NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Remedial Bureau E
625 Broadway, 12th Floor, Albany, NY 12233-7017
P: (518) 402-9813 I F: (518) 402-9819
www.dec.ny.gov

June 26, 2020

Greg Haack, PE
Sr. Facilities Engineer
Capital Projects and Facilities Engineering
Corning Incorporated
Corning, NY 14831

Subject: Corning-Painted Post School District Property Soil Cover Sampling Work Plan, dated June 2020, Site No. 851046, Corning, Steuben County

Dear Mr. Haack:

The New York State Department of Environmental Conservation (NYSDEC), in consultation with New York State Department of Health (NYSDOH), reviewed the June 2020 Corning-Painted Post School District Property Soil Cover Sampling Work Plan and accept it.

Please note that while the State understands that glass cutting and engraving produces waste, it does not produce large chucks of glass, furnace bricks or ash. According to Sinclaire and Spillman (1997) the class cutting and engraving industry in Corning obtained blanks, where this type of waste is produced, from relatively few sources.

It is the State's expectation that the sampling work and any necessary corrective measures will be completed during the summer of 2020 while school is not in session.

Sincerely,

Samantha Salotto
Assistant Engineer
Remedial Bureau E, Section A
Division of Environmental Remediation

Ec: D. Harrington
M. Cruden
K. Cloyd, Region 8

D. Pratt, Region 8
M. Doroski, NYSDOH
J. Deming, NYSDOH
M. Vetter, Parsons
J. Novotny, Corning Incorporated
M. Taegtmeier, Corning Incorporated
A. Ruiter, AECOM
C. Hunt, AECOM

AECOM

CORNING-PAINTED POST SCHOOL DISTRICT PROPERTY
SOIL COVER SAMPLING WORK PLAN

Study Area
Corning, NY

NYSDEC Project ID 851046

June 2020

Prepared for:

Corning Incorporated
Corning, New York

Prepared by:

AECOM
Latham, New York 12110

Project Number 60599493

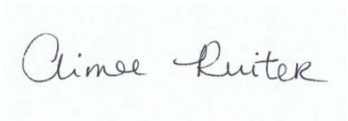
AECOM

Certifications

I, Aimee Ruiter, 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 standards and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Executed on the 25th day of June 2020

AECOM



_____ (Signature)

Senior Project Manager

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LIST OF ACRONYMS

AECOM	AECOM Technical Services, Inc.
ASP	Analytical Services Protocol
CAMP	Community Air Monitoring Plan
cfs	cubic feet per second
DD	Decision Document
DUSR	Data Usability Summary Report
EDD	electronic data deliverable
ELAP	NYSDOH Environmental Laboratory Approval Program
FEMA	Federal Emergency Management Agency
ft amsl	feet above mean sea level
ft bgs	feet below ground surface
HASP	Health and Safety Plan
IDW	investigation-derived waste
IRM	Interim Remedial Measure
in bgs	inches below ground surface
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OU	Operable Unit
PC	public-conservation zoning
PCB	polychlorinated bi-phenyls
PDD	Proposed Decision Document
PID	photoionization detector
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
SCO	soil cleanup objective
SOP	Standard Operating Procedure
SVOC	semi-volatile organic compound
TAL	Target Analyte List

LIST OF ACRONYMS (Continued)

TCL	Target Compound List
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VOC	volatile organic compound
WESTON	Weston Solutions, Inc.

1. INTRODUCTION

This Soil Cover Sampling Work Plan (Soil Cover Sampling Plan) has been prepared for the Corning-Painted Post School District property located in Operable Unit 3 (OU3) of the Study Area in Corning, New York, pursuant to the terms of an Order on Consent and Administrative Settlement (NYSDEC, 2017f). The December 2017 Order on Consent is between Corning Incorporated and the New York State Department of Environmental Conservation (NYSDEC) to perform remedial activities and additional characterization activities within the Study Area. This Soil Cover Sampling Plan has been prepared by AECOM Technical Services, Inc. (AECOM) on behalf of Corning Incorporated.

The Study Area is NYSDEC Project ID No. 851046 located in the City of Corning, New York, as illustrated on Figure 1-1. In general, the Study Area is bound by the Chemung River to the south; Post Creek and Interstate 86 to the east and north; and the Guthrie Medical Center, the City of Corning Fire Department, and Centerway to the west. The Study Area is separated into five operable units (OUs), based on location and land use, to assist in advancing properties through the remedial process. The five OUs in the Study Area are identified as follows: the Residential Area (OU1), the Residential Area at the Eastern End of Corning Boulevard (OU2), School/Community Use Areas (OU3), Flood Control Areas (OU4), and the Residential Expansion Area (OU5). The Study Area and OUs are depicted on Figure 1-2. This Soil Cover Sampling Plan applies only to the Corning-Painted Post School District property located in OU3.

In 2012, during a capital improvement project, the Corning-Painted Post School District (School District) encountered fill material that they described as containing ash, brick, and glass in the subsurface soils of the School District property and the City of Corning Memorial Stadium property, which the School District leases from the City of Corning. As part of the capital improvement project, the School District placed cover soil and a demarcation layer in areas where it excavated soil at the Corning-Painted Post School District and the City of Corning Memorial Stadium properties (see the School District soil cover map contained in Appendix A).

On June 27, 2014, Corning Incorporated entered into an Order on Consent and Administrative Settlement (NYSDEC, 2014) with NYSDEC to perform characterization activities within OU1,

OU2, OU3 and OU4 of the Study Area. On behalf of Corning Incorporated, Weston Solutions , Inc. (WESTON) prepared a Study Area Characterization Work Plan dated June 2014 (WESTON, 2014a), which was Attachment B to the June 2014 Order on Consent. Subsequent to the June 2014 Order on Consent, NYSDEC approved Study Area Work Plan Addendum 1 (Work Plan Addendum 1), Study Area Work Plan Addendum 2 (Work Plan Addendum 2), Study Area Work Plan Addendum 3 (Work Plan Addendum 3) and Study Area Work Plan (Work Plan Addendum 4) (WESTON, 2014b; WESTON, 2015a; WESTON, 2015b; WESTON, 2017). Collectively, the June 2014 Study Area Characterization Work Plan and its Addenda (as modified, amended, and approved by NYSDEC) are referenced herein as the Study Area Work Plan.

The purpose of the characterization activities performed in OU3 of the Study Area, under the Study Area Work Plan, was to define the nature and extent of the following material (collectively referred to as "Subject Material"):

1. Soil with concentrations greater than the applicable NYSDEC Soil Cleanup Objectives (SCOs; New York Codes, Rules and Regulations (NYCRR) Subpart 375-6)[1]
2. Layers of fill material containing ash, brick, and/or glass[2] with concentrations greater than the applicable SCOs; and
3. Layers of fill material containing ash, brick, and/or glass that do not contain concentrations greater than the applicable SCOs[3].

In accordance with Section II.5 and Appendix A, Section III of the June 2014 Order on Consent, Interim Remedial Measures (IRMs) were proposed for the Corning-Painted Post School District, the City of Corning Memorial Stadium, and the Corning Christian Academy properties based on

[1] NYSDEC restricted residential SCOs are applicable to the Corning-Painted Post School District property.

[2] A "layer of fill material containing ash, brick, and/or glass" is defined as a non-native material containing ash, brick, and/or glass with a thickness of greater than 1 inch.

[3] Layers of fill material containing ash, brick, and/or glass which do not contain concentrations greater than the applicable SCOs are being remediated at the direction of NYSDEC. Remediation of this material is not an admission that remediation is necessary and/or that such materials represent a potential for exposure.

analytical data collected during field investigation activities performed under the Study Area Work Plan. Three Draft IRM Work Plans (one for each property in OU3) were submitted to NYSDEC in May 2016 and NYSDEC accepted written comments about the Draft IRM Work Plans for 30 days, from May 5, 2016 through June 6, 2016. The Corning-Painted Post School District submitted written comments to NYSDEC and the New York State Department of Health (NYSDOH) in a letter dated June 20, 2016 (CPPSD, 2016). NYSDEC responded to the Corning-Painted Post School District in a letter dated September 20, 2016 (NYSDEC, 2016). No other written comments were received.

Following public comment, the IRM Work Plans were approved by NYSDEC in a series of letters from Kelly Cloyd dated January 26, 2017 (NYSDEC, 2017a; NYSDEC, 2017b; NYSDEC, 2017c). The three NYSDEC-approved IRM Work Plans include:

- Interim Remedial Measures Work Plan, Corning-Painted Post School District Property, November 10, 2016 (WESTON, 2016a).
- Interim Remedial Measures Work Plan, City of Corning Memorial Stadium Property, November 10, 2016 (WESTON, 2016b).
- Interim Remedial Measures Work Plan, Corning Christian Academy Property, November 10, 2016 (WESTON, 2016c).

On March 9, 2017, NYSDEC issued a Proposed Decision Document (PDD) for public comment which proposed a remedial alternative of excavation of Subject Material with a cover system for properties in OU3 (NYSDEC, 2017d). The proposed remedial alternative in the PDD included soil excavation from 0 to 1 feet below ground surface (ft bgs) with a cover system at the Corning-Painted Post School District property and soil excavation from 0 to 2 ft bgs with a cover system for the City of Corning Memorial Stadium and Corning Christian Academy properties. Following the public comment period, NYSDEC issued a final Decision Document (DD) on July 12, 2017 describing the selected remedial alternative for properties in OU3 (NYSDEC, 2017e).

The approved IRM work, which is consistent with the NYSDEC DD, was completed in July and August 2017 and included soil excavation, removal, and backfill/restoration as detailed in the NYSDEC-approved IRM Work Plans listed above.

The NYSDEC DD requires, as an element of the selected remedy, a design-phase investigation to be conducted at the Corning-Painted Post High School property to determine if the existing 1-foot soil cover meets the restricted residential SCOs. This Soil Cover Sampling Plan has been prepared to describe the design-phase investigation to be conducted at the Corning-Painted Post High School property, in the areas where the School District placed cover soil and a demarcation layer as part of the capital improvement project and where characterization activities were not conducted under the Study Area Work Plan, to meet the requirement of the NYSDEC DD.

1.1 SOIL COVER SAMPLING PLAN OBJECTIVES

The purpose of this Soil Cover Sampling Plan is to gather additional data to determine if the existing 1-foot cover at the Corning-Painted Post School District property meets the restricted residential SCOs.

1.2 ORGANIZATION OF THIS DOCUMENT

This Soil Cover Sampling Plan is organized into the following sections:

- **Section 1 – Introduction.** This section contains an introduction to the project and the objectives of the sampling activities.
- **Section 2 – Study Area Description and History.** This section contains a description and history of the Study Area.
- **Section 3 – Environmental Setting.** This section contains a brief description of the location, land use, topography and drainage, geology, hydrogeology, and ecological setting of the Study Area.
- **Section 4 – Soil Cover Sampling Activities.** This section contains a description of the sampling activities to be conducted, including the locations, types, and numbers of samples to be collected, the rationale for sample collection, and the method of sample collection for the planned work.
- **Section 5 – Project Management.** This section contains information regarding the scheduling of the field work, as well as the reporting schedule. Additionally, this section provides details about project logistics, including project controls, management, and community relations.

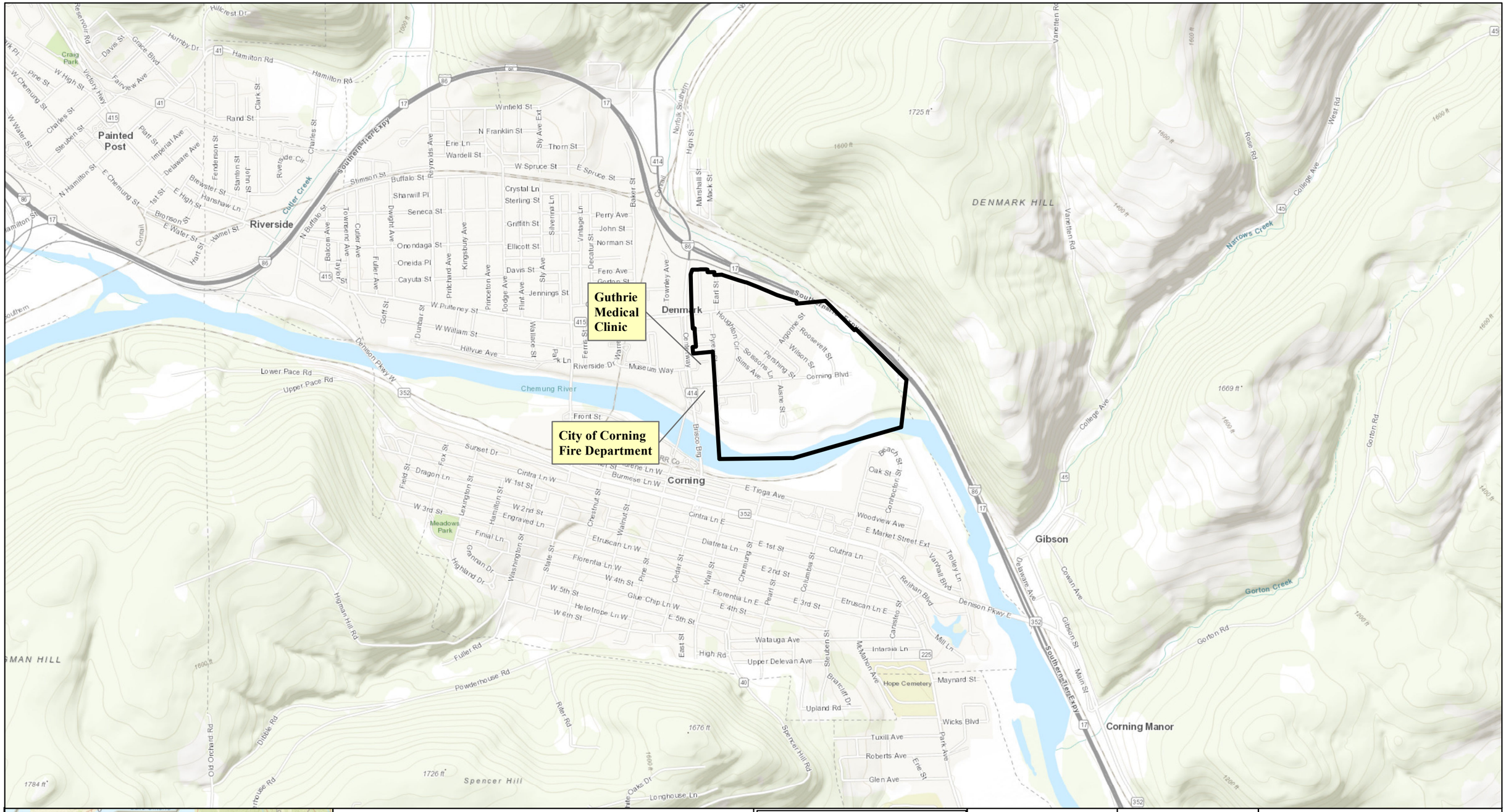
- **Section 6 – References.** This section includes references for documents that were cited in this Work Plan.

Tables and figures are provided at the end of each section for ease of review.

A Health and Safety Plan (HASP), Community Air Monitoring Plan (CAMP), Quality Assurance Project Plan (QAPP), and Standard Operating Procedures (SOPs) are included in the Appendices of this Soil Cover Sampling Plan.

SECTION 1

FIGURES



NOTES: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P,

Study Area
Corning, NY

AECOM

Figure 1-1
Location of Study Area

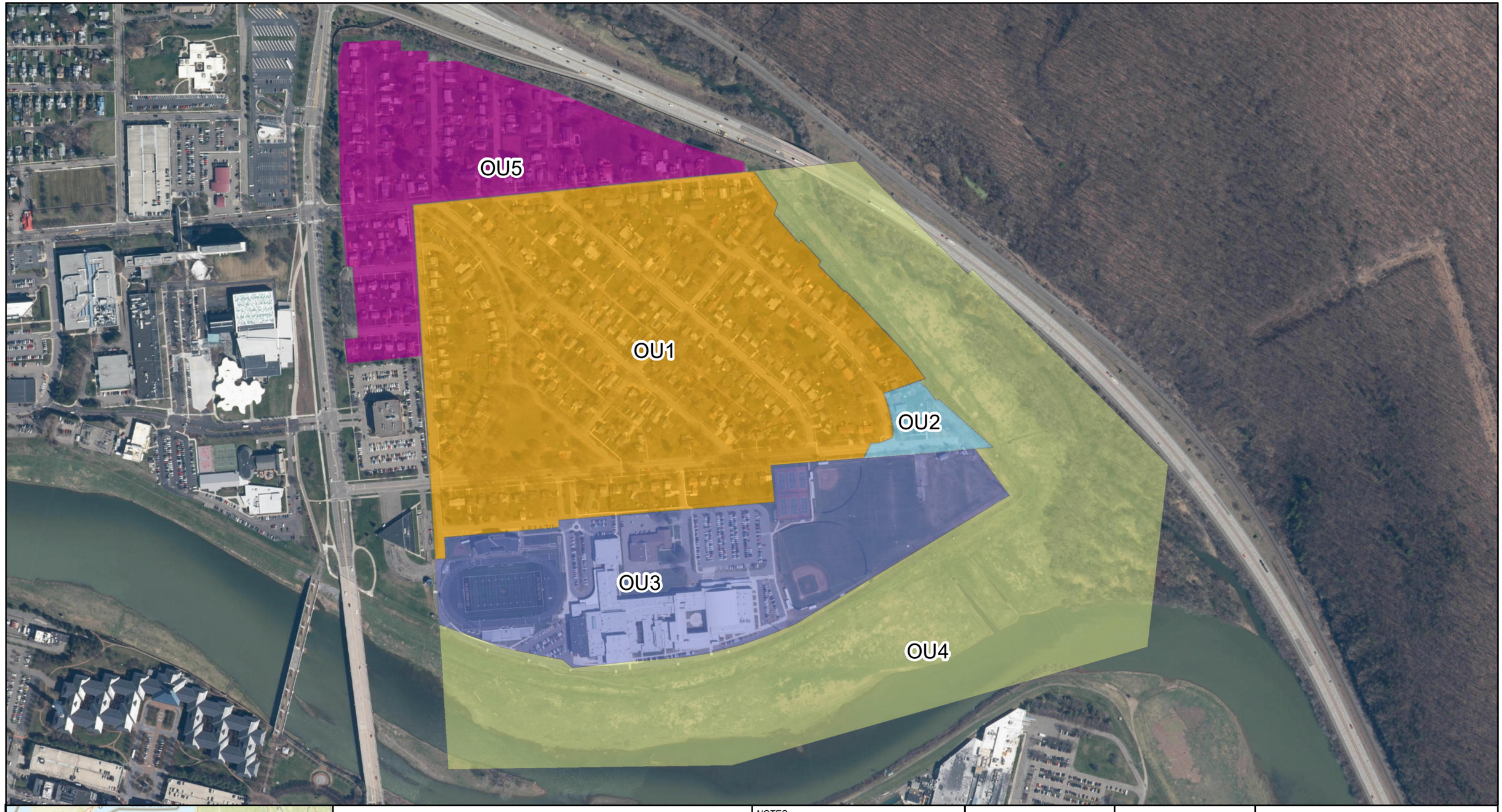
N

0 400 800 1,200 1,600 2,000 Feet

0 260 520 780 Meters

Document Name: F1-1 Topo.MXD

5/26/2020



Legend

- OU1 = Residential Area
- OU2 = Residential Area at the Eastern End of Corning Boulevard
- OU3 = School/Community Use Areas
- OU4 = Flood Control Areas
- OU5 = Residential Expansion Area

NOTES:
Base Imagery: Robinson Aerial Imagery, Dec 2015
Coordinate System: NAD 1983 State Plane New York Central Feet
Datum: NAD83. Units: Feet

Study Area
Corning, NY

AECOM

Figure 1-2
Study Area Operable Units

N

0 400 800 Feet

0 80 160 240 Meters

Document Name: F1-1 OUs.MXD

3/18/2020

2. STUDY AREA DESCRIPTION AND HISTORY

2.1 STUDY AREA LOCATION AND DESCRIPTION

The Study Area is located in the City of Corning, New York, as illustrated on Figure 1-1. In general, it is bound by the Chemung River to the south; Post Creek and Interstate 86 to the east and north; and the Guthrie Medical Center, the City of Corning Fire Department, and Centerway to the west. The Study Area is separated into five OUs, which are depicted in Figure 1-2:

1. OU1 – Residential Area (includes 212 residential properties)
2. OU2 – Residential Area at the Eastern End of Corning Boulevard (includes five residential properties)
3. OU3 – School/Community Use Areas (includes the Corning-Painted Post School District, Corning Christian Academy, and City of Corning Memorial Stadium properties)
4. OU4 – Flood Control Areas
5. OU5 – Residential Expansion Area (includes 109 residential properties)

2.2 STUDY AREA HISTORY

The City of Corning has a long history of manufacturing, particularly in brick and glassmaking. Historical references indicate that in the late 1800s and early 1900s, one of the country's largest brick manufacturers and more than sixty glass manufacturers were located in the City of Corning (Dimitroff and Janes, 1991) (Sinclaire and Spillman, 1997), including Corning Incorporated, which was formerly known as Corning Glass Works. During that time frame, coal was the primary fuel source in the Corning, New York area and most of the local industries and municipalities used coal to heat their furnaces. In the early 1900s, when natural gas was introduced to the region, some industries converted their fuel sources to natural gas.

Between 1949 and at least 1968, the City of Corning operated a municipal incinerator that created significant volumes of ash. Historical City Council meeting minutes indicate that the City applied ash and cinders to roadways within the City to control ice during the winter months during, at least, the mid-1950s (City of Corning, 1936; 1941; 1958; 1959). These records also indicate that when

land within the Study Area (now comprising OU3) was being considered for redevelopment as a school in the late 1950s, the City of Corning stated that it would require "a considerable amount of work and expense involved in filling and grading to render the track suitable for recreational and educational purposes." (City of Corning, 1950). Ultimately, a school that opened in 1962 was constructed on this portion of the Study Area.

The Chemung River overflowed its banks several times during the City of Corning's history; this resulted in construction and improvement of flood control structures within the Study Area on multiple occasions, including in the mid-1940s and again after Hurricane Agnes in the mid-1970s, according to NYSDEC and U.S. Army Corps of Engineers (USACE) records (USACE, 1941; USACE, 1973). Such construction efforts would have likely required the import of significant volumes of material of uncertain origin, the removal or relocation of material deemed unsuitable as foundation for earthworks, the creation and filling of borrow areas from which soils suitable for construction were obtained, and other potential grading and filling activities. These activities occurred within and surrounding the perimeters of the Study Area, including along the Chemung River, along Post Creek, and along what is now Interstate-86 (USACE, 1941; USACE, 1973).

Over time, the land use within the Study Area has developed from farmland into a residential area and a school/community use area. In general, aerial photographs indicate that the development of the residential area north of Corning Boulevard began prior to 1938 along Pyrex Street and Houghton Circle. The residential area subsequently expanded in an easterly direction across farmlands until about 1964, by which time the Study Area was mostly developed. During development activities, fill material was commonly used as sub-grade material for construction, to fill in low-lying areas and to serve as an aid to drainage.

Through a title search of property deeds, it was found that part of the Study Area[1] encompasses lands previously owned by Corning Homes, Inc. (a residential developer not affiliated with Corning Incorporated). The deeds for these properties contained a condition that allowed Corning

[1] This portion includes OU1, OU2, OU3 and OU4.

Glass Works (not a party to the transaction) to maintain structures, buildings, and "ash dumps as now located" on the properties. Despite reviewing available historical maps, aerial photographs, documents, and public records, Corning Incorporated has not, to date, located any maps or records that depict the location, if any, of potential "ash dumps" as referenced in the deeds (i.e., that may have existed as of 1920).

In 2012, during a capital improvement project at the Corning-Painted Post High School located in OU3, within the southern portion of the Study Area, fill material that the Corning-Painted Post School District described as containing ash, brick, and glass was encountered in the subsurface soils. During the capital improvement project, the Corning-Painted Post School District's consultant tested excavated material to determine appropriate disposal methods. A review of a summary of the analytical results for these samples, prepared by the Corning-Painted Post School District's consultant for NYSDEC, indicates that over 200 samples were collected and analyzed for various constituents. The majority of the constituents were either not detected or were reported at concentrations less than the SCOs. The primary constituents that exceeded the SCOs in the excavated materials were lead, cadmium, and arsenic.

In this Soil Cover Sampling Plan, the term "fill" is used in several contexts. First, the term is used to refer to sub-grade construction material such as that found at the high school property and other material containing brick, ash, and/or glass (i.e., "fill material containing ash, brick and/or glass"). The term is also used to describe cover or backfill, such as top soil and clay or sand, that is brought in to support lawn and garden growth. The terms "backfill" and/or "cover" will be used in this Soil Cover Sampling Plan to describe materials that may be brought in to support lawn and garden growth to distinguish such materials from other references to previously existing fill material.

3. ENVIRONMENTAL SETTING

3.1 LAND USE

The Study Area consists of approximately 201 acres of land located on the eastern side of the City of Corning, New York along the northern bank of the Chemung River, northwest of the confluence with Post Creek (see Figure 1-1). The Study Area includes the Corning-Painted Post School District property; the Corning Christian Academy property; the City of Corning Memorial Stadium property; a residential area consisting of 326 individual properties; and flood control areas along the Chemung River and Post Creek.

The Corning-Painted Post School District property is zoned as public-conservation (PC) and is classified as School or Athletic Field. Key features of the Corning-Painted Post School District property are illustrated on Figure 3-1, including the newly constructed parking lot, roadway and sidewalk areas, and natural turf fields.

3.2 REGIONAL TOPOGRAPHY AND DRAINAGE

The Study Area is relatively flat with a slight gradient to the south and east. The Corning, New York 1976 U.S. Geological Service (USGS) 7.5-minute topographic quadrangle map indicates that the Study Area is approximately 929 feet above mean sea level (ft amsl). Within a 1-mile radius of the Study Area, the ground surface elevation ranges from 915 ft amsl to 1,459 ft amsl, with two steep elevation changes, one located to the north and one to the east.

Surface water within the Study Area generally flows south/southeast toward the Chemung River. Storm water is believed to be conveyed to the river through one or more storm drains located in the southeast corner of the Study Area. While the flow of Post Creek and the Chemung River have changed over time and have been altered for flood control, drainage and development purposes, surface flow in these waterways has generally been toward the south/southeast. Surface water from the confluence of Post Creek and the Chemung River flows southward to where it ultimately joins the Susquehanna River. Due to the proximity of the Chemung River and Post Creek, OU4 is located within both the Federal Emergency Management Agency (FEMA) 100-year and 500-year flood zones (FEMA, 2002).

The Chemung River flows along the southern portion of the Study Area and has a drainage area of approximately 2,006 square miles. Measured daily flows range from a minimum of 640 cubic feet per second (cfs) to 20,200 cfs, with median and mean flows of 1,820 and 3,620 cfs, respectively, based on 38 years of records. The Chemung River is designated as Class C water in the New York State classification system (USGS, 2014). Class C waters are designated as suitable for non-contact activities and are best used for supporting fisheries.

The much smaller, second order Post Creek along the eastern edge of the Study Area also has a Class C designation in the vicinity of the Study Area. The riparian zone immediately adjacent to Post Creek is wooded.

3.3 REGIONAL GEOLOGY

The Study Area is located in the Chemung River valley and contains predominately sand and gravel deposits of glaciofluvial origin and more recent alluvial deposits. The river valley deposits are on the order of 100-feet thick in the vicinity of the Study Area. These river valley deposits are underlain by low-permeability shale/siltstone bedrock (Miller, et al., 1982). In the vicinity of the Study Area, a low permeability, lacustrine silt and clay layer (approximately 10-feet thick) is present about 30 ft bgs (Miller, et al., 1982).

3.4 REGIONAL HYDROGEOLOGY

The saturated portions of the Chemung River valley deposits are recharged principally by infiltration of precipitation. This valley-filled glacial/alluvial aquifer is generally unconfined (i.e., the water table forms the upper boundary of the aquifer) and saturated approximately to the level of nearby rivers (such as the Chemung River) (Olcot, 1995). In the higher topographic portions of the Study Area, the depth to the water table is expected to be on the order of 20 to 25 ft bgs; however, groundwater levels may be deeper where supply wells actively extract groundwater from the valley aquifer. Groundwater in the valley aquifer generally flows toward and discharges to nearby rivers/creeks; however, groundwater flow directions can be locally altered by supply well withdrawals from the valley aquifer.

3.5 ECOLOGICAL SETTING

Much of the Study Area is composed of a terrestrial cultural ecological community created and maintained by human activities. It has been modified by human influence to such a degree that the physical conformation of the substrate and the biological composition of the resident ecological community is substantially different from the character of the substrate or community as it existed prior to human influence. The vegetative ground cover at the Corning-Painted Post School District property is primarily mowed lawn with trees.

AECOM

SECTION 3

FIGURE

1 Corning-Painted Post School District Property

NOTES: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the

Study Area
Corning, NY

AECOM

Figure 3-1
Corning-Painted Post School District
Property Features

N

0 400 800 1,200 1,600 2,000 Feet

0 260 520 780 Meters

Document Name: F3-1 CPPSD.MXD

3/18/2020

4. SOIL COVER SAMPLING ACTIVITIES

This section describes the sampling planned under this Soil Cover Sampling Plan to determine if the existing 1-foot cover soil, in the areas where the School District placed cover soil and a demarcation layer as part of the capital improvement project and where characterization activities were not conducted under the Study Area Work Plan, meets restricted residential SCOs and shows no evidence of Subject Material.

The methodologies may be adjusted in the field based upon a variety of factors including field conditions, selected subcontractor equipment, and other necessary adjustments. Corning Incorporated will notify NYSDEC of any proposed changes or deviations from the approved Soil Cover Sampling Plan (including any proposed use of investigation methodologies other than those described below), and NYSDEC verbal approval, followed by written confirmation, will be obtained prior to implementation of any changes.

Planned sampling activities include a combination of surface and shallow soil sampling. The number of samples is described in the subsequent subsections. Final locations will be established based on utility clearance, accessibility, and discussions with the property owner and the NYSDEC project manager. SOPs for sample collection, handling, and shipment are provided in Appendix B. Utility clearance procedures are described in Appendix C.

4.1 WRITTEN ACCESS CONSENT

The Corning-Painted Post School District property is not owned by or under the control of Corning Incorporated or NYSDEC; therefore, activities proposed in this Soil Cover Sampling Plan will be performed under a written access agreement between Corning Incorporated and the Corning-Painted Post School District. The Corning-Painted Post School District will be notified by AECOM of pending activities on the owner's property in accordance with the terms of the access agreement.

4.2 FIELD INVESTIGATION METHODOLOGIES

4.2.1 Surface and Shallow Soil Sampling

The intent of the surface and shallow soil sampling is to collect one sample from the topsoil and one from the underlying bank run backfill. Surface soil samples will be collected for analysis from the topsoil excluding the vegetative cover or sod layer. Shallow soil samples will be collected from the bank run gravel below the topsoil. The field geologist will determine which portion of the core is topsoil and which portion is bank run gravel. If no bank run gravel is identified, one sample will be collected from 0 to 1 foot bgs. The contents of the soil core will be sampled from 0 to 1 foot bgs. If the transition between topsoil and bank run gravel cannot be determined, then topsoil will be collected from 0-6 inches bgs and the bank run gravel will be sampled from 6-12 inches bgs. Sampling starts below the vegetative cover or sod.

Prior to sample collection, visible vegetative matter (i.e., sod layer) will be removed. Surface soil and shallow soil samples will be collected using a small Geoprobe rig. If recovery is poor, a hand-held steel soil auger, or a hand-held stainless steel scoop may be used. The soil will be described, noting the color, moisture content, texture, layering, evidence of disturbance (foreign debris), and the distribution/abundance of roots. If present, layers of fill material containing ash, brick, and/or glass will be noted in the field logs. Surface and shallow soil samples will be homogenized (with the exception of samples to be analyzed for volatile organic compounds [VOCs]) and placed directly into appropriate sample containers.

If the Geoprobe method is used, soil sampling will be conducted on a continuous basis from the ground surface, excluding the vegetative layer (i.e., sod layer), to 1 ft bgs using a 2-inch diameter, macrocore sampler. Retrieved soil samples will be examined in the field for physical description by a qualified AECOM geologist and screened using a photoionization detector (PID). Layers of fill material containing ash, brick, and/or glass, if any, will be identified in the field by the AECOM geologist. A layer of fill material is defined as a non-native material containing ash, brick, and/or glass with a thickness greater than 1 inch. If a demarcation layer is observed in the retrieved soil sample, it will be noted. The Geoprobe rods and associated drilling equipment will be cleaned between boring locations using the procedures described in Appendix B.

Soil samples and appropriate quality control (QC) samples (e.g., duplicate samples) will be placed in appropriate sample containers, in iced coolers, and shipped with completed chain-of-custody documentation to TestAmerica for analysis.

The sample locations will be backfilled with commercially available soil (i.e., bagged topsoil). The surface will be restored with topsoil and the vegetative layer will be replaced.

4.2.2 Analytics

A summary of the planned sampling activities including the number of samples and anticipated analyses is provided in Table 4-1. Detailed descriptions of the sampling approach and rationale are included in Section 4.3 of this Soil Cover Sampling Plan. The analytical methods/protocols to be used during this project as well as the expanded list of parameters for analysis with reporting limits and method detection limits are provided in Table 4-2 and Table 4-3, respectively. Samples will be analyzed by Eurofins TestAmerica, a NYSDOH Environmental Laboratory Approval Program (ELAP)-certified laboratory, in accordance with the QAPP provided in Appendix C.

4.2.3 Quality Assurance / Quality Control

To ensure quality throughout the project, AECOM will utilize trained and experienced personnel as well as SOPs and analytical methods for sample collection, preservation, analysis, and documentation. In addition to the laboratory quality assurance (QA) and QC samples analyzed in accordance with the laboratory QA/QC Plan, several types of field QC samples will be collected and submitted for analysis during the course of the field investigation activities to assess the quality of the data resulting from the field sampling program. These samples include:

- Duplicates: These samples are duplicate samples collected in the field and submitted to the laboratory. These samples will be collected at a rate of one per every 20 samples and will provide a measure of laboratory precision and matrix variability.

- Field Rinsate Blanks: These samples will be collected to document the adequacy of field decontamination of reusable sampling equipment. Field rinsate blanks will be prepared by pouring deionized water over the dedicated sampling equipment (i.e., one field blank for dedicated scoops, etc.) after a decontamination procedure has been completed. This rinse water is then collected and submitted for analysis to provide an indication of the

effectiveness of decontamination procedures (carry-over from sample to sample). These samples will be collected at a rate of one per 20 environmental sample analyses.

The number of QA/QC samples anticipated is tabulated in Table 4-1. Further description of the QA/QC samples and analytical procedures are provided in the QAPP provided in Appendix C.

Laboratory data deliverable packages will meet the requirements of NYSDEC Analytical Services Protocol (ASP) Category B (See DER-10 Appendix 2B Section 1.0b; NYSDEC, 2010). Validation of laboratory data deliverable packages will be performed as described in Section 5.2.4 and Appendix C.

4.2.4 Survey Activities

The boring locations will be located by a New York State-licensed surveyor. The final sample locations will be recorded by the surveyor.

4.2.5 Waste Handling

The non-dedicated sampling and monitoring equipment will be decontaminated by washing with phosphate-free detergent and rinsing with distilled water. Alternatively, dedicated, disposable sampling equipment (e.g., scoops, plastic blending trays) may be used. The decontamination fluids will be containerized and properly disposed of by Corning Incorporated in accordance with applicable requirements. Decontamination procedures are described in Appendix B (Standard Operating Procedures).

The soil and water investigation-derived waste (IDW) will be handled in accordance with DER-10 Section 3.3(e). Drill cuttings and other soil, water, and decontamination fluids generated during investigation activities will be collected and containerized in sealed containers (e.g., drums or other appropriate containers) on a daily basis. The filled containers will be staged in a secondary containment area at the NYSDEC-approved staging area, pending proper disposal. The IDW will be properly disposed of by Corning Incorporated in accordance with applicable requirements.

4.3 CHARACTERIZATION ACTIVITIES

The sampling approach, described herein, has been directed by NYSDEC to meet the requirements of the NYSDEC DD. A 30-foot grid system will be placed across the areas where the cover soil was installed by the Corning-Painted Post School District during the capital improvement project and where characterization activities were not conducted under the Study Area Work Plan. Soil samples will be collected from every third grid node (i.e., approximately at 1/3 of the grids). At each sampling location, two samples will be collected: one sample from the topsoil sampling interval and one sample from the bank run gravel (see Section 4.2.1). If no bank run gravel is identified, one sample will be collected from 0 to 1 foot bgs. The samples will be analyzed for Target Analyte List (TAL) metals plus mercury and Target Compound List (TCL) semi-volatile organic compounds (SVOCs) with 20% of the samples to be analyzed for TAL metals plus mercury, TCL SVOCs, the additional list of parameters identified in Appendix 5 of DER-10 (i.e., trivalent chromium, hexavalent chromium, cyanide, VOCs, polychlorinated biphenyls [PCBs] and pesticides). 20% of the samples will be selected to provide coverage across the site. The samples will be biased toward those with visible staining or elevated PID readings, if observed.

It is anticipated that samples will be collected from approximately 63 sampling locations (i.e., 126 samples) in the areas where cover soil was installed by the Corning-Painted Post School District during the capital improvement project and where characterization activities were not conducted under the Study Area Work Plan. The proposed sampling locations are illustrated on Figure 4-1.

Additional sampling may be required to delineate exceedances of the DER-10 Appendix 5 Restricted Residential criteria. If needed, a sampling plan consisting of a figure showing the additional sample locations will be submitted to NYSDEC for approval.

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SECTION 4

FIGURE

Legend

- No Sampling Proposed
- Corning-Painted Post School District Property
- Grid (30x30ft)
- Proposed Soil Cover Sampling Locations

NOTES:
Base Image: Hunt Engineering, Febuary 25, 2015
Coordinate System: NAD 1983 State Plane New York Central Feet
Datum: NAD83. Units: Feet

Study Area
Corning NY

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Figure 4-1
Proposed Sampling Locations
Corning-Painted Post
School District Property

N

0 125 250 Feet

0 30 60 90

Document Name: Soil_Cover_Sampling.MXD

5/6/2020

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SECTION 4

TABLES

AECOM

Table 4-1
Sample Summary Table
Soil Cover Sampling Work Plan

No. of Sample Locations	Estimated No. Samples per Location		Analysis[1]	No. Primary Samples	Estimated No. QA/QC Samples				Total
					DUP	RB	TB	MS/MSD	
63	1	Top Soil[2]	TAL Metals	63	4	4	0	4	75
			Mercury	63	4	4	0	4	75
			TCL SVOCs	63	4	4	0	4	75
			Chromium (III and VI)[3]	13	1	1	0	1	16
			Cyanide[3]	13	1	1	0	1	16
			VOCs[3]	13	1	1	0	1	16
			PFAS	13	1	1	0	1	16
			PCBs	13	1	1	0	1	16
			Pesticides[3]	13	1	1	0	1	16
		Bank Run Gravel[2]	TAL Metals	63	4	4	0	4	75
			Mercury	63	4	4	0	4	75
			TCL SVOCs	63	4	4	0	4	75
			Chromium (III and VI)[3]	13	1	1	0	1	16
			Cyanide[3]	13	1	1	0	1	16
			VOCs[3]	13	1	1	0	1	16
			PFAS	13	1	1	0	1	16
			PCBs	13	1	1	0	1	16
			Pesticides[3]	13	1	1	0	1	16
Total Number of Samples including QA/QC Samples:									**150**

Notes:

[1] - Analytical methods are presented in Table 4-2 and complete analyte lists are presented in Table 4-3.

[2] - The field geologist will determine which portion of the core is topsoil and which portion is bank run gravel. All contents of the soil core will be sampled from 0 to 1 foot bgs. If the transition between topsoil and bank run gravel cannot be determined, then topsoil will be collected from 0-6 inches bgs and the bank run gravel will be sampled from 6-12 inches bgs.

[3] - List of constituents under this analysis are from the DER-10 List (see Appendix 5, Allowable Constituent Levels for Imported Fill or Soil, Subdivision 5.4(3)).

bgs - below ground surface

DUP - duplicate sample

MS/MSD - matrix spike/matrix spike duplicate

NA - not applicable (no analytical samples collected)

No. - number

PCBs - Polychlorinated biphenyls

PFAS - Per- and Polyfluoroalkyl Substances

TAL - Target Analyte List

QA/QC - quality assurance/quality control

RB - rinsate blank

TB - trip blank

TCL SVOCs - Target Compound List Semi-volatile organic compounds

TCLP Metals - Toxicity Characteristic Leaching Procedure

TPH - Total petroleum hydrocarbons

VOCs - Volatile organic compounds

TCLP Metals - Toxicity Characteristic Leaching Procedure

Assumptions:

All samples analyzed for list (as shown)

For sample numbers it was assumed 20% of samples analyzed for full list, actual samples collected will be determined in the field.

For sample number estimates it was assumed two groundwater monitoring wells would be installed, actual number of wells (if any) will be determined based upon discussions with the New York State Department of Environmental Conservation (NYSDEC) following NYSDEC approval of the validated soil results.

DUP, RB, TB and MS/MSD collected at 1 per 20 samples (5%)

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Table 4-2
Analytical Methodologies
Soil Cover Sampling Work Plan

Analysis	Analytical Methods	Container	Preservation[7]	Hold Time
SOIL				
TAL ICP Metals	SW846 6010	10 grams, wide mouth glass w/Fluoropolymer Resin / Teflon®-lined lid	4°C	180 days
Mercury	SW846 7471	10 grams, wide mouth glass w/Fluoropolymer Resin / Teflon®-lined lid	4°C	28 days
TCL SVOCs	SW846 8270	30 grams, wide mouth glass w/Fluoropolymer Resin / Teflon®-lined lid	4°C	14 days[1]
Cyanide[3]	SW846 9012	4 oz soil jar	4°C	14 days
Chromium (VI)[3]	SW846 3060A/7196	4 oz soil jar	4°C	30/7 days[4]
Chromium (III)[3]	SM 3500 (calculation)	4 oz soil jar	None	NA
TAL PCBs	SW846 8082	30 grams, wide mouth glass w/Fluoropolymer Resin / Teflon®-lined lid	4°C	14 days[1]
VOCs[3]	SW846 8260	Wide mouth bulk jar, TerraCore® or EnCore® sampler[5]	4°C	14 days
PFAS	EPA Method 537.1 mod.	4 oz., High-density polyethylene (HDPE) or polypropylene containers with HDPE or polypropylene caps.	4°C	14/28 days[2]
Pesticides[3]	SW846 8081 & SW846 8151	2-4 oz wide mouth jars	4°C	14 days[1]
WATER				
TAL Metals	SW846 6010	250 mL, Polyethylene or Glass	4°C, $HN0_3$ to pH < 2	180 days
Mercury	SW846 7470	50 mL, Polyethylene or Glass	4°C, $HN0_3$ to pH < 2	28 days
TCL SVOCs	SW846 8270	2-250 mL, Glass with Teflon®-lined cap (amber)	4°C	7 days[6]
Cyanide[3]	SW846 9012	250 mL, Polyethylene	4°C, NaOH to pH > 12	14 days
Chromium (VI)[3]	SW846 7196	125 mL, Polyethylene	4°C	24 hours
Chromium (III)[3]	SM 3500 (calculation)	125 mL, Polyethylene	None	NA
TAL PCBs	SW846 8082	2-250 mL, Glass with Teflon®-lined cap (amber)	4°C	7 days[6]
VOCs[3]	SW846 8260	3-40 mL, Glass with Teflon®-lined septum	4°C, HCl to pH < 2	14 days
PFAS	EPA Method 537.1 mod.	2-250 mL, High-density polyethylene (HDPE) or polypropylene containers with HDPE or polypropylene caps.	4°C	14/28 days[2]
Pesticides[3]	SW846 8081 & SW846 8151	4-250 mL, Glass with Teflon®-lined cap (amber)	4°C	7 days[6]

Notes:
1. 14 days for extraction; 40 days after extraction for analysis
2. 14 days for extraction; 28 days after extraction for analysis
3. List of constituents under this analysis are from the DER-10 List (see Appendix 5, Allowable Constituent Levels for Imported Fill or Soil, Subdivision 5.4(3)).
4. 30 days for alkaline digestion, 7 days to instrumental analysis
5. There are a number of options for collecting soil samples for volatile analysis. The options include: EnCore® devices, TerraCore® devices, and wide mouth bulk jars. A separate 2 oz jar must be collected for dry weight determination.
6. 7 days for organic extraction, 40 days after extraction for analysis
7. All samples will be preserved on ice.

HDPE - High-density polyethylene
PCBs - Polychlorinated biphenyls
PFAS - Per- and Polyfluoroalkyl Substances
SVOCs - Semi-volatile organic compounds
TAL - Target Analyte List
TCLP - Toxicity Characteristic Leaching Procedure
TPH - Total petroleum hydrocarbons
VOCs - Volatile organic compounds

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Table 4-3
Reporting Limits and Method Detection Limits

	Soil	Soil	
	Restricted Residential SCOs	RL	MDL
TAL Metals [Method SW846 6010]	**mg/kg**	**mg/Kg**	
Aluminum	NS	10.0	4.40
Antimony	NS	15.0	0.400
Arsenic	16	2.00	0.400
Barium	400	0.500	0.110
Beryllium	72	0.200	0.0280
Boron	NS	2.00	0.190
Cadmium	4.3	0.200	0.0300
Calcium	NS	50.0	3.30
Chromium	180	0.500	0.200
Cobalt	NS	0.500	0.0500
Copper	270	1.00	0.210
Iron	NS	10.0	1.10
Lead	400	1.00	0.240
Magnesium	NS	20.0	0.927
Manganese	2000	0.200	0.0320
Nickel	310	5.00	0.230
Potassium	NS	30.0	20.0
Selenium	180	4.00	0.400
Silver	180	0.600	0.200
Sodium	NS	140	13.0
Thallium	NS	6.00	0.300
Vanadium	NS	0.500	0.110
Zinc	10000	2.00	0.153
Mercury [Method SW846 7471B/7470A]		**mg/Kg**	
Mercury	0.81	0.0200	0.00810
Semi-Volatile Organic Compounds (SVOCs) [Method SW846 8270]		**µg/Kg**	
Biphenyl	NS	170	28.2
bis (2-chloroisopropyl) ether	NS	170	34.0
2,4,5-Trichlorophenol	NS	170	46.0
2,4,6-Trichlorophenol	NS	170	34.0
2,4-Dichlorophenol	NS	170	18.0
2,4-Dimethylphenol	NS	170	72.7
2,4-Dinitrophenol	NS	1660	784
2,4-Dinitrotoluene	NS	170	35.0
2,6-Dinitrotoluene	NS	170	20.0
2-Chloronaphthalene	NS	170	28.0
2-Chlorophenol	NS	170	31.0
2-Methylphenol	100	170	20.0
2-Methylnaphthalene	NS	170	34.0
2-Nitroaniline	NS	330	25.0
2-Nitrophenol	NS	170	48.0
3,3'-Dichlorobenzidine	NS	330	200
3-Nitroaniline	NS	330	47.0
4,6-Dinitro-2-methylphenol	NS	330	170
4-Bromophenyl phenyl ether	NS	170	24.0
4-Chloro-3-methylphenol	NS	170	42.0
4-Chloroaniline	NS	170	42.0
4-Chlorophenyl phenyl ether	NS	170	21.0
4-Methylphenol	100	330	20.0
4-Nitroaniline	NS	330	89.0
4-Nitrophenol	NS	330	159
Acenaphthene	100	170	25.0
Acenaphthylene	100	170	22.0
Acetophenone	NS	170	23.0
Anthracene	100	170	42.0
Atrazine	NS	170	59.0
Benzaldehyde	NS	170	135
Benzo[a]anthracene	1	170	27.6
Benzo[a]pyrene	1	170	25.0
Benzo[b]fluoranthene	1	170	27.0

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Table 4-3
Reporting Limits and Method Detection Limits
(continued)

	Soil	Soil	
	Restricted Residential SCOs	RL	MDL
Semi-Volatile Organic Compounds (SVOCs) [Method SW846 8270] (continued)		µg/Kg	
Benzo[g,h,i]perylene	100	170	19.0
Benzo[k]fluoranthene	3.9	170	22.0
Bis(2-chloroethoxy)methane	NS	170	36.0
Bis(2-chloroethyl)ether	NS	170	22.0
Bis(2-ethylhexyl) phthalate	NS	170	58.0
Butyl benzyl phthalate	NS	170	28.0
Caprolactam	NS	170	51.0
Carbazole	NS	170	20.0
Chrysene	3.9	170	38.0
Dibenz(a,h)anthracene	0.33	170	30.0
Di-n-butyl phthalate	NS	170	29.0
Di-n-octyl phthalate	NS	170	20.0
Dibenzofuran	59	170	20.0
Diethyl phthalate	NS	170	22.0
Dimethyl phthalate	NS	170	20.0
Fluoranthene	100	170	18.0
Fluorene	100	170	20.0
Hexachlorobenzene	1.2	170	23.0
Hexachlorobutadiene	NS	170	25.0
Hexachlorocyclopentadiene	NS	170	23.0
Hexachloroethane	NS	170	22.0
Indeno[1,2,3-cd]pyrene	0.5	170	22.0
Isophorone	NS	170	36.0
N-Nitrosodi-n-propylamine	NS	170	29.0
N-Nitrosodiphenylamine	NS	170	138
Naphthalene	100	170	22.0
Nitrobenzene	NS	170	30.0
Pentachlorophenol	6.7	330	170
Phenanthrene	100	170	25.0
Phenol	100	170	26.0
Pyrene	100	170	20.0
Chromium [Method SW846 7196A & SM 3500_CR3_D]		mg/Kg	
Chromium, Hexavalent	110	2.00	0.395
Chromium Trivalent	180	1.50	0.630
Cyanide [Method SW846 9012B]		mg/Kg	
Cyanide	27	0.100	0.0270
Volatile Organic Compounds (VOCs) [Method SW846 8260 per DER-10 [1]]		ug/Kg	
1,1,1-Trichloroethane	100	5.00	0.363
1,1-Dichloroethane	26	5.00	0.610
1,1-Dichloroethene	100	5.00	0.612
1,2,4-Trimethylbenzene	52	1.00	0.340
1,2-Dichlorobenzene	100	5.00	0.391
1,2-Dichloroethane	3.1	5.00	0.251
1,2-Dichloroethene (cis)	100	1.00	0.220
1,2-Dichloroethene (trans)	100	1.00	0.390
1,3-Dichlorobenzene	49	5.00	0.257
1,3,5-Trimethylbenzene	52	1.00	0.130
1,4-Dichlorobenzene	13	5.00	0.700
1,4-Dioxane	13	20.0	6.39
2-Butanone (MEK)	100	25.0	1.83
Acetone	100	25.0	4.21
Benzene	4.8	5.00	0.245
Butylbenzene	100	1.00	0.210
Carbon tetrachloride	2.4	5.00	0.484
Chlorobenzene	100	5.00	0.660
Chloroform	49	5.00	0.309
Ethylbenzene	41	5.00	0.345
Methyl tert-butyl ether	100	5.00	0.491
Methylene Chloride	100	5.00	2.30
n-Propylbenzene	100	1.00	0.180
sec-Butylbenzene	100	1.00	0.170
Tetrachloroethene	19	5.00	0.671
Tert-Butylbenzene	100	1.00	0.340
Toluene	100	5.00	0.378
Trichloroethene	21	5.00	1.10
Vinyl chloride	0.9	5.00	0.610
Xylenes, Total	100	10.0	0.840

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Table 4-3
Reporting Limits and Method Detection Limits
(continued)

	Soil	Soil	
	Restricted Residential SCOs	RL	MDL
Polychlorinated Biphenyls (PCBs) [Method SW846 8082]		mg/Kg	
PCB-1016	NS	0.0167	0.00326
PCB-1221	NS	0.0167	0.00326
PCB-1232	NS	0.0167	0.00326
PCB-1242	NS	0.0167	0.00326
PCB-1248	NS	0.0167	0.00326
PCB-1254	NS	0.0167	0.00782
PCB-1260	NS	0.0167	0.00782
Total PCBs	1	0.250	0.117
Per-and Polyfluoroalkyl Substances (PFAS) [Method 537.1 mod.]		ug/kg	
6:2 FTS	NS	2.00	0.150
8:2 FTS	NS	2.00	0.250
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	NS	2.00	0.370
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	NS	2.00	0.390
Perfluorobutanesulfonic acid (PFBS)	NS	0.200	0.0250
Perfluorobutanoic acid (PFBA)	NS	0.200	0.0280
Perfluorodecanesulfonic acid (PFDS)	NS	0.200	0.0390
Perfluorodecanoic acid (PFDA)	NS	0.200	0.0220
Perfluorododecanoic acid (PFDoA)	NS	0.200	0.0670
Perfluoroheptanesulfonic Acid (PFHpS)	NS	0.200	0.0350
Perfluoroheptanoic acid (PFHpA)	NS	0.200	0.0290
Perfluorohexanesulfonic acid (PFHxS)	NS	0.200	0.0310
Perfluorohexanoic acid (PFHxA)	NS	0.200	0.0420
Perfluorononanoic acid (PFNA)	NS	0.200	0.0360
Perfluorooctanesulfonamide (FOSA)	NS	0.200	0.0820
Perfluorooctanesulfonic acid (PFOS)	NS	0.500	0.200
Perfluorooctanoic acid (PFOA)	NS	0.200	0.0860
Perfluoropentanoic acid (PFPeA)	NS	0.200	0.0770
Perfluorotetradecanoic acid (PFTeA)	NS	0.200	0.0540
Perfluorotridecanoic acid (PFTriA)	NS	0.200	0.0510
Perfluoroundecanoic acid (PFUnA)	NS	0.200	0.0360
Pesticides [Method SW846 8081 & Method SW846 8151 per-DER10 [1]]		µg/Kg	
2,4,5-TP Acid (Silvex)	100	17.0	11.4
4,4'-DDD	13	6.70	0.880
4,4'-DDE	8.9	6.70	0.970
4,4'-DDT	7.9	6.70	0.690
Aldrin	0.097	6.70	0.810
Alpha-BHC	0.48	2.00	0.610
Chlordane (alpha)	4.2	6.70	1.09
Beta-BHC	0.36	2.00	0.650
Delta-BHC	100	2.00	0.730
Dieldrin	0.2	2.00	0.870
Endosulfan I	24	6.70	0.930
Endosulfan II	24	6.70	1.05
Endosulfan sulfate	24	6.70	0.780
Endrin	11	6.70	0.850
gamma-BHC (Lindane)	1.3	2.00	0.600
Heptachlor	2.1	6.70	0.860

Notes:

[1] - List of constituents under this analysis are from the DER-10 List (see Appendix 5, Allowable Constituent Levels for Imported Fill or Soil, Subdivision 5.4(3)).

mg/Kg - milligram per kilogram

µg/Kg - microgram per kilogram

RL - Reporting Limit

MDL - Method Detection Limit

NS - No Standard

SCO - Soil Cleanup Objective

Listed limits are the highest current MDL and RL inclusive of Eurofins TestAmerica Buffalo and Edison laboratories for standard analytical testing.

5. PROJECT MANAGEMENT

5.1 SCHEDULE

The activities described in this Soil Cover Sampling Plan are expected to be performed in the summer of 2020, following the end of the 2019-2020 academic school year. The property is not owned or under the control of Corning Incorporated or NYSDEC; therefore, activities proposed in this Soil Cover Sampling Plan will be performed under a written access agreement between Corning Incorporated and the School District. The project schedule for the Soil Cover Sampling Plan activities is provided in Figure 5-1 This work schedule is predicated on coordination of activities with the School District.

5.2 DOCUMENTATION

5.2.1 Field Logs

Essential project information pertinent to field activities, including sampling, will be recorded in bound field logbooks with consecutively numbered pages and/or field data record forms specific to a given activity. Entries into the logbook will typically contain information such as:

- Date and time of logbook entry
- Names of the team members present
- Weather conditions
- Field observations
- Log and summary of daily activities and significant events
- Description of sample and sampling location
- Date and time of sample collection
- Collector's sample identification number(s) and/or name
- Name and affiliation of personnel or visitors
- Decontamination activities
- Description of problems encountered and problem resolution

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

5.2.2 Photo Log

A project photo log will be prepared and maintained throughout the Soil Cover Sampling Plan sampling activities to provide photo documentation of field activities.

5.2.3 Field Reports

During the execution of the work described in this Soil Cover Sampling Plan, AECOM will provide NYSDEC and NYSDOH with periodic verbal updates of the field activities and electronic copies of weekly work activity reports, including select supporting photographs. AECOM will record the ambient air monitoring data in the field logbook or designated field sheets and will communicate the results of the air monitoring to NYSDEC and NYSDOH on a scheduled basis (i.e. daily for levels which require actions, weekly for routine monitoring data). AECOM and subcontractors will confirm daily that the COVID-19 protocols in Appendix D are being followed. At the completion of the field work and data validation activities described in this Soil Cover Sampling Plan, no additional weekly work activity reports will be provided to NYSDEC and NYSDOH.

5.2.4 Data Management

Laboratory analytical data will be managed by AECOM in an electronic database and will be uploaded in an electronic data deliverable (EDD) format compatible with NYSDEC's EQuIS database system.

AECOM will review laboratory data deliverable packages for completeness, adherence to holding times, comparison with chains-of-custody, etc. AECOM will perform data validation and prepare corresponding Data Usability Summary Reports (DUSRs). The data review/validation activities are described in the QAPP provided in Appendix C.

5.2.5 Reporting

Upon receipt of validated data, Corning Incorporated will supply the validated data to NYSDEC in a DUSR. The DUSR will include a description of the completion of the field scope and a summary of the sample analytical results, as well as tables summarizing the QA/QC sample results, all sample logs, and CAMP results. The report will include a table listing the soil cover thickness

based on the geologist's characterization at each sample location to serve as verification of the cover thickness for use in the final construction completion report.

NYSDEC will review the data and Corning Incorporated's transmittal letters before they are provided to the Corning-Painted Post School District.

5.3 HEALTH AND SAFETY PLAN

The health and safety of field workers, clients, visitors, and the community are of utmost importance. For the field work, it is planned that workers will be in modified Level D personal protection (i.e., coveralls or work clothes, work boots, safety glasses, and hard hats). COVID-19 protocols are included in Appendix D. All field activities will be conducted in accordance with the HASP and CAMP provided in Appendix D and Appendix E, respectively.

5.4 STUDY AREA CONTROLS

A temporary field office and equipment storage area is located in a NYSDEC-approved staging area near the Study Area. This temporary field office area is surrounded by temporary fencing for security and the access gate is closed and locked when not in use.

The temporary field office area presently consists of an office trailer, for document and sample preparation, and staging area for field equipment. Electricity is currently supplied to the mobile office via a power drop.

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SECTION 5

FIGURE

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ID	Task Name	Duration	Start
1	Effective Data of AOC	0 days	12/14/17
2	CPPSD Provide PE Drawing of Soil Cover System	0 days	2/27/18
3	Draft Design-Phase Investigation Work Plan	0 days	3/23/18
4	Revise Draft Design-Phase Investigation Work Plan	0 days	3/31/20
5	NYSDEC Comments on Work Plan	1 day	4/29/20
6	Revise Draft Design-Phase Investigation Work Plan	23 days	4/30/20
7	NYSDEC Comments on Work Plan	13 days	6/2/20
8	Final Design-Phase Investigation Work Plan	5 days	6/19/20
9	Obtain Written Access Consent	10 days	6/26/20
10	Utility Clearances	1 wk	7/17/20
11	Soil Cover Sampling	2 wks	7/24/20
12	Sample Analysis and Validation	2 mons	7/31/20
13	Draft DUSR to NYSDEC	0 days	9/24/20
14	NYSDEC Review DUSR	5 days	9/25/20
15	Finalize DUSR	5 days	10/2/20
16	Submittal of data to Property Owners	1 mon	10/9/20
17	Prepare Sampling Summary Report	1 mon	10/9/20
18	NYSDEC Review Sampling Summary Report	10 days	11/6/20
19	Finalize Sampling Summary Report	10 days	11/20/20

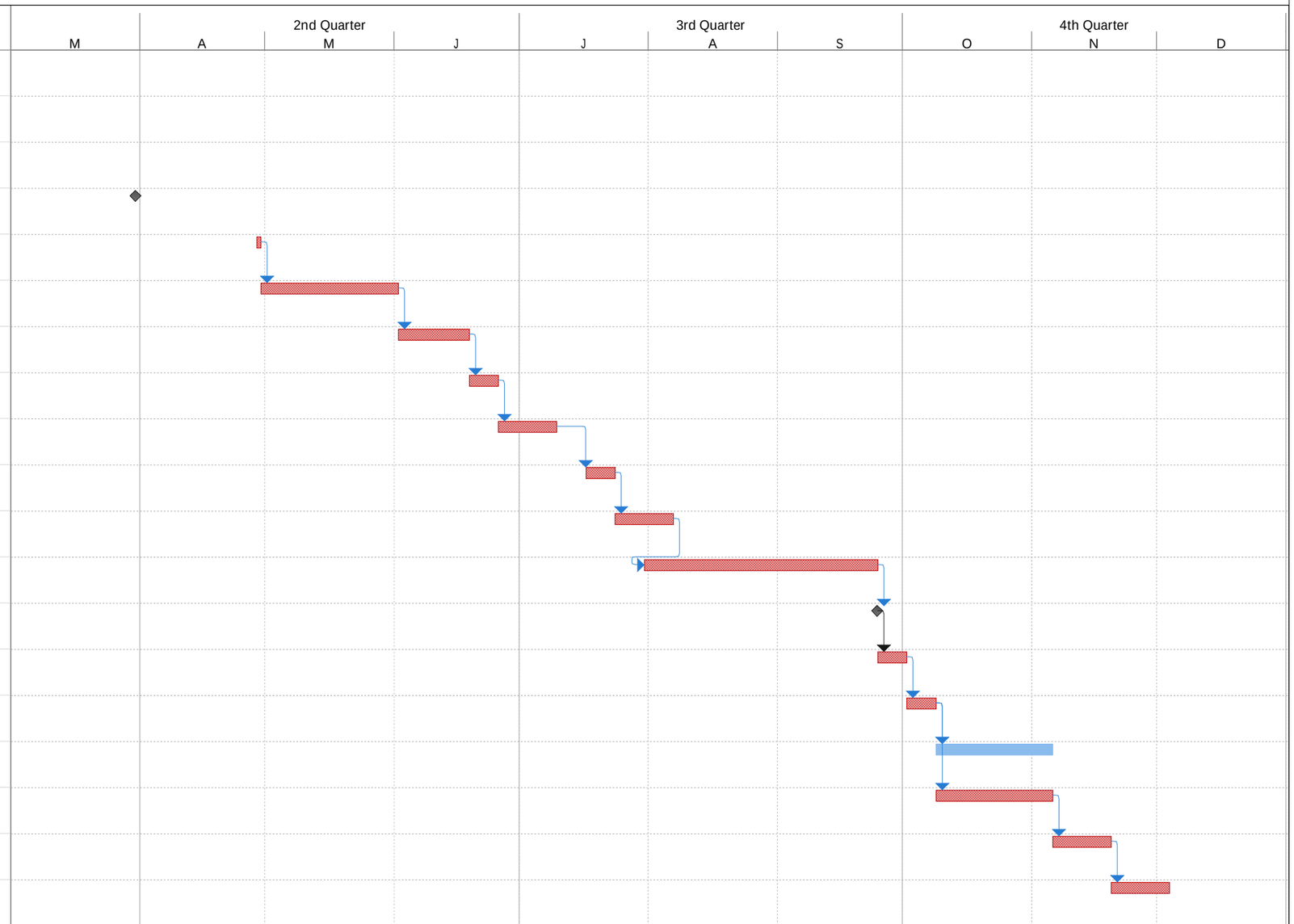

Figure 5-1
Project Schedule
Study Area, Corning, NY

6/22/20

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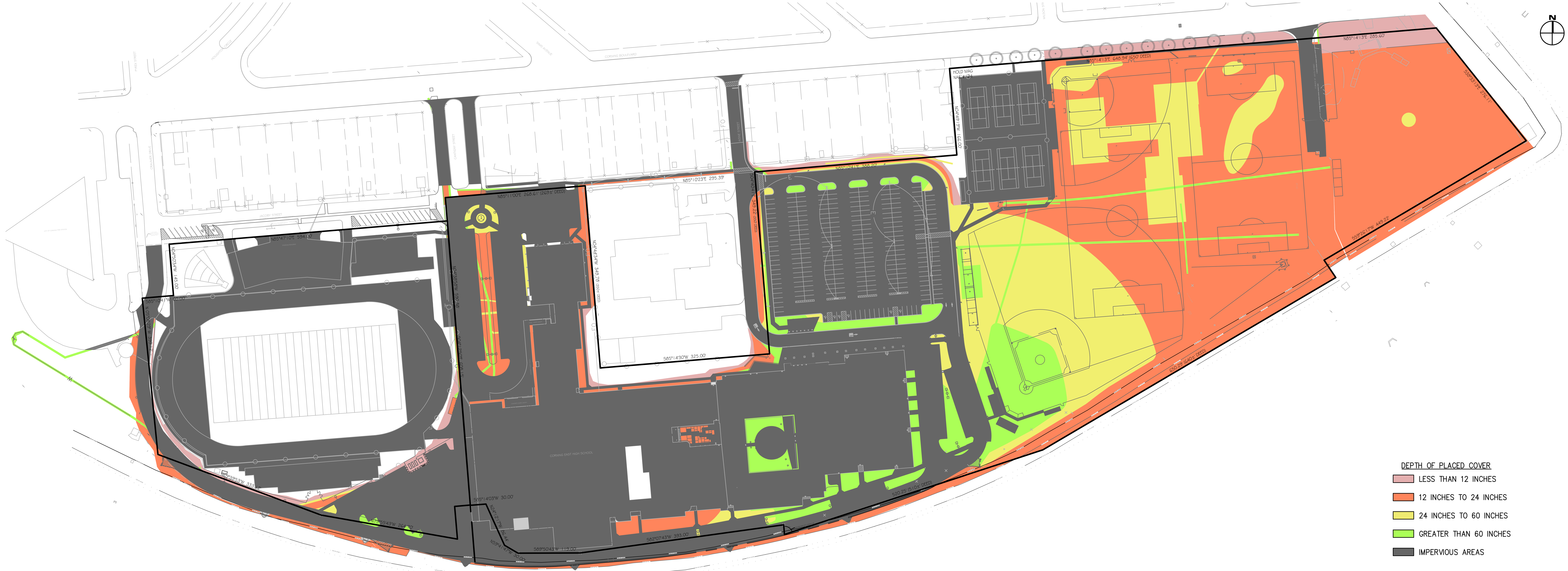
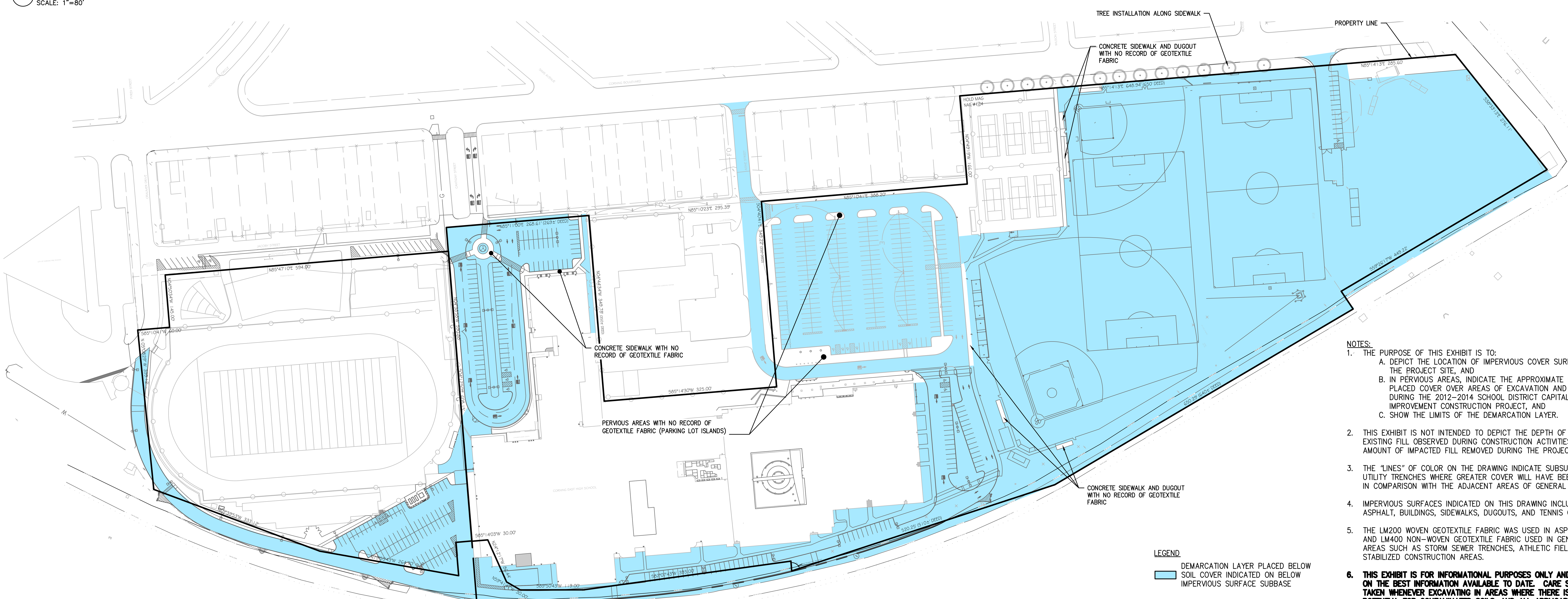
APPENDIX A

CORNING-PAINTED POST SCHOOL DISTRICT SOIL COVER MAP



1 **DEPTH OF PLACED COVER**
SCALE: 1"=80'



2 **DEMARCATION LAYER**
SCALE: 1"=80'

NOTES:

1. THE PURPOSE OF THIS EXHIBIT IS TO:
   A. DEPICT THE LOCATION OF IMPERVIOUS COVER SURFACES ON THE PROJECT SITE, AND
   B. IN PERVIOUS AREAS, INDICATE THE APPROXIMATE DEPTH OF PLACED COVER OVER AREAS OF EXCAVATION AND GRADING DURING THE 2012–2014 SCHOOL DISTRICT CAPITAL IMPROVEMENT CONSTRUCTION PROJECT, AND
   C. SHOW THE LIMITS OF THE DEMARCATION LAYER.
2. THIS EXHIBIT IS NOT INTENDED TO DEPICT THE DEPTH OF THE EXISTING FILL OBSERVED DURING CONSTRUCTION ACTIVITIES, NOR THE AMOUNT OF IMPACTED FILL REMOVED DURING THE PROJECT.
3. THE "LINES" OF COLOR ON THE DRAWING INDICATE SUBSURFACE UTILITY TRENCHES WHERE GREATER COVER WILL HAVE BEEN PLACED IN COMPARISON WITH THE ADJACENT AREAS OF GENERAL GRADING.
4. IMPERVIOUS SURFACES INDICATED ON THIS DRAWING INCLUDE ASPHALT, BUILDINGS, SIDEWALKS, DUGOUTS, AND TENNIS COURTS.
5. THE LM200 WOVEN GEOTEXTILE FABRIC WAS USED IN ASPHALT AREAS AND LM400 NON-WOVEN GEOTEXTILE FABRIC USED IN GENERAL AREAS SUCH AS STORM SEWER TRENCHES, ATHLETIC FIELD AND STABILIZED CONSTRUCTION AREAS.
6. **THIS EXHIBIT IS FOR INFORMATIONAL PURPOSES ONLY AND IS BASED ON THE BEST INFORMATION AVAILABLE TO DATE. CARE SHOULD BE TAKEN WHENEVER EXCAVATING IN AREAS WHERE THERE IS THE POTENTIAL FOR CONTAMINATED SOILS, AND ALL APPLICABLE STATE AND FEDERAL REGULATIONS AND GUIDELINES SHALL BE FOLLOWED.**

STATE OF NEW YORK · BENJAMIN JON GUSTAFSON · LICENSED PROFESSIONAL ENGINEER · No.

DRAWN BY : CED
CHECKED BY : BJG
DATE : JUNE 8, 2016
SCALE : 1" = 80'

#	DATE:	DESCRIPTION OF REVISION:	BY:
1	12/19/14	CONSTRUCTION PROGRESS	
2	01/24/18	DEMARCATION LAYER UPDATE	
3	02/26/18	SOIL COVER AND DEMARCATION LAYER AND NOTES UPDATE	
4			
5			
6			
7			
8			
9			
10			

HUNT
ENGINEERS/ARCHITECTS/SURVEYORS
AIRPORT CORPORATE PARK
100 HUNT CENTER
HORSEHEADS, N.Y. 14845
607 · 358 · 1000
FAX · 358 · 1800
HORSEHEADS, NY ROCHESTER, NY TOWANDA, PA

SOIL COVER AND DEMARCATION LAYER

HIGH SCHOOL ADDITIONS AND ALTERATIONS
CORNING PAINTED POST AREA SCHOOL DISTRICT

201 CANTIGNY ST. CORNING, NY 14830

1

PROJECT NO: 2649-016

AECOM

APPENDIX B

STANDARD OPERATING PROCEDURES (SOPs)

DECONTAMINATION
STANDARD OPERATING PROCEDURE B.1

1.0 Scope and Application

1.1 This standard operating procedure (SOP) is generally applicable to the development and application of a decontamination program for a field investigation program in Level D health and safety protection.

2.0 Summary of Method

2.1 This document has been prepared to assist personnel with the performance of specific tasks and procedures related to decontamination procedures during implementation of certain investigation activities. The procedures addressed in this SOP include the following:

- Personnel Decontamination Procedures
- Decontamination of Drilling Equipment
- Decontamination of Sampling Equipment
- Decontamination of Support Equipment
- Management of Investigation-Derived Waste (IDW)

3.0 Health and Safety Issues

3.1 As with any activities associated with potential contaminants, work tasks should be conducted in strict accordance with Environmental Protection Agency (EPA), Occupational Safety & Health Administration (OSHA), client, and AECOM safety policies and procedures. This should include preparation of a site-specific Health and Safety Plan (HASP) to ensure that all aspects of potential risk are evaluated and properly addressed.

4.0 Personnel Qualifications

4.1 All field personnel with potential for exposure to contaminated media are required to take the 40-hour Health and Safety Training and regular refresher courses prior to engaging in any field effort. Certificates for each person should be incorporated into the site HASP. Additionally, all field personnel should have medical clearance in accordance with the HASP.

5.0 Equipment and Supplies

5.1 The equipment necessary for decontamination in the field may vary depending on the activities being conducted. A general list of equipment that may be utilized is as follows:

- Nitrile gloves
- Alconox (or other non-phosphate soap solution)
- Potable or distilled water
- Paper towels
- Plastic (polyethylene) sheeting
- Containers for storage of decontamination liquids (e.g., poly-tank or 55-gallon drums)

6.0 Decontamination Activities

6.1 The following are the steps to be considered for decontamination of equipment and personnel during field investigation activities. The effectiveness of the decontamination process should be evaluated as part of the Work Plan.

7.0 Personnel Decontamination

7.1 The following steps should be followed for personnel decontamination:

- Remove any gross debris from gloves and place it in the designated waste accumulation point.
- Remove nitrile gloves, taking care not to contact the outside of the gloves, and place the gloves in the designated waste accumulation point.

8.0 Decontamination of Drilling Equipment

8.1 Decontamination of drilling equipment (e.g., augers, rods) should be conducted prior to and between drilling locations. This should be conducted in a manner to contain all fluids and cuttings and may include a temporary decontamination pad specifically constructed for this purpose. Potable water should be available for the decontamination pad area. The following steps should be considered during the decontamination process:

- Position the equipment on the pad to avoid release of debris or overspray beyond the pad area.
- Don nitrile gloves and safety glasses.

- Remove gross debris from equipment and contain at a designated waste accumulation point.
- Thoroughly wash the equipment using a steam cleaner and potable water.
- Contain wastewater at a designated accumulation point.

8.2 Decontamination Steps for Non-Dedicated Sampling Equipment

- Don nitrile gloves.
- Remove any gross debris or expendables and place it into the designated waste accumulation point.
- Wash the equipment in a non-phosphate soap solution.
- Thoroughly rinse the equipment with distilled water.
- Contain wastewater at a designated accumulation point.

9.0 Decontamination of Field Monitoring Equipment

- Don nitrile gloves.
- Remove any gross debris and place it into the designated waste accumulation point.
- Wipe the outside of the equipment with a moist towel.

10.0 Investigation-Derived Waste Management

Investigation-Derived Waste (IDW) from the investigation activities should be properly managed to ensure safety to site personnel and to reduce potential impacts to other areas of the site by the IDW. IDW may include expendable sampling items such as gloves, paper towels, media solids including soil cuttings or decontamination debris, or liquids such as decontamination fluids. Should media be encountered that potentially meets the classification as a hazardous waste, these materials should be properly contained, labeled, and stored until a formal waste characterization may be achieved. Final disposition will be based on the classification of the waste. The following procedures should be considered to ensure proper management of IDW:

10.1 Expendable Materials

Expendable items are commercially acquired materials used in support of field activities. These materials may include, but are not limited to, gloves, plastic zip-sealed bags, paper towels, etc.

These materials should be placed into plastic garbage bags placed within the areas of activity or carried on the vehicle. Upon completion of the activity or when the bag has filled, the wastes should be placed into a designated disposal area for disposal of solid waste.

10.2 Solid Media IDW

Sampling-IDW included in this category may include the following:

- Soil cuttings
- Solids accumulated during decontamination
- Personal protective equipment (PPE)

Unless otherwise authorized, cuttings should be placed into 55-gallon drums; sealed; labeled with the date, contents, and location; and subsequently transferred to a designated soil staging location until the waste can be adequately characterized and properly disposed.

Solids accumulated during decontamination should be placed into 55-gallon drums. Once filled, each drum should be sealed, identified with the contents and date, and transferred to the onsite staging area for subsequent testing prior to disposal.

PPE coated in solid IDW should also be placed into a 55-gallon drum; sealed; labeled with contents and date; and transferred to the onsite staging area for subsequent testing prior to disposal. PPE with little or no solids can be decontaminated by removing solids and/or washing in accordance with the decontamination procedure and disposed of with general household waste.

10.3 Liquid Media Waste

Liquid wastes potentially generated during investigation activities may include the following:

- Drilling fluids
- Decontamination fluids

Unless otherwise authorized, liquid wastes generated during the investigation should be containerized in 55-gallon drums, or other appropriate storage (i.e. polyethylene tanks). Containerized liquids should

be labeled with the date, contents and location and transferred to the staging pad for subsequent testing prior to disposal.

11.0 Data and Records Management

11.1 All data and information (e.g., location of decontamination pad, water source, site conditions) should be documented within site logbooks or field data sheets.

WATER SAMPLING
STANDARD OPERATING PROCEDURE B.2

1.0 Scope and Application

1.1 This Standard Operating Procedure (SOP) is generally applicable to the collection of representative water samples from 55-gallon drums and/or storage containers for disposal profiling.

2.0 Summary of Method

2.1 The procedures presented herein address the collection of water from 55-gallon drums or other storage containers for disposal profiling.

3.0 Health and Safety Issues

3.1 As with any activities associated with potential contaminants, work tasks should be conducted in strict accordance with Environmental Protection Agency (EPA), Occupational Safety & Health Administration (OSHA), client, and AECOM safety policies and procedures. This should include preparation of a site-specific Health and Safety Plan (HASP) to ensure that all aspects of potential risk are evaluated and properly addressed.

4.0 Personnel Qualifications

4.1 All field personnel with potential for exposure to contaminated media on site are required to take the 40-hour Health and Safety Training and regular refresher courses prior to engaging in any field effort. Certificates for each person should be incorporated into the site HASP. Additionally, all field personnel should have medical clearance in accordance with the HASP.

5.0 Equipment and Supplies

5.1 Equipment needed for collection of samples may include:

- Logbook and waterproof pen
- Calculator
- Safety equipment (e.g. safety shoes, safety glasses, hard hat, nitrile gloves, first aid kit)
- Appropriate sample bottles and preservatives
- Chain-of-custody forms

- Coolers
- Commercial plastic zip-sealed bags
- Sample bottle labels
- Approved Work Plan

6.0 Water Sampling Procedures

The general procedures to be applied for the sampling of water from 55-gallon drums or other containers are as follows:

6.1 Sample Preparation

The following tasks should be conducted in preparation for sampling:

- Locate and confirm the identification of the drums/containers to be sampled.
- Organize equipment in the immediate area of the drums/containers to be sampled.
- Inspect the condition of the drum/container. Record the observations on the sampling form and/or the field logbook (as needed).
- Don nitrile gloves.
- Open the drum/container and stir the water using a bailer or other tool to ensure the water is homogeneous.

6.2 Aliquot Sampling Activities

Sampling is the process of obtaining, containerizing, and preserving the groundwater sample after the purging process is complete. The precautions to be applied are as follows:

- Prior to sampling, personnel should thoroughly wash per the decontamination procedures outlined in the Decontamination SOP.
- Gloves should be changed prior to sample collection.
- Where possible, sampling materials and equipment should be disposable (or dedicated to a location) to avoid potential cross-contamination between drums/containers.

6.2.1 Dip Sampling Method

The dip sampling procedure includes:

- Prepare the sample containers and complete the labels.
- Don nitrile gloves.
- Dip a laboratory supplied, unpreserved bottle into the drum/sample container to collect a known volume of sample.
- Pour aliquot into larger, laboratory supplied, unpreserved bottle.
- Repeat this process until an equal volume aliquot is collected from each drum/container sampled and all aliquots are combined into the larger, laboratory supplied, unpreserved bottle.
- Stir larger laboratory-supplied bottle until homogeneous and pour the combined water into the preserved, laboratory supplied bottleware for shipment to the lab. Any excess homogenized water can be placed in one or more of the sampled drums/containers from which the aliquots for that specific sample were collected.
- Record the sample time on the field purge log and/or field logbook.

7.0 Sample Handling

7.1 Once the samples have been collected:

- Seal the containers, inspect the labels and place sample containers into cooler(s).
- Record all pertinent data in a site logbook or on a field data sheet.
- Complete the chain-of-custody form.
- Discard the expendable materials (e.g., bottleware used for aliquot collection and homogenization).
- Decontaminate non-disposable equipment via the procedures outlined in the Decontamination SOP.
- Secure the drum/container lids and inspect the grounds for trash or loose equipment.

8.0 Data and Records Management

All data and information (e.g., sample collection method used) must be documented on field data sheets or within site logbooks with permanent ink.

SOIL SAMPLING
STANDARD OPERATING PROCEDURE B.3

1.0 Scope and Application

1.1 This standard operating procedure (SOP) is generally applicable to the development and application of a soil sampling program including discussion of methodology and equipment. The procedures discussed herein focus on the collection of surface soil samples (within approximately 2 feet from ground surface) utilizing manual hand-operated equipment and the collection of subsurface soil samples utilizing Geoprobe® and/or hollow-stem auger drilling techniques.

2.0 Summary of Method

2.1 This document has been prepared to assist personnel with the performance of specific tasks and procedures related to the collection of surface soil samples and subsurface samples (with the sample depths defined in the associate work plan). Where possible, Geoprobe drilling technology should be considered for subsurface soil sampling to minimize the quantity of investigation-derived waste (IDW) generated during sampling activities. A hollow-stem auger drill rig should be utilized to install borings in locations where a Geoprobe cannot penetrate to the desired depth.

3.0 Health and Safety Issues

3.1 As with any activities associated with potential contaminants, work tasks should be conducted in accordance with applicable Environmental Protection Agency (EPA), Occupational Safety & Health Administration (OSHA), client and AECOM safety policies and procedures. This should include preparation of a site-specific Health and Safety Plan (HASP) to ensure that all aspects of potential risk are evaluated and properly addressed.

4.0 Personnel Qualifications

4.1 All field personnel with potential for exposure to contaminated media on site are required to take the 40-hour Health and Safety Training and regular refresher courses prior to engaging in any field effort. Certificates for each person should be incorporated into the site HASP. Additionally, all field personnel should have medical clearance in accordance with the HASP.

5.0 Equipment and Supplies

5.1 To the extent possible, equipment used for sampling should be constructed of inert materials such as stainless steel or polyethylene. Ancillary equipment such as auger flights may be constructed of other materials.

5.2 Selection of equipment is usually based on the depth of the samples to be collected, but it is also controlled to a certain extent by the characteristics of the material. Equipment and supplies that may be required as part of this SOP include the following:

- Stainless steel hand-operated bucket auger
- Stainless steel or polyethylene scoops
- Stainless steel bowls or disposable plastic/polyethylene trays
- Stainless steel split-barrel sampler
- Plastic zip-sealed bags
- Survey stakes or survey flags
- Permanent markers
- Field logbook/field sheets
- Photoionization detector (PID)
- Area maps, ruler, waterproof pens
- Measuring tape (100 foot)
- Munsell Soil Color Reference Guide
- Shovel or post-hole diggers
- Safety equipment (e.g. safety shoes, safety glasses, hard hat, nitrile gloves, leather gloves, first aid kit)
- Plastic (polyethylene) sheeting
- Sample bottles, and labels
- Trip blanks
- Chain-of-custody forms
- Coolers
- Approved Work Plan
- Radio or cell phone
- Truck or suitable off-road vehicle

6.0 Sample Collection – Preparation

Pre-sampling preparation activities may include:

- Determine the extent of the sampling effort, the sampling methods to be employed, minimum sample volume requirements, and which equipment and supplies are needed.
- Obtain necessary sampling and monitoring equipment.
- Decontaminate or pre-clean equipment (see decontamination SOP), and ensure that equipment is in working order.
- Use stakes or flags to identify and mark sampling locations. If required, the proposed locations may be adjusted based on site access, utility clearance and surface obstructions.

7.0 Sample Collection – Secondary Parameters

- Soil characterization data should be collected during soil sampling. Visual observations of soil color and texture, descriptions of soil horizons, moisture, and the presence of any non-native material should be recorded on field data sheets or in the field logbook (as necessary).

8.0 Sampling Methodology

8.1 Surface Sampling Procedures

8.1.1 This discussion of soil sampling methodology is generally applicable to the collection of surface soil samples using scoops or hand augers.

8.1.2 The boring locations will be located by a New York State-licensed surveyor. The following procedures may be applied to the site for sampling:

- The boring locations will be located by a New York State-licensed surveyor. Designate the location with a unique sample identifier and place a stake or survey flag at the location with the sample site identification.

- Don gloves and prepare equipment. If hand augers are to be used, leather gloves are permitted provided there is no contact with the sampled media.
- Begin construction of the sample boring by removing the soil horizon (upper soil horizon containing the vegetative root mat generally high in organic debris).
- Continue the boring until the desired depth is achieved.
- Collect soil from the sampling interval using decontaminated or disposable equipment (scoop or auger).
- Collect grab samples (as required in accordance with the Work Plan).
- Adequately describe the sample including sample depth, soil color, texture, moisture content, and a soil description.
- When adequate volume is achieved, blend the soil in the bowl/bag until the soil is adequately homogenized.
- Place the soil media into appropriately prepared laboratory containers.
- Seal, label, and place the containers into a cooler.
- Adequately describe the sample location. May include site setting, vegetation, drainage conditions, depth to sampling location, and a soil description.
- Complete the chain-of-custody.
- Decontaminate the sampling equipment (according to the procedures outlined in the Decontamination SOP).
- Dispose of expendable items in the waste allocation area and backfill sampling site (as necessary).
- The final sample locations will be recorded by the New York State-licensed surveyor.

8.2 Subsurface Soil Sampling

This discussion of soil sampling methodology is applicable to the collection of subsurface soil samples using Geoprobe or hollow-stem auger drilling techniques using stainless steel split-barrel samplers. The following procedures may be applied to the site for sampling:

- Don gloves and expose the surface soil by either pulling barrels apart or cutting the boring liner.

- Follow necessary Work Plan procedures for logging of the soil core and sample collection.
- Adequately describe the sample including sample depth, soil color, texture, moisture content, and a soil description.
- Collect grab samples (as required in accordance with the Work Plan).
- For composite sampling (excluding VOCs), place the sampled soil into a decontaminated disposable tray or plastic bag for blending (blend the soil until the soil is adequately homogenized).
- Place the soil media into appropriately prepared laboratory containers.
- Seal, label, and place the containers into a cooler.
- Complete the chain-of-custody.
- Decontaminate the sampling equipment (according to the procedures outlined in the Decontamination SOP).

9.0 Data and Records Management

All data and information (e.g., sample collection method used) must be documented on field data sheets or within site logbooks.

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APPENDIX C

QUALITY ASSURANCE PROJECT PLAN (QAPP)

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APPENDIX C
Quality Assurance Project Plan

Study Area

Corning, NY
NYSDEC Project ID 851046

June 2020

Prepared for

Corning Incorporated
Corning, New York

Prepared by

AECOM Technical Services, Inc.
Latham, New York 12110

Project Number 60599493

AECOM

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ATTACHMENTS

LIST OF ACRONYMS

AECOM	AECOM Technical Services, Inc.
ASP	Analytical Services Protocol
ASTM	American Society of Testing and Materials
CAMP	Community Air Monitoring Plan
CPR	cardiopulmonary resuscitation
DAR	data applicability report
DQO	data quality objective
DUSR	data usability summary report
EDD	electronic data deliverable
ELAP	Environmental Laboratory Approval Program
ETA	Eurofins TestAmerica
GPR	ground penetrating radar
HASP	Health and Safety Plan
ID	sample identification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LCSRM	laboratory control sample reference material
MCAWW	Methods for Chemical Analyses of Waters and Wastes
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
ND	non-detect
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OU	operable unit
OSHA	Occupational Safety and Health Administration
PID	photoionization detector
PM_{10}	particulate matter 10 microns or less in diameter

LIST OF ACRONYMS (Continued)

PPE	personal protective equipment
QA	quality assurance
QAM	Eurofins TestAmerica Quality Assurance Manual
QAO	quality assurance objective
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
SCO	Soil Cleanup Objective
SOP	standard operating procedure
SOW	scope of work
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compounds

1. INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared by AECOM Technical Services (AECOM) on behalf of Corning Incorporated to detail the quality assurance/quality control (QA/QC) procedures for conducting field activities in the Study Area located in Corning, New York as illustrated on Figure 1-1. In general, the Study Area is bound by the Chemung River to the south; Post Creek and Interstate 86 to the east and north; and the Guthrie Medical Center, the City of Corning Fire Department, and Centerway to the west. The Study Area is separated into five operable units (OUs), based on location and land use, to assist in advancing properties through the remediation process. The five OUs in the Study Area are identified as follows: the Residential Area (OU1), the Residential Area at the Eastern End of Corning Boulevard (OU2), School/Community Use Areas (OU3), Flood Control Areas (OU4), and the Residential Expansion Area (OU5). The Study Area and OUs are depicted on Figure 1-2.

1.1 PROJECT SCOPE AND GOALS

The purpose of the Soil Cover Sampling Plan is to gather additional data to determine if the existing 1-foot soil cover at the Corning-Painted Post School District property meets the NYSDEC restricted residential Soil Cleanup Objectives (SCOs; New York Codes, Rules and Regulations (NYCRR) Subpart 375-6).

1.2 PROJECT DATA QUALITY AND OBJECTIVES

This QAPP documents the QA/QC measures that will be followed during the implementation of Soil Cover Sampling Plan activities and any follow-up activities that may be conducted (if required). The objective of the data collection is to support the characterization activities within OU3 of the Study Area.

The QAPP provides a description of the analytical, field, and reporting procedures that may be used by AECOM and its subcontractors within the Study Area for the following activities:

- Soil sampling;

- Laboratory analysis; and
- Report preparation.

The purpose of the QA/QC program is to produce analytical measurement data of known quality that satisfy the project data quality objectives (DQOs). DQOs are data quality planning and evaluation tools for sampling and analysis activities. A consistent and comprehensive approach for developing and using these tools is necessary to ensure that enough data are produced and that the data are of sufficient quality to make decisions for the project. The DQO process is described in the subsequent subsection.

1.3 DATA QUALITY OBJECTIVES

The DQO process and quality assurance objectives for program planning are presented in this section. The procedures of the overall QA/QC have been developed to ensure that the analytical data collected through implementation of the Soil Cover Sampling Plan are of a known and acceptable level of quality.

The primary DQO is:

- Complete the soil cover sampling activities to determine if the existing 1-foot soil cover at the Corning-Painted Post School District property meets the restricted residential SCOs.

To achieve the DQO, QA measures will be implemented throughout the project to ensure that the data meet known and suitable data quality criteria such as selectivity, precision, accuracy/bias, representativeness, comparability, and completeness. The sampling data will be quality-controlled through the collection of field QC samples and the calibration of field and laboratory equipment. In addition, replicate samples will be collected and submitted as part of the QA program. Implementation of QA/QC measures to achieve the DQO will limit the chance of generating inadequate or incomplete data.

The DQO will be accomplished by ensuring that the following analytical objectives are met. These analytical objectives will include the following:

- To prepare and analyze samples using standard methods; and
- To obtain usable and defensible analytical results.

Quality assurance objectives (QAOs) are the detailed QC specification for selectivity, precision, accuracy, representativeness, comparability, and completeness. In regards to measurements of data quality, the QA/QC program will include the following QAOs:

