (C-402)	2000	1250	2500	1000

OLMO4 Added ICV Solution

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (uL)	Final Volume (mL)	Final Concentration (ug/mL)
CLP BNA Additionals Mix	NSI Solutions (C-601)	2000	1000	2.0	1000

8270C Routine Working Calibration Standard Preparation

Sample Type	Final Conc. (ng/uL)	Calibration Stock (uL)	Benzidines Added (uL)	Puf/Surrogate Added (uL)	OLM04 Added (uL)	ISTD (uL)	MeCl2 (uL)	Final Volume (uL)
CAL Level 1	10	6	1	1	1	4.0	91	104
CAL Level 2	25	15	2.5	2.5	2.5	4.0	77.5	104
CAL Level 3	40	24	4	4	4	4.0	64	104
CAL Level 4	50	30	5	5	5	4.0	55	104
CAL Level 5	60	36	6	6	6	4.0	46	104
CAL Level 6	70	42	7	7	7	4.0	37	104
CAL Level 7	80	48	8	8	8	4.0	28	104

Appendix IX & MASOGD Working Standard Preparation

Sample Type	Final Concentration (ng/uL)	80ppm CAL Std (uL)	ISTD (uL)	MeCl2 (uL)	Final Volume (uL)
CAL Level 1	10	12.5	4.0	87.5	104
CAL Level 2	25	30.3	4.0	69.7	104
CAL Level 3	40	50	4.0	50	104
CAL Level 4	50	62.5	4.0	37.5	104
CAL Level 5	60	75	4.0	25	104
CAL Level 6	70	87.5	4.0	12.5	104
CAL Level 7	80	100	4.0	0	104

320 Acid Working Standard Preparation

Sample Type	Final Concentration (ng/uL)	320 Acid Solution (uL)	ISTD (uL)	MeCl2 (uL)	Final Volume (uL)
CAL Level 8	320	16	4.0	84	104

8270C Routine Working ICV Standard Preparation

Sample Type	Final Conc. (ng/uL)	8270C ICV Solution (uL)	Benzidines ICV (uL)	OLM04 ICV (uL)	ISTD (uL)	MeCl2 (uL)	Final Volume (uL)
ICV	50	50	5	5	4.0	40	104

SURROGATE AND SPIKE STANDARDS

The following standards are used to spike field and QC samples prior to extraction. Assign an expiration date of 6 months from date prepared unless the stock standard expires sooner in which case use the earliest expiration date. Store the prepared solutions under refrigeration and protected from light at a temperature of 4ºC (±2).

8270 Matrix Spike

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/mL)
8270 MegaMix	Restek (31850)	1000	5.0	100	50
Custom Rev. AP9 Adds w/ Benzoic Acid	Restek (564928)	1000	5.0		

Solvent: Acetone

Benzidines Matrix Spike

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/mL)
Benzidines Mixture	Ultra Scientific #US-105N	2000	6.25	250	50

Solvent: Acetone

OLM04 Matrix Spike

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/mL)
8270 Benzidines Mixture	Restek (31852)	2000	6.25	250	50

Solvent: Acetone

Benzoic Acid Matrix Spike

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/mL)
Benzoic Acid	NSI Solutions (W-541)	5000	1.0	50	100

Solvent: Acetone

BNA Surrogate Spike

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/mL)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/mL)
Acid Surrogate Standard Mix (3/90)	Restek (31073)	7500	9.0	450	150
B/N Surrogate Standard Mix (3/90)	Restek (31072)	5000	9.0		100

Solvent: Acetone

MASOGD Matrix Spike

Stock Standard	Vendor (Catalog No.)	Stock Standard Concentration (ug/L)	Volume Added (uL)	Final Volume (mL)	Final Concentration (mg/L)
Custom 2-Chlorobenzoic Acid	Restek (562264)	5000	900	30	150
Custom MMR 1	Restek (562265)	1000	900		30
Custom MMR 2	Restek (562266)	1000	900		

Solvent: Acetone

Appendix C: Equations

Response Factor (RFx)

$$\text{Response Factor } (RF_x) = \frac{\text{Area}_x \times \text{Concentration}_{is}}{\text{Area}_{is} \times \text{Concentration}_x}$$

Where:
x = compound,
is = Internal Standard

Relative Retention Time (RRT)

$$\text{Relative Retention Time (RRT)} = \frac{\text{Retention Time}_x}{\text{Retention Time}_{is}}$$

Where:
x = compound
is = Internal Standard

Mean Response Factor ($\overline{RF}$)

$$\text{Mean Response Factor } (\overline{RF}) = \frac{\sum_{i=1}^{n} RF_i}{n}$$

Where:
n = number of calibration levels

Standard Deviation of the Response Factor (SD)

$$\text{Standard Deviation of the Response Factor (SD)} = \sqrt{\frac{\sum_{i=1}^{n} \left(RF_i - \overline{RF}\right)2}{n-1}}$$

Where:
n = number of calibration levels

Percent Relative Standard Deviation (RSD) of the Response

$$\text{Percent Relative Standard Deviation (RSD) of the Response} = \frac{SD}{\overline{RF}} \times 100\%$$

Percent Difference (%D)

$$\text{Percent Difference (\%D)} = \frac{RF_v - \overline{RF}}{\overline{RF}} \times 100\%$$

Where:
RF_v = Response Factor from the Continuing Calibration Verification (CCV)

Percent Drift

$$\text{Percent Drift} = \frac{\text{Calculated Concentration - Theoretical Concentration}}{\text{Theoretical Concentration}} \times 100\%$$

Percent Recovery (%R)

$$\text{Percent Recovery (\%R)} = \frac{C_s}{C_n} \times 100\%$$

Where:
C_s = Concentration of the Spiked Field or QC Sample
C_n = Nominal Concentration of Spike Added

Percent Recovery (%R) for MS/MSD

$$\text{Percent Recovery (\%R) for MS/MSD} = \frac{C_s - C_u}{C_n} \times 100\%$$

Where:
C_s = Concentration of the Spiked Sample
C_u = Concentration of the Unspiked Sample
C_n = Nominal Concentration of Spike Added

Relative Percent Difference (%RPD)

$$\text{Relative Percent Difference (\%RPD)} = \frac{C_1 - C_2}{\left(\frac{C_1 + C_2}{2}\right)} \times 100\%$$

Where:
C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Sample Concentration (for average RF quantification)

Aqueous Samples

$$C_x = \frac{A_x \times C_{is} \times V_t}{A_{IS} \times \text{MeanRF} \times V_o \times V_i} \times DF$$

Where:
C_x = Concentration of compound (ug/L)
A_x = Area of quantitation ion
C_{IS} = Concentration of associated internal standard (ng)
V_t = Extract Volume (uL)
A_{IS} = Area of quantitation ion for associated internal standard.
Mean RF = Mean Response Factor from initial calibration, or 1 for a TIC or Alkane

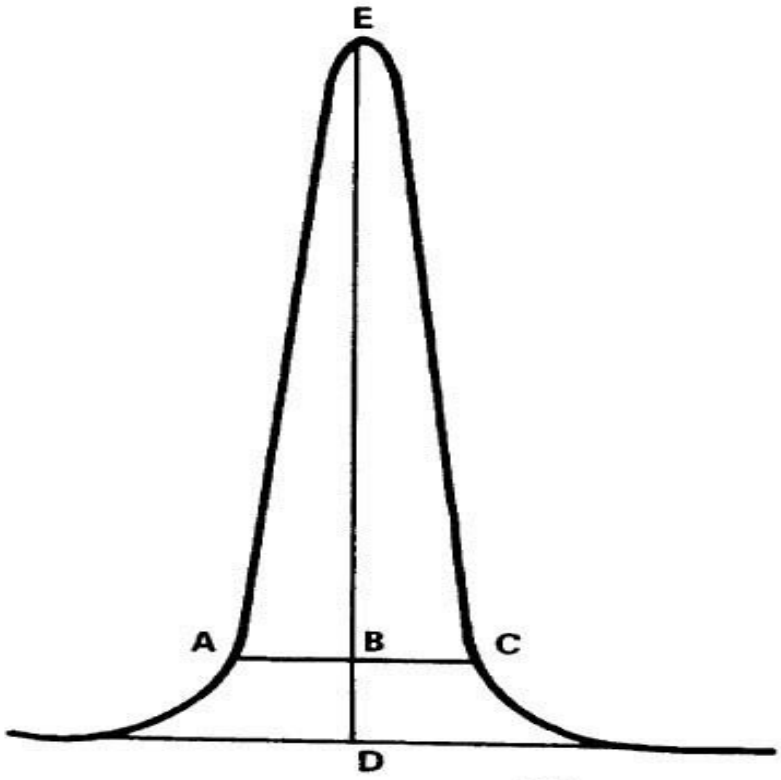
V_o = Sample volume (mL)
V_i = Volume injected (uL)
DF = Dilution Factor

Solid Samples

$$C_x = \frac{A_x \times C_{IS} \times V_t \times GPC \times 10^3 g/Kg}{A_{IS} \times MeanRF \times W_s \times S \times V_i \times 10^3 ng/ug} \times DF$$

Where:
C_x = Concentration of compound (ug/L)
A_x = Area of quantitation ion
C_{IS} = Concentration of associated internal standard (ng)
V_t = Extract Volume (uL)
AIS = Area of quantitation ion for associated internal standard.
Mean RF = Mean Response Factor from initial calibration, or 1 for a TIC or Alkane
Ws = Sample weight (g)
S = Percent Solid
Vi = Volume injected (uL)
DF = Dilution Factor

TAILING FACTOR CALCULATION



$$\text{TAILING FACTOR} = \frac{BC}{AB}$$

Example calculation: Peak Height = DE = 100 mm
10% Peak Height = BD = 10 mm
Peak Width at 10% Peak Height = AC = 23 mm
AB = 11 mm
BC = 12 mm

Therefore: Tailing Factor $= \frac{12}{11} = 1.1$

ATTACHMENT 1: SW-846 8270D Method Information

The tables associated to Attachment 1 summarize the laboratory's established RL for each matrix along with the in-house control limits for accuracy and precision, internal standard associations, characteristic ions used for quantitation and minimum response factor criteria for each analyte.

The RL's provided in these tables are those that can be achieved in a blank water or soil matrix using the routine extraction volume / mass of sample specified in the laboratory SOP for these matrices. These RLs are always adjusted for field samples based on actual sample amount used, final extract volume, percent moisture (solids) and dilutions.

The information provided in these tables is entered in the laboratory's management information system (LIMS) called TALS and is kept current by the local TALS system administrator. The values in TALS are the values used by the laboratory's data processing systems to evaluate and report data. The information presented in these tables is pulled from TALS and current as of the effective date of this SOP but is subject to change. Updates to these tables are made with each SOP revision. For the most current information, refer to the method, equipment and ICAL limit groups maintained in the TALS database.

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	RL		Control Limits (%R)				Precision
			Water	Soil	Water		Soil		RPD
			(ug/L)	ug/Kg)	Lower	Upper	Lower	Upper	≤
Analyte	1,1'-Biphenyl	92-52-4	10	330	60	140	60	140	30
Analyte	1,2,4,5-Tetrachlorobenzene	95-94-3	10	330	60	140	60	140	30
Analyte	1,2,4-Trichlorobenzene	120-82-1	10	330	60	130	55	120	30
Analyte	1,2-Dichlorobenzene	95-50-1	10	330	55	130	55	120	30
Analyte	1,3,5-Trinitrobenzene	99-35-4	10	330	60	140	60	140	30
Analyte	1,3-Dichlorobenzene	541-73-1	10	330	50	125	50	115	30
Analyte	1,3-Diethyl-1,3-Diphenyl Urea	85-98-3	10	330	55	130	50	120	30
Analyte	1,3-Dinitrobenzene	99-65-0	10	330	60	140	60	140	30
Analyte	1,4-Dichlorobenzene	106-46-7	10	330	55	125	55	120	30
Analyte	1,4-Naphthoquinone	130-15-4	10	330	60	140	60	140	30
Analyte	1-Methylnaphthalene	90-12-0	10	330	60	140	60	140	30
Analyte	1-Naphthylamine	134-32-7	10	330	60	140	60	140	30
Analyte	2,2'-oxybis[1-chloropropane]	108-60-1	10	330	60	150	60	130	30
Analyte	2,3,4,6-Tetrachlorophenol	58-90-2	10	330	60	140	60	140	30
Analyte	2,4,5-Trichlorophenol	95-95-4	25	830	60	140	60	130	30
Analyte	2,4,6-Trichlorophenol	88-06-2	10	330	55	155	60	135	30
Analyte	2,4-Dichlorophenol	120-83-2	10	330	55	150	55	130	30
Analyte	2,4-Dimethylphenol	105-67-9	10	330	30	165	25	150	30
Analyte	2,4-Dinitrophenol	51-28-5	25	830	35	150	25	160	30
Analyte	2,4-Dinitrotoluene	121-14-2	10	330	60	130	50	120	30
Analyte	2,6-Dichlorophenol	87-65-0	10	330	60	140	60	140	30
Analyte	2,6-Dinitrotoluene	606-20-2	10	330	70	135	55	130	30
Analyte	2-Acetylaminofluorene	53-96-3	10	330	60	140	60	140	30
Analyte	2-Chlorobenzaldehyde	89-98-5	10	330	30	120	10	105	30
Analyte	2-Chlorobenzoic Acid	118-91-2	380	1660	10	35	10	285	30
Analyte	2-Chloronaphthalene	91-58-7	10	330	50	125	45	120	30
Analyte	2-Chlorophenol	95-57-8	10	330	65	140	60	125	30
Analyte	2-Methyl-3-Nitroaniline	603-83-8	10	330	10	95	10	75	30

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	RL		Control Limits (%R)				Precision
			Water	Soil	Water		Soil		RPD
			(ug/L)	ug/Kg)	Lower	Upper	Lower	Upper	≤
Analyte	2-Methylnaphthalene	91-57-6	10	330	50	145	45	150	30
Analyte	2-Methylphenol	95-48-7	10	330	55	130	50	135	30
Analyte	2-Naphthylamine	91-59-8	10	330	60	140	60	140	30
Analyte	2-Nitroaniline	88-74-4	25	830	65	140	50	125	30
Analyte	2-Nitrodiphenylamine	119-75-5	10	330	45	125	50	120	30
Analyte	2-Nitrophenol	88-75-5	10	330	70	145	55	135	30
Analyte	2-Picoline	109-06-8	10	330	60	140	60	140	30
Analyte	2-Toluidine	95-53-4	10	330	60	140	60	140	30
Analyte	3 & 4 Methylphenol	15831-10-4	10	670	35	130	35	140	30
Analyte	3,3'-Dichlorobenzidine	91-94-1	10	330	10	140	10	120	30
Analyte	3,3'-Dimethylbenzidine	119-93-7	10	330	60	140	60	140	30
Analyte	3,5-Dinitroaniline	618-87-1	10	330	30	140	40	105	30
Analyte	3-Chlorobenzaldehyde	587-04-2	10	330	40	115	5	100	30
Analyte	3-Methylcholanthrene	56-49-5	10	330	60	140	60	140	30
Analyte	3-Nitroaniline	99-09-2	25	830	30	95	20	85	30
Analyte	4,6-Dinitro-2-methylphenol	534-52-1	40	330	55	180	55	160	30
Analyte	4-Aminobiphenyl	92-67-1	10	330	60	140	60	140	30
Analyte	4-Bromophenyl phenyl ether	101-55-3	10	330	55	150	55	130	30
Analyte	4-Chloro-3-methylphenol	59-50-7	10	330	50	155	60	140	30
Analyte	4-Chloroaniline	106-47-8	10	330	10	95	10	90	30
Analyte	4-Chlorobenzaldehyde	104-88-1	10	330	40	110	5	100	30
Analyte	4-Chlorophenyl phenyl ether	7005-72-3	10	330	60	140	50	120	30
Analyte	4-Nitroaniline	100-01-6	25	830	50	135	25	115	30
Analyte	4-Nitrophenol	100-02-7	25	830	10	110	30	155	30
Analyte	4-Nitroquinoline-1-oxide	56-57-5	10	330	60	140	60	140	30
Analyte	7,12-Dimethylbenz(a)anthracene	57-97-6	10	330	60	140	60	140	30
Analyte	Acenaphthene	83-32-9	10	330	60	135	55	120	30
Analyte	Acenaphthylene	208-96-8	10	330	60	125	51	115	30

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	RL		Control Limits (%R)				Precision
			Water	Soil	Water		Soil		RPD
			(ug/L)	ug/Kg)	Lower	Upper	Lower	Upper	≤
Analyte	Acetophenone	98-86-2	10	330	60	140	60	140	30
Analyte	alpha,alpha-Dimethyl phenethylamine	122-09-8	10	330	60	140	60	140	30
Analyte	Aniline	62-53-3	25	830	10	110	10	105	30
Analyte	Anthracene	120-12-7	10	330	70	135	60	125	30
Analyte	Aramite, Total	140-57-8	10	330	60	140	60	140	30
Analyte	Atrazine	1912-24-9	10	330	60	140	60	140	30
Analyte	Azobenzene	103-33-3	10	330	65	135	60	140	30
Analyte	Benzaldehyde	100-52-7	25	330	60	140	60	140	30
Analyte	Benzidine	92-87-5	25	830	10	235	10	120	30
Analyte	Benzo[a]anthracene	56-55-3	10	330	70	135	55	130	30
Analyte	Benzo[a]pyrene	50-32-8	10	330	65	130	55	120	30
Analyte	Benzo[b]fluoranthene	205-99-2	10	330	40	150	45	130	30
Analyte	Benzo[e]pyrene	192-97-2	10	330	60	140	60	140	30
Analyte	Benzo[g,h,i]perylene	191-24-2	10	330	50	140	45	135	30
Analyte	Benzo[k]fluoranthene	207-08-9	10	330	60	140	60	125	30
Analyte	Benzoic acid	65-85-0	110	830	10	70	25	145	30
Analyte	Benzyl alcohol	100-51-6	10	330	45	150	50	155	30
Analyte	Bis(2-chloroethoxy)methane	111-91-1	10	330	45	160	55	125	30
Analyte	Bis(2-chloroethyl)ether	111-44-4	10	330	70	140	60	125	30
Analyte	Bis(2-ethylhexyl) phthalate	117-81-7	10	330	80	145	55	140	30
Analyte	Butyl benzyl phthalate	85-68-7	10	330	75	140	65	145	30
Analyte	Caprolactam	105-60-2	10	330	60	140	60	140	30
Analyte	Carbazole	86-74-8	10	330	60	140	55	125	30
Analyte	Chlorobenzilate	510-15-6	10	330	60	140	60	140	30
Analyte	Chrysene	218-01-9	10	330	65	130	60	125	30
Analyte	Diallate	2303-16-4	10	330	60	140	60	140	30
Analyte	Dibenz(a,h)anthracene	53-70-3	10	330	45	150	35	145	30
Analyte	Dibenzofuran	132-64-9	10	330	65	140	55	120	30

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	RL		Control Limits (%R)				Precision
			Water	Soil	Water		Soil		RPD
			(ug/L)	ug/Kg)	Lower	Upper	Lower	Upper	≤
Analyte	Diethyl phthalate	84-66-2	10	330	55	140	50	125	30
Analyte	Dimethoate	60-51-5	10	330	60	140	60	140	30
Analyte	Dimethyl phthalate	131-11-3	10	330	65	140	55	120	30
Analyte	Di-n-butyl phthalate	84-74-2	10	330	60	135	50	120	30
Analyte	Di-n-octyl phthalate	117-84-0	10	330	70	135	60	135	30
Analyte	Dinoseb	88-85-7	40	330	60	140	60	140	30
Analyte	Di-n-propyl Adipate	106-19-4	10	330	50	130	50	115	30
Analyte	Disulfoton	298-04-4	10	330	60	140	60	140	30
Analyte	Ethyl methacrylate	97-63-2	10	330	60	140	60	140	30
Analyte	Ethyl methanesulfonate	62-50-0	10	330	60	140	60	140	30
Analyte	Ethyl Parathion	56-38-2	10	330	60	140	60	140	30
Analyte	Famphur	52-85-7	10	330	60	140	60	140	30
Analyte	Fluoranthene	206-44-0	10	330	50	140	50	120	30
Analyte	Fluorene	86-73-7	10	330	65	135	50	125	30
Analyte	Hexachlorobenzene	118-74-1	10	330	55	150	55	125	30
Analyte	Hexachlorobutadiene	87-68-3	10	330	35	140	50	130	30
Analyte	Hexachlorocyclopentadiene	77-47-4	10	330	10	155	30	105	30
Analyte	Hexachloroethane	67-72-1	10	330	50	140	55	120	30
Analyte	Hexachloropropene	1888-71-7	10	330	60	140	60	140	30
Analyte	Indeno[1,2,3-cd]pyrene	193-39-5	10	330	45	150	55	135	30
Analyte	Isodrin	465-73-6	10	330	60	140	60	140	30
Analyte	Isophorone	78-59-1	10	330	45	135	50	115	30
Analyte	Isosafrole	120-58-1	10	330	60	140	60	140	30
Analyte	Kepone	143-50-0	40	830	60	140	60	140	30
Analyte	Methapyrilene	91-80-5	10	830	60	140	60	140	30
Analyte	Methyl methanesulfonate	66-27-3	10	330	60	140	60	140	30
Analyte	Methyl parathion	298-00-0	10	330	60	140	60	140	30
Analyte	Naphthalene	91-20-3	10	330	65	135	55	120	30

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	RL		Control Limits (%R)				Precision
			Water	Soil	Water		Soil		RPD
			(ug/L)	ug/Kg)	Lower	Upper	Lower	Upper	≤
Analyte	Nitrobenzene	98-95-3	10	330	60	135	55	120	30
Analyte	N-Nitro-o-toluidine	99-55-8	10	330	35	120	20	85	30
Analyte	N-Nitrosodiethylamine	55-18-5	10	330	60	140	60	140	30
Analyte	N-Nitrosodimethylamine	62-75-9	10	330	45	110	55	125	30
Analyte	N-Nitrosodi-n-butylamine	924-16-3	10	330	60	140	60	140	30
Analyte	N-Nitrosodi-n-propylamine	621-64-7	10	330	60	130	45	125	30
Analyte	N-Nitrosodiphenylamine	86-30-6	10	330	65	125	45	130	30
Analyte	N-Nitrosomethylethylamine	10595-95-6	10	330	60	140	60	140	30
Analyte	N-Nitrosomorpholine	59-89-2	10	330	60	140	60	140	30
Analyte	N-Nitrosopiperidine	100-75-4	10	330	60	140	60	140	30
Analyte	N-Nitrosopyrrolidine	930-55-2	10	330	60	140	60	140	30
Analyte	o,o',o''-Triethylphosphorothioate	126-68-1	10	330	60	140	60	140	30
Analyte	p-Dimethylamino azobenzene	60-11-7	10	330	60	140	60	140	30
Analyte	Pentachlorobenzene	608-93-5	10	330	60	140	60	140	30
Analyte	Pentachloroethane	76-01-7	10	330	60	140	60	140	30
Analyte	Pentachloronitrobenzene	82-68-8	10	330	60	140	60	140	30
Analyte	Pentachlorophenol	87-86-5	25	830	50	165	50	140	30
Analyte	Perylene	198-55-0	10	330	60	140	60	140	30
Analyte	Phenacetin	62-44-2	10	330	60	140	60	140	30
Analyte	Phenanthrene	85-01-8	10	330	70	135	60	125	30
Analyte	Phenol	108-95-2	10	330	25	90	60	140	30
Analyte	Phorate	298-02-2	10	330	60	140	60	140	30
Analyte	p-Phenylene diamine	106-50-3	25	330	60	140	60	140	30
Analyte	Pronamide	23950-58-5	10	330	60	140	60	140	30
Analyte	Pyrene	129-00-0	10	330	70	160	35	175	30
Analyte	Pyridine	110-86-1	10	330	10	105	15	105	30
Analyte	Safrole, Total	94-59-7	10	330	60	140	60	140	30
Analyte	Sulfotepp	3689-24-5	10	330	60	140	60	140	30

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	RL		Control Limits (%R)				Precision
			Water	Soil	Water		Soil		RPD
			(ug/L)	ug/Kg)	Lower	Upper	Lower	Upper	≤
Analyte	Thionazin	297-97-2	10	330	60	140	60	140	30
Surrogate	2,4,6-Tribromophenol	118-79-6	NA	NA	50	135	50	120	NA
Surrogate	2-Fluorobiphenyl	321-60-8	NA	NA	30	95	45	110	NA
Surrogate	2-Fluorophenol	367-12-4	NA	NA	90	95	45	110	NA
Surrogate	Nitrobenzene-d5	4165-60-0	NA	NA	55	125	50	115	NA
Surrogate	Phenol-d5	4165-62-2	NA	NA	10	75	50	120	NA
Surrogate	Terphenyl-d14	1718-51-0	NA	NA	55	145	40	145	NA
Surrogate	2-Chlorophenol-d4	93951-73-6	NA	NA	55	120	50	115	NA
Surrogate	1,2-Dichlorobenzene-d4	2199-69-1	NA	NA	55	120	50	115	NA
ISTD 1	1,4-Dichlorobenzene-d4	3855-82-1	NA	NA	NA	NA	NA	NA	NA
ISTD 2	Naphthalene-d8	1146-65-2	NA	NA	NA	NA	NA	NA	NA
ISTD 3	Acenaphthene-d10	15067-26-2	NA	NA	NA	NA	NA	NA	NA
ISTD 4	Phenanthrene-d10	1517-22-2	NA	NA	NA	NA	NA	NA	NA
ISTD 5	Chrysene-d12	1719-03-5	NA	NA	NA	NA	NA	NA	NA
ISTD 6	Perylene-d12	1520-96-3	NA	NA	NA	NA	NA	NA	NA

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	ICAL Group	Internal Standard Association	Characterisitc Ion			Minimum Response Factor
					Primary	Secondary	Tertiary	
Analyte	1,1'-Biphenyl	92-52-4	A	3	154	153	152	0.010
Analyte	1,2,4,5-Tetrachlorobenzene	95-94-3	A	3	216	214	218	0.010
Analyte	1,2,4-Trichlorobenzene	120-82-1	A	2	180	182	145	
Analyte	1,2-Dichlorobenzene	95-50-1	A	1	146	148	111	
Analyte	1,3,5-Trinitrobenzene	99-35-4	A	4	213	74	91	
Analyte	1,3-Dichlorobenzene	541-73-1	A	1	146	148	111	
Analyte	1,3-Diethyl-1,3-Diphenyl Urea	85-98-3	A	4	148	120	77	
Analyte	1,3-Dinitrobenzene	99-65-0	A	3	168	50	76	
Analyte	1,4-Dichlorobenzene	106-46-7	A	1	146	148	111	
Analyte	1,4-Naphthoquinone	130-15-4	A	3	158	102	76	
Analyte	1-Methylnaphthalene	90-12-0	A	2	142	141	115	
Analyte	1-Naphthylamine	134-32-7	A	3	143	116	115	
Analyte	2,2'-oxybis[1-chloropropane]	108-60-1	A	1	45	121	NA	0.010
Analyte	2,3,4,6-Tetrachlorophenol	58-90-2	A	3	232	231	131	0.010
Analyte	2,4,5-Trichlorophenol	95-95-4	B	3	196	198	97	0.200
Analyte	2,4,6-Trichlorophenol	88-06-2	A	3	196	198	220	0.200
Analyte	2,4-Dichlorophenol	120-83-2	A	2	162	164	98	0.200
Analyte	2,4-Dimethylphenol	105-67-9	A	2	122	107	121	0.200
Analyte	2,4-Dinitrophenol	51-28-5	B	3	187	107	NA	0.010
Analyte	2,4-Dinitrotoluene	121-14-2	A	3	165	89	NA	0.200
Analyte	2,6-Dichlorophenol	87-65-0	A	2	162	164	98	
Analyte	2,6-Dinitrotoluene	606-20-2	A	3	165	89	NA	0.200
Analyte	2-Acetylaminofluorene	53-96-3	A	5	181	223	152	
Analyte	2-Chlorobenzaldehyde	89-98-5	A	2	139	140	141	
Analyte	2-Chlorobenzoic Acid	118-91-2	C	3	141	156	111	
Analyte	2-Chloronaphthalene	91-58-7	A	3	162	127	164	0.800
Analyte	2-Chlorophenol	95-57-8	A	1	128	64	130	0.800
Analyte	2-Methyl-3-Nitroaniline	603-83-8	A	3	135	104	NA	

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	ICAL Group	Internal Standard Association	Characterisitc Ion			Minimum Response Factor
					Primary	Secondary	Tertiary	
Analyte	2-Methylnaphthalene	91-57-6	A	2	115	141	142	0.400
Analyte	2-Methylphenol	95-48-7	A	1	107	108	79	0.800
Analyte	2-Naphthylamine	91-59-8	A	3	143	116	115	
Analyte	2-Nitroaniline	88-74-4	B	3	65	92	138	0.010
Analyte	2-Nitrodiphenylamine	119-75-5	A	4	214	167	180	
Analyte	2-Nitrophenol	88-75-5	A	2	139	109	65	0.100
Analyte	2-Picoline	109-06-8	A	1	93	66	NA	
Analyte	2-Toluidine	95-53-4	A	1	106	107	NA	
Analyte	3 & 4 Methylphenol	15831-10-4	A	1	107	108	79	0.600
Analyte	3,3'-Dichlorobenzidine	91-94-1	A	5	252	254	126	0.010
Analyte	3,3'-Dimethylbenzidine	119-93-7	A	5	212	213	106	
Analyte	3,5-Dinitroaniline	618-87-1	A	4	183	64	67	
Analyte	3-Chlorobenzaldehyde	587-04-2	A	2	139	140	141	
Analyte	3-Methylcholanthrene	56-49-5	A	6	268	253	126	
Analyte	3-Nitroaniline	99-09-2	B	3	138	65	92	0.010
Analyte	4,6-Dinitro-2-methylphenol	534-52-1	B	4	198	121	106	0.010
Analyte	4-Aminobiphenyl	92-67-1	A	4	169	168	115	
Analyte	4-Bromophenyl phenyl ether	101-55-3	A	4	248	250	141	0.100
Analyte	4-Chloro-3-methylphenol	59-50-7	A	2	107	44	NA	0.200
Analyte	4-Chloroaniline	106-47-8	A	2	127	129	NA	0.010
Analyte	4-Chlorobenzaldehyde	104-88-1	A	2	139	140	141	
Analyte	4-Chlorophenyl phenyl ether	7005-72-3	A	3	204	206	141	0.400
Analyte	4-Nitroaniline	100-01-6	B	3	139	92	108	0.010
Analyte	4-Nitrophenol	100-02-7	B	3	109	81	65	0.010
Analyte	4-Nitroquinoline-1-oxide	56-57-5	A	4	101	128	174	
Analyte	7,12-Dimethylbenz(a)anthracene	57-97-6	A	6	256	241	128	
Analyte	Acenaphthene	83-32-9	A	3	154	153	152	0.900
Analyte	Acenaphthylene	208-96-8	A	3	152	153	NA	0.900

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	ICAL Group	Internal Standard Association	Characterisitc Ion			Minimum Response Factor
					Primary	Secondary	Tertiary	
Analyte	Acetophenone	98-86-2	A	1	105	77	51	0.010
Analyte	alpha,alpha-Dimethyl phenethylamine	122-09-8	A	2	58	91	NA	
Analyte	Aniline	62-53-3	B	1	93	66	65	
Analyte	Anthracene	120-12-7	A	4	178	176	179	0.700
Analyte	Aramite, Total	140-57-8	A	5	185	191	319	
Analyte	Atrazine	1912-24-9	A	4	200	173	215	0.010
Analyte	Azobenzene	103-33-3	A	4	182	77	NA	
Analyte	Benzaldehyde	100-52-7	A	1	77	105	106	0.010
Analyte	Benzidine	92-87-5	B	5	184	92	185	
Analyte	Benzo[a]anthracene	56-55-3	A	5	228	229	226	0.800
Analyte	Benzo[a]pyrene	50-32-8	A	6	252	253	125	0.700
Analyte	Benzo[b]fluoranthene	205-99-2	A	6	252	253	125	0.700
Analyte	Benzo[e]pyrene	192-97-2	A	6	252	253	125	
Analyte	Benzo[g,h,i]perylene	191-24-2	A	6	276	138	277	0.500
Analyte	Benzo[k]fluoranthene	207-08-9	A	6	252	253	125	0.700
Analyte	Benzoic acid	65-85-0	A	2	93	95	123	
Analyte	Benzyl alcohol	100-51-6	A	1	108	79	77	0.300
Analyte	Bis(2-chloroethoxy)methane	111-91-1	C	2	93	95	123	
Analyte	Bis(2-chloroethyl)ether	111-44-4	A	1	93	95	NA	0.700
Analyte	Bis(2-ethylhexyl) phthalate	117-81-7	A	5	149	167	NA	0.010
Analyte	Butyl benzyl phthalate	85-68-7	A	5	149	91	206	0.010
Analyte	Caprolactam	105-60-2	A	2	113	55	56	0.010
Analyte	Carbazole	86-74-8	A	4	167	139	NA	0.010
Analyte	Chlorobenzilate	510-15-6	A	5	251	139	111	
Analyte	Chrysene	218-01-9	A	5	228	226	229	0.700
Analyte	Diallate	2303-16-4	A	4	86	234	43	
Analyte	Dibenz(a,h)anthracene	53-70-3	A	6	278	139	279	0.400
Analyte	Dibenzofuran	132-64-9	A	3	168	139	NA	0.800

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	ICAL Group	Internal Standard Association	Characterisitc Ion			Minimum Response Factor
					Primary	Secondary	Tertiary	
Analyte	Diethyl phthalate	84-66-2	A	3	149	177	150	0.010
Analyte	Dimethoate	60-51-5	A	4	87	125	93	
Analyte	Dimethyl phthalate	131-11-3	A	3	330	163	194	0.010
Analyte	Di-n-butyl phthalate	84-74-2	A	4	149	150	104	0.010
Analyte	Di-n-octyl phthalate	117-84-0	A	6	149	NA	NA	0.010
Analyte	Dinoseb	88-85-7	A	4	211	163	147	
Analyte	Di-n-propyl Adipate	106-19-4	A	3	171	129	111	
Analyte	Disulfoton	298-04-4	A	4	97	142	NA	
Analyte	Ethyl methacrylate	97-63-2	A	1	69	99	41	
Analyte	Ethyl methanesulfonate	62-50-0	A	1	79	109	97	
Analyte	Ethyl Parathion	56-38-2	A	4	109	97	291	
Analyte	Famphur	52-85-7	A	5	218	125	93	
Analyte	Fluoranthene	206-44-0	A	4	202	203	101	0.600
Analyte	Fluorene	86-73-7	A	3	166	165	NA	0.900
Analyte	Hexachlorobenzene	118-74-1	A	4	284	142	249	0.100
Analyte	Hexachlorobutadiene	87-68-3	A	2	225	223	227	0.010
Analyte	Hexachlorocyclopentadiene	77-47-4	A	3	237	235	272	0.050
Analyte	Hexachloroethane	67-72-1	A	1	117	201	199	0.300
Analyte	Hexachloropropene	1888-71-7	A	2	213	211	106	
Analyte	Indeno[1,2,3-cd]pyrene	193-39-5	A	6	276	138	277	0.500
Analyte	Isodrin	465-73-6	A	4	193	147	66	
Analyte	Isophorone	78-59-1	A	2	82	95	138	0.400
Analyte	Isosafrole	120-58-1	A	2	162	104	131	
Analyte	Kepone	143-50-0	A	5	272	237	143	
Analyte	Methapyrilene	91-80-5	A	4	58	97	71	
Analyte	Methyl methanesulfonate	66-27-3	A	1	80	79	65	
Analyte	Methyl parathion	298-00-0	A	4	109	125	263	
Analyte	Naphthalene	91-20-3	A	2	128	129	NA	0.700

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	ICAL Group	Internal Standard Association	Characterisitc Ion			Minimum Response Factor
					Primary	Secondary	Tertiary	
Analyte	Nitrobenzene	98-95-3	A	2	77	123	65	0.200
Analyte	N-Nitro-o-toluidine	99-55-8	A	3	152	106	79	
Analyte	N-Nitrosodiethylamine	55-18-5	A	1	102	57	44	
Analyte	N-Nitrosodimethylamine	62-75-9	A	1	74	42	NA	
Analyte	N-Nitrosodi-n-butylamine	924-16-3	A	2	84	116	158	
Analyte	N-Nitrosodi-n-propylamine	621-64-7	A	1	70	42	130	0.500
Analyte	N-Nitrosodiphenylamine	86-30-6	A	4	169	168	167	0.010
Analyte	N-Nitrosomethylethylamine	10595-95-6	A	1	88	42	43	
Analyte	N-Nitrosomorpholine	59-89-2	A	1	56	86	116	
Analyte	N-Nitrosopiperidine	100-75-4	A	2	114	42	55	
Analyte	N-Nitrosopyrrolidine	930-55-2	A	1	100	68	42	
Analyte	o,o',o''-Triethylphosphorothioate	126-68-1	A	2	198	121	97	
Analyte	p-Dimethylamino azobenzene	60-11-7	A	5	120	225	77	
Analyte	Pentachlorobenzene	608-93-5	A	3	250	248	215	
Analyte	Pentachloroethane	76-01-7	A	1	117	167	83	
Analyte	Pentachloronitrobenzene	82-68-8	A	4	237	214	142	
Analyte	Pentachlorophenol	87-86-5	B	4	266	268	204	0.050
Analyte	Perylene	198-55-0	A	6	252	253	125	
Analyte	Phenacetin	62-44-2	A	4	108	179	137	
Analyte	Phenanthrene	85-01-8	A	4	178	179	176	0.700
Analyte	Phenol	108-95-2	A	1	94	65	66	0.800
Analyte	Phorate	298-02-2	A	4	121	260	NA	
Analyte	p-Phenylene diamine	106-50-3	A	2	108	80	53	
Analyte	Pronamide	23950-58-5	A	4	173	175	145	
Analyte	Pyrene	129-00-0	A	5	202	203	101	0.600
Analyte	Pyridine	110-86-1	A	1	79	52	NA	
Analyte	Safrole, Total	94-59-7	A	3	104	103	131	
Analyte	Sulfotepp	3689-24-5	A	4	322	202	266	

Attachment 1: SW846 8270D Method Information (BR-MS-001)

Type	Analytes	CAS #	ICAL Group	Internal Standard Association	Characterisitc Ion			Minimum Response Factor
					Primary	Secondary	Tertiary	
Analyte	Thionazin	297-97-2	A	3	97	107	143	
Surrogate	2,4,6-Tribromophenol	118-79-6	NA	4	330	332	141	
Surrogate	2-Fluorobiphenyl	321-60-8	NA	3	172	171	NA	
Surrogate	2-Fluorophenol	367-12-4	NA	1	112	64	NA	
Surrogate	Nitrobenzene-d5	4165-60-0	NA	2	82	54	128	
Surrogate	Phenol-d5	4165-62-2	NA	1	99	71	42	
Surrogate	Terphenyl-d14	1718-51-0	NA	5	244	122	212	
Surrogate	2-Chlorophenol-d4	93951-73-6	NA	1	132	68	134	
Surrogate	1,2-Dichlorobenzene-d4	2199-69-1	NA	1	152	150	115	
ISTD 1	1,4-Dichlorobenzene-d4	3855-82-1	NA	NA	152	115	150	
ISTD 2	Naphthalene-d8	1146-65-2	NA	NA	136	68	NA	
ISTD 3	Acenaphthene-d10	15067-26-2	NA	NA	164	162	160	
ISTD 4	Phenanthrene-d10	1517-22-2	NA	NA	188	94	80	
ISTD 5	Chrysene-d12	1719-03-5	NA	NA	240	120	236	
ISTD 6	Perylene-d12	1520-96-3	NA	NA	264	260	265	

Attachment D

Example Chain of Custodies

Chain of Custody Record

Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Tel: 203-929-8140
Fax: 203-929-8142

TAL-0015 (0508)

151209

Client	Project Manager	Date	Chain of Custody Number
GEI Consultants Inc.	Melissa Felter / Kim Bradley		18896

Address	Telephone Number (Area Code)/Fax Number/e-mail address	Field Telephone Number	Page / of
455 Winding Brook Dr.	860-368-5300 / mfelter@geiconsultants.com / kbradley@geiconsultants.com	860-917-0670	Page 1 of

City	State	Zip Code	Site Contact	Lab Contact
Glastonbury	CT	06033	Kim Bradley / Kari Weber	Pat McIssac

Project Name and Location (State)	Sample Disposal	Analysis (Attach list if more space is needed)
Gowanus Canal Brooklyn, NY	☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months (A fee may be assessed if samples are retained longer than 1 month)	

Contract/Purchase Order/Project No.
093010-2-1202

Field Sample I.D. (Containers for each sample may be combined on one line)	Collection Date	Collection Time	Matrix: Aqueous	Solid	Other	Containers & Preservatives: Unpres.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/NaOH	Other	SEE ATTACHED SLW Analytical	SEE ATTACHED SEDIMENT ANALYTICAL	SEE ATTACHED Pace Analytical	Comments
													X			
														X		
															X	

Turn Around Time Required (business days) Report / EDD Requirements

☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☒ Other SEE Contact

State Regulatory QC Requirements

1. Relinquished By	Date	Time	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Received By	Date	Time	Cooler Temps	Passed Rad. Screen (Lab Use Only)	☐ Yes ☐ No

Comments

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

Note: Deliverable Type → NYS ASP Cat B + EPA II EDD

EDD to datagroup@geiconsultants.com
Hard Copy to Lori Macinnon

CMS

Gowanus Canal Sediment Sampling - Chain of Custody TestAmerica Analytical Chemistry List

Analyze **bulk surficial sediment** samples from 38 locations for bulk sediment chemistry and characteristics:

- VOCs according to USEPA Method 8260B
- SVOCs according to USEPA Method 8270C
- PCBs according to USEPA Method 8082A
- PCB congeners according to USEPA Method 1668A Only locations: 301, 305, 307A, 308A, 308B, 312, 320, and 325)
- Pesticides according to USEPA Method 8081A
- Herbicides according to USEPA Method 8151A
- Target Analyte List (TAL) metals according to USEPA Method 6020
- Mercury according to USEPA 7471
- Methyl Mercury according to USEPA 1630
- Total cyanide according to USEPA Method 9012
- Ammonia according to USEPA Method 350.1
- Total organic carbon (TOC) according to USEPA Method Lloyd Kahn
- Nitrate/nitrite according to USEPA Method 300.0
- Sulfate according to USEPA Method 300.0
- Sulfide according to USEPA 9030B/9034
- SEM/AVS TAL metals according to USEPA Method 200 series
- Biological Oxygen Demand (BOD) according to SM 5210B
- Black Carbon
- Bulk Density according to ASTM D2937
- Percent Water Content according to ASTM D2216
- Grain Size according to ASTM D422
- pH according to EPA Method 9045C
- Hardness according to ASTM 2340B
- Salinity according to ASTM 2520B

Analyze **interstitial water samples** from 38 locations for:

- 34 PAHs according to USEPA Method 8272-SPME GC/MS
- TAL metals according to USEPA Method 6020
- Mercury according to USEPA Method 7470
- Methyl Mercury according to USEPA 1630
- Free cyanide according to USEPA Method 9016
- Total cyanide according to USEPA Method 9012
- Ammonia according to USEAP Method 350.1
- TOC according to USEPA Method 9060
- Nitrate/nitrite according to USEPA Method 300.0
- Sulfate according to USEPA Method 300.0
- Dissolved Organic Carbon (DOC) according to SM5310C
- pH according to EPA Method 9045C
- Hardness according to ASTM 2340B
- Salinity according to ASTM 2520B

Analyze depth-integrated **surface water samples** from 38 locations for:

- VOCs according to USEPA Method 8260B
- SVOCs according to USEPA Method 8270C
- PCBs according to USEPA Method 8082A
- Pesticides according to USEPA Method 8081A
- Herbicides according to USEPA Method 8151A
- TAL metals according to USEPA Method 6020
- Mercury according to USEPA Method 7470
- Methyl Mercury according to USEPA 1630
- Free cyanide according to USEPA Method 9016
- Total cyanide according to USEPA Method 9012
- Ammonia according to USEAP Method 350.1
- Nitrate/nitrite according to USEPA Method 300.0
- Sulfate according to USEPA Method 300.0
- TOC according to USEPA Method Lloyd Kahn
- Biological Oxygen Demand (BOD) according to SM 5210B
- Chemical Oxygen Demand (COD) according to USEPA Method 410.4
- Dissolved Organic Carbon (DOC) according to SM5310C
- Total Suspended Solids (TSS) according to ASTM 2540D
- pH according to EPA Method 9045C
- Hardness according to ASTM 2340B
- Salinity according to ASTM 2520B

Columbia Analytical Services™ — CHAIN OF CUSTODY

SR#: _____

1317 South 13th Ave, Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

PAGE _____ OF _____ COC #_____

PROJECT NAME: Gowanus Canal Sediment
PROJECT NUMBER: 092410-3 ~~Bat~~ 2-1202
PROJECT MANAGER: Dave Terry / Melissa Felter
COMPANY/ADDRESS: 455 Winding Brook Dr Suite 201
CITY/STATE/ZIP: Glastonbury, CT 06033
E-MAIL ADDRESS: mfelter@geiconsultants.com
PHONE #: 860 368 5300 | FAX #: 860 368 5307
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐ ☐Fuel Fingerprint (FIQ) ☐NW-HCID Screen	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCB's Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081A☐ 8141A☐ 8151A☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	PAHS 8310☐ SIM☐	Metals, Total or Dissolved (See list below)	Cyanide☐ Hex-Chrom☐	pH; Cond.; Cl; SO_4; P; F; NO_2; NO_3; BOD; TSS; TDS (circle) NH_3-N; COD, Total-P, TKN, TOC, DOC (circle) NO_2+NO_3	TOX 9020☐ AOX 1650☐ 506☐	Group I & II EDD/PDF, P1694	Group 5 Alkylphenols D7065-A	REMARKS
				SED	1-8 oz														X	X			
				SW	4-1L Amber														X	X			

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. Data Validation Report (includes all raw data)
X IV. CLP Deliverable Report
X V. EDD EPA Region II

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

____ 24 hr. ____ 48 hr.
____ 5 Day
X Standard (10-15 working days)
____ Provide FAX Results

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER:_____ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

Please send EDD to datagroup@geiconsultants.com

Please send hard copy to Lorie MacInnon
113 Odell Rd
Sandown, NH 03873

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature / Date/Time	Signature / Date/Time	Signature / Date/Time	Signature / Date/Time
Printed Name / Firm	Printed Name / Firm	Printed Name / Firm	Printed Name / Firm

Analytical Services, Inc.

CHAIN OF CUSTODY RECORD

Ship to: Analytical Services, Inc., 130 Allen Brook Lane, Williston, VT 05495, Attn: Sample Management
Phone: 1-800-723-4432 or 802-878-5138 • Fax: 802-878-6765 *Web site: www.analyticalservices.com*

Submitted By: GEI Consultants 455 Winding Brook Dr. Suite 201 Glastonbury, CT 06033 Phone: 860 368 5300 Fax: 860 368 5307	Report To: CLP deliverable-Lorie McInnon 113 Odell Rd. Sandown, NH 03873 EDD to datagroup@geiconsultants.com Phone: _____ Fax: _____
Project Name: Gowanus Canal Sediment Job Site: P.O. Number: 5878	Invoice To: Melissa Felter GEI Consultants 455 Winding Brook Dr Glastonbury, CT 06033 Phone: 860 368 5300 Fax: 860 368 5307

Sample Identification*	Sample Collection		Sample Matrix (check one)						Analysis Requested
	Date	Time	Water - Raw	Water - Finished	Waste Water	Biosolids	Soil/Sediment	Other	
							X		Enteroviruses

*Sample ID should match ID written on the sample containers and data sheets. Sample ID will appear on the report for identification.

Relinquished By (signature)	Date/Time	Received By (signature)	Date/Time

Field Comments:
Region 2 EPA EDD
CLP data package

Lab Comments:

White – To accompany samples • Yellow – Sampler Copy

Analytical Services, Inc.

CHAIN OF CUSTODY RECORD

Ship to: Analytical Services, Inc., 130 Allen Brook Lane, Williston, VT 05495, Attn: Sample Management
Phone: 1-800-723-4432 or 802-878-5138 • Fax: 802-878-6765 *Web site: www.analyticalservices.com*

Submitted By: GEI Consultants 455 Winding Brook Dr, Suite 201 Glastonbury, CT 06033 Phone: 860 368 5300 Fax: 860 368 5307	Report To: CLP Deliverable - Lorie MacInnon 113 Adell Rd Sandown, NH 03873 EDP to datagroup@geiconsultants.com Phone: _____ Fax: _____
Project Name: Gowanus Canal Sediment	Invoice To: Melissa Felter GEI Consultants
Job Site:	
P.O. Number: 5878	Phone: 860 368 5300 Fax: 860 368 5307

Sample Identification*	Sample Collection		Sample Matrix (check one)						Analysis Requested
	Date	Time	Water - Raw	Water - Finished	Waste Water	Biosolids	Soil/Sediment	Other	
							X		Clostridium, E. coli, Fecal
							X		Coliforms, Enterococcus
							X		Cryptosporidium, Coliphage

*Sample ID should match ID written on the sample containers and data sheets. Sample ID will appear on the report for identification.

Relinquished By (signature)	Date/Time	Received By (signature)	Date/Time

Field Comments:
Region II EPA EDD
CLP Data package

Lab Comments:

White – To accompany samples • Yellow – Sampler Copy

Nautilus Environmental

☐ **CALIFORNIA**
5550 Morehouse Drive • Suite 150
San Diego, California 92121
Phone 858.587.7333
Fax 858.587.3961

☒ **WASHINGTON**
5009 Pacific Highway East • Suite 2
Tacoma, Washington 98424
Phone 253.922.4296
Fax 253.922.5814

☐ **BRITISH COLUMBIA**
8664 Commerce Court
Burnaby British Columbia Canada V5A 4N7
Phone 604.420.8773
Fax 604.357.1361

Chain of Custody

Date _____ **Page** 1 **of** _____

Sample Collection by: _____

Report to:
Company GEI Consultants
Address 455 Winding Brook Dr.
City Glastonbury State CT Zip 06033
Contact Melissa Felter / Kim Bradley
Phone/Email 860-368-5300 kbradley@geiconsultants.com

Invoice to:
Company GEI Consultants Inc.
Address 455 Winding Brook Dr
City Glastonbury State CT Zip 06033
Contact Melissa Felter
Phone/Email 860-368-5300 mfelter@geiconsultants.com

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NUMBER OF CONTAINERS	COMMENTS	ANALYSES REQUIRED: Acute Toxicity (10-day Neptacherius)	ANALYSES REQUIRED: TIE	ANALYSES REQUIRED	ANALYSES REQUIRED	ANALYSES REQUIRED	ANALYSES REQUIRED	ANALYSES REQUIRED	ANALYSES REQUIRED	ANALYSES REQUIRED	ANALYSES REQUIRED	RECEIPT TEMPERATURE (°C)
			SD	5 gallon Double Poly Bag	1		X	X									

PROJECT INFORMATION	SAMPLE RECEIPT
CLIENT	TOTAL NO. OF CONTAINERS
P.O. NO.	REC'D GOOD CONDITION
SHIPPED VIA:	MATCHES TEST SCHEDULE

SPECIAL INSTRUCTIONS/COMMENTS:

RELINQUISHED BY (CLIENT)	RELINQUISHED BY (COURIER)
(Signature) (Time)	(Signature) (Time)
(Printed Name) (Date)	(Printed Name) (Date)
(Company)	(Company)
RECEIVED BY (COURIER)	**RECEIVED BY (LABORATORY)**
(Signature) (Time)	(Signature) (Time)
(Printed Name) (Date)	(Printed Name) (Date)
(Company)	Nautilus Environmental Log-in No.

Additional costs may be required for sample disposal or storage. Net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

GEI Consultants, Inc./Ecological Division
4601 DTC BLVD., SUITE L100
DENVER, CO 80237
(303) 662-0100

CHAIN-OF-CUSTODY RECORD
Macroinvertebrate

PROJECT: Gowanus Canal Sediment Sampling
PROJECT *(as name will appear on the report)*: 093010 - 2 - 1202
PROJECT MANAGER: Dave Terry / Kim Bradley Contact

Site Name	Sample Type	Sample Date	Sufficient Alcohol? initial & date	Remarks / Special Instructions

Relinquished By:	Date/Time:	Received By:	Date/Time:
Signature:		Signature:	

Attachment E

Field Change Order Form

Field Modification Form
for
Paerdegat Basin , Sediment, Tissue and Porous Surface Sampling
GEI Consultants, Inc.

Date:

Document:

Activity:

Requested Modification:

Rationale:

Attachments:

Project Manager:

Attachment F

Project Manager and Data Validation Resumes

BARRY L. GIROUX, P.E., LEP
SENIOR PROJECT MANAGER

resume

Mr. Giroux is a principal environmental engineer with GEI. He has 30 years of environmental engineering experience, including consulting engineering, government regulatory, and contracting. Mr. Giroux's primary experience is in regard to hazardous and industrial waste remediation and management, including compliance with environmental regulations.

RELEVANT PROJECT EXPERIENCE

Shelly Ditch Removal Action Raybestos Products Company (Raybestos), Raytech Corp, Crawfordsville, IN. Project Manager for a time-critical removal action at the Shelly Ditch. The removal action was required pursuant to a Unilateral Administrative Order issued by the USEPA. The Order required the removal and proper disposal of soils containing elevated levels of polychlorinated biphenyls (PCB) and lead along a length of county drainage ditch extending in excess of 3,000 feet. Work included preparation of remedial actions plans and remedial designs for approval by the EPA, and oversight of the removal action including confirmation sampling, air monitoring, and general oversight of all contractor activities. A final closure report was prepared and submitted to EPA.

Occum Park Brownfield Redevelopment, The Norwich Community Development Corp. Inc., Norwich, CT. Project engineer and manager of PCB remediation activities, which were completed under the U.S. EPA risk-based standards in 40 CFR 761.61(c). GEI, under a CTDEP Voluntary Cleanup Program, developed a cleanup plan which capped certain waste to remain on site while removing other waste and soils containing PCBs. Regulatory alternatives allowed under the CTDEP Remediation Standard Regulations were utilized including an engineered control variance and environmental land use restriction (ELUR). In addition, GEI designed a municipal recreation facility at the site including play areas, fields, walkways and river access. GEI was responsible for remediation and construction oversight and preparation of all closure reports.

Facility Restoration, The United Illuminating Company, Bridgeport, CT. Project Manager for overall project management for decontamination and demolition of the former Steel Point electric generating facility located in Bridgeport, Connecticut and investigation and remediation of impacted soil. The eight-story, 95,000-square-foot facility occupied the 15-acre site. Abatement included asbestos, polychlorinated biphenyls, mercury, chemical containers, and contaminated building debris. Remedial action plans were coordinated with the City of Bridgeport's overall development plan for the Steel Point Peninsula which includes major waterfront commercial, retail,

EDUCATION
B.S., Civil Engineering, University of Connecticut

EXPERIENCE IN THE INDUSTRY
36 years

EXPERIENCE WITH GEI
21 years

REGISTRATIONS AND LICENSES
Licensed Environmental Professional, CT No. 139
Professional Engineer, CT No. 12395

CERTIFICATIONS
OSHA Supervisor Hazard Waste Operations and Emergency Response Training

GEI Consultants

and residential developments. Phase I through III investigations were completed and a "Phase One" remedial action plan was prepared and implemented. GEI was the LEP for this work, which was conducted under the CTDEP's voluntary remediation program. Remediation activities included excavation and off-site disposal of over 6000 cubic yards of soil containing petroleum hydrocarbons, polycyclic aromatic hydrocarbons and/or polychlorinated biphenyls. Work associated with removal included installation of sheet piles, construction of soil storage areas and treatment of dewatering waste waters.

Site Investigation and Remediation, Registered Environmental Consultant Program, Confidential Client, North Carolina, Ongoing. Project Manager for oversight of investigation and remediation activities being conducted under North Carolina's Registered Environmental Consultant program. GEI works for the corporate owner of the site and is responsible for peer review of activities conducted by a local consultant. Contaminant concerns at the site include chlorinated solvent in overburden and bedrock groundwater, and PCBs in a fill area. Remediation work, which was directly supervised by GEI, included the excavation and disposal of over 50 buried drums. Extensive investigations of the extent of solvents in groundwater (on and off site) and of the extent of PCBs in fill have been completed. Investigation methods have included conventional soil borings and groundwater monitoring wells in addition to a membrane interface probe survey.

Goffe Street Substation Closure, The United Illuminating Company (UI), New Haven, CT. Project manager of Phase I, II and III environmental site investigations of this electric substation parcel. All buildings and structures were demolished and the property was transferred. Work also included preparation of a remedial action plan, and plans and specifications for remediation of PCB and TPH impacted soil. PCB-impacted soil was remediated in accordance with the Remediation Standard Regulations and under the U.S. EPA performance-based remediation standards in 40 CFR 761.61(b).

Transfer Act and Compliance Order Site Investigation and Remediation, Sargent Manufacturing Company, New Haven, CT. Project Manager and LEP for investigation and remediation of this site. Architectural hardware is manufactured at the site. Areas of concern include former wastewater treatment lagoons, plating operations, a former drum storage area, a former drum disposal area, and miscellaneous petroleum release areas. GEI is presently overseeing operation and maintenance of the soil vapor extraction/air sparging and oil recovery treatment system.

Phase III Remedial Investigation of Former CT Coke Company Site, The United Illuminating Company (UI), New Haven, CT. Project Manager and licensed environmental professional (LEP) for Phase I, II, and III investigations at UI's retained portion of the former Connecticut Coke Company site. This 10-acre parcel is contaminated with coal tar, petroleum products, and ash. Investigations have been conducted to evaluate the site's environmental conditions relative to the Connecticut Remediation Standard Regulations. A Remedial Action Plan and a request for use of engineered controls has been prepared and submitted to the DEP.

Jet Fuel Remediation, Bradley International Airport, Connecticut Dept. of Transportation, Windsor Locks, CT. Project Manager regarding investigation and remediation of a jet fuel release at Bradley International Airport in Windsor Locks, Connecticut. The area of contamination was at the location where the a new terminal building was constructed. Work completed included supplemental investigations to better define the extent and degree of contamination and preparation of a technical memorandum recommending the preferred remedial alternative for the site. The remedial alternatives were presented to CTDEP and conceptually approved. Pilot-scale testing was conducted to evaluate the following technologies: high vacuum extraction for free product removal; soil vapor extraction; air sparging; and bioventing. The final remedy selected was an air sparging and soil vapor extraction system utilizing horizontal wells.

Steel Plant Closure and Remedial Design, Carpenter Technology Corporation, Bridgeport, CT. Project Manager for a facility closure and environmental assessment/remedial design for Carpenter Technology's former steel plant in Bridgeport, Connecticut. This project included an extensive field investigation to characterize the environmental conditions at the site; a health and environmental risk assessment for various development scenarios; and remedial design including contract plans and specifications (soil excavation/disposal and building dust cleanup), regulation compliance, and construction inspection. Extensive coordination was involved with the CTDEP regarding negotiating a Consent Agreement and successfully completing the remediation to ready the site for real estate development.

Consent Order and Transfer Act Compliance, Stanadyne Corporation, Windsor, CT. Project Manager for investigation and remediation activities being conducted under a Consent Order with CTDEP regarding transfer of this establishment. Responsibilities for investigation and remediation are divided between Stanadyne and the former owner. GEI is responsible for oversight of activities conducted by the former owner's consultant and for investigation and remediation of Stanadyne's environmental items. The facility has been a manufacturing facility since 1948. Over 120 site activities were investigated from which over 50 environmental items were identified for investigation. Conditions of note with regard to the Remediation Standard Regulations were identified at 39 environmental items.

Transfer Act Compliance, Corbin Russwin, Berlin, CT. Project Manager for investigation and remediation activities being conducted under the Transfer Act and RCRA Corrective Actions. Responsibilities for investigation and remediation are divided between Corbin Russwin and the former owner. GEI is responsible for oversight of activities conducted by the former owner's consultant that are required under the Transfer Act and for conducting actions required under RCRA or TSCA. The facility manufactures architectural hardware. There have been over 50 areas of concern identified at the site. Investigations have been required at most of these areas and remediation has been completed or is required at several of the areas. Remediation activities have included dual phase extraction, groundwater pump and treat, and excavation with off-site disposal.

Reflexite Investigation and Remediaion, Reflexite Corporation, New Britain, CT. Project Manager and LEP for investigation and remediation of this site at which hand tools were formerly manufactured. Work has included supplemental investigations and remediation of solvent contaminated soil located below the building floor. GEI prepared plans and specifications for the remediation work and supervised the remediation activities. Other smaller impacted areas were also remediation and post-remediation groundwater monitoring was completed. A sub-slab depressurization system was installed, to prevent vapor intrusion, an environmental land use restriction was established, and an LEP verification report is being prepared.

KeySpan MGP Services Program, National Grid, Brooklyn, NY. MGP Site Feasibility Study, Former Nassau Gas Works, Brooklyn, NY. Project Manager for preparation of feasibility study of remedial alternatives. The former MGP property is located on an approximately 13 acre parcel within the former Brooklyn Navy Yard. The MGP was operating by 1873 and ceased operations prior to 1935. The FS describes the development, screening, and detailed evaluation of remedial alternatives and was conducted in accordance with New York State Department of Environmental Conservation (NYSDEC) requirements.

Licensed Environmental Professional Verification, Bridgeport Energy LLC, Bridgeport, CT. Licensed Environmental Professional (LEP) for the investigation and verification of remediation for a former warehouse and illegal commercial hazardous waste storage facility. Documents prepared under Connecticut's voluntary remediation program included an environmental conditions assessment form (ECAF) and a parcel verification which verified that the site had been remediated in compliance with Connecticut's Remediation Standard Regulations (RSRs). The verification was not audited. This project included the review of remedial activities and several reports prepared by previous consultants and

supplemental groundwater and soil sampling and analysis. A request for approval of alternative cleanup criteria was prepared. The site was subsequently transferred several times and supplemental investigations and preparation of transfer act forms were completes.

On-Call Environmental Services, Connecticut Statewide, Connecticut Department of Public Works, Winsted, CT. Project Manager for Phase II site investigation under the Army's Installation Restoration Program at the Stratford Armory and Groton/New London Airport. Project manager for Phase I, II, and III investigations at the Seaside Regional Center in Waterford under the Connecticut Transfer Act. Mr. Giroux was the primary point of contact with CTDPW and managed all aspects (contractual and technical) of this contract.

Installation Restoration Study of the Naval Submarine Base, Department of the Navy, Groton, CT. Project Manager for work at the Naval Submarine Base in Groton, Connecticut for the United States Navy. This Superfund project included RI/FS investigations at four former waste disposal/release sites, extensive multimedia sampling, including biological and marine sampling and environmental impact assessment, and screening level investigations at nine additional potential waste disposal sites. Remedial designs were prepared at four sites, including closure design and hot spot removal at two landfill sites. Proposed Plan and Record of Decision (ROD) development were also included.

Voluntary Site Remediation, The United Illuminating Company, West Haven, CT. Project Manager and LEP for the voluntary remediation of a former warehouse and present electric substation site. Work included preparation of an environmental conditions assessment form, evaluation of the site's compliance with the Connecticut RSRs, supplemental investigations, post-remediation groundwater monitoring, and submittal of a verification to the DEP that the site had been investigated and remediated in compliance with the Remediation Standard Regulations. This verification was not audited.

On-Call Environmental Services, Connecticut Statewide, Connecticut Department of Transportation (ConnDOT). Project Manager for an on-call environmental services. The project included environmental compliance activities for ConnDOT facilities and environmental evaluations to determine the relative environmental risk associated with land uses in the vicinity of transportation projects; surficial, exploratory, site impact, water quality, and remedial investigations; remedial management planning; both groundwater and soil remedial design development; water supply rehabilitation, including water supply treatment, public supply connection, supply well replacement, and public water supply extension. Construction management tasks include compliance management, surveillance, and inspection.

Investigation and Remediation of UI's Former Skiff Street Service Center, Hamden, Connecticut, The United Illuminating Company. Project Manager and licensed environmental professional (LEP) for Phase III investigation, remedial action plan, and remediation of this petroleum and PCB-impacted site. Remediation included removal of PCB-impacted soil under EPA's self-implementing PCB-remediation waste regulations, and removal of petroleum-contaminated soils from a sheet piled excavation with pre-determined cut lines including permitting and discharge of construction dewatering wastewaters. Final verification that this site was made and accepted by the CTDEP.

Investigation of UI's Vehicle Maintenance Facility, Shelton, Connecticut, The United Illuminating Company. Project Manager and licensed environmental professional (LEP) for Phase I to III environmental site assessments under the Transfer Act. Work included preparation of an ECAF and Form III. Investigation of potential releases of hydraulic oil from vehicle lifts, surfical petroleum contamination, and historical urban fill were completed.

LORIE MACKINNON
DATA VALIDATOR

resume

Ms. MacKinnon is a data validator with 18 years of experience at GEI.

EXPERIENCE IN THE INDUSTRY
19 years

EXPERIENCE WITH GEI
19 years

EDUCATION
B.A., Chemistry, Boston University

RELEVANT PROJECT EXPERIENCE

Self-Employed Contractor, Data Validator. Performing data validation in accordance with the United States Environmental Protection Agency (EPA) Region I, Region II and Region IV, EPA National Functional Guidelines, and New Jersey Department of Environmental Protection (DEP) Guidelines for environmental consulting firms. Responsible for producing data validation reports and data spreadsheets.

Data Validator, GEI Consultants, Inc. Performing data validation in accordance with EPA Region I and Region II, EPA National Functional Guidelines, and New Jersey DEP Guidelines. Responsible for in-house review of all project data.

Inorganic Contract Laboratory Protocol (CLP) Coordinator. Responsible for CLP data management and data package review for the inorganic laboratory to ensure a high level of data quality.

Jacobs Engineering Group Inc. Performed data validation in accordance with Jacobs' modified Region I guidelines.

Independent Consultant. Performed methods development and validation for EPA Method 218.6, Hexavalent Chromium Analysis by High Performance Liquid Chromatography, and EPA Method 610, Polynuclear Aromatic Hydrocarbon Analysis by High Performance Liquid Chromatography. Developed standard operating procedures for both methods, allowing NET to offer these analytical procedures as routine services.

Quality Assurance Coordinator. Responsible for developing and overseeing the laboratory quality assurance and quality control practices to ensure that a high level of data quality is achieved. Responsible for the submission of performance evaluation samples from external regulating agencies and managing a program of internal performance evaluation audits for the Cambridge Division and subcontract laboratories. Acted as the primary contact for state and program-specific certification programs and, as such, was responsible for communicating all audit and PE sample results and corrective action responses.

Supervisor, Wet Chemistry Laboratory. Responsible for

training and performance of all laboratory technicians, as well as troubleshooting and instrument maintenance. Duties also included the scheduling of inorganic work in house, and reviewing and reporting all analytical results. Responsible for the preparation, analysis, and reporting of cyanide under EPA CLP protocol.

Project Manager. Responsibilities included defining the scope of work with a variety of industrial, engineering and governmental clients, developing price quotations, outlining the required quality control/quality assurance, arranging sampling and analytical schedules with the laboratory director and managers, and monitoring the project to its completion, including data review and report production.

Lead Project Chemist. Performed method development, validation, and residue analysis for several pesticide registration studies. Analyses included the use of gas chromatography and high-performance liquid chromatography.

Associate Scientist. Performed inorganic analyses on environmental and industrial samples. Analytical skills included quantitation of analytes by inductively coupled argon emission spectroscopy and atomic absorption spectroscopy under EPA CLP protocols.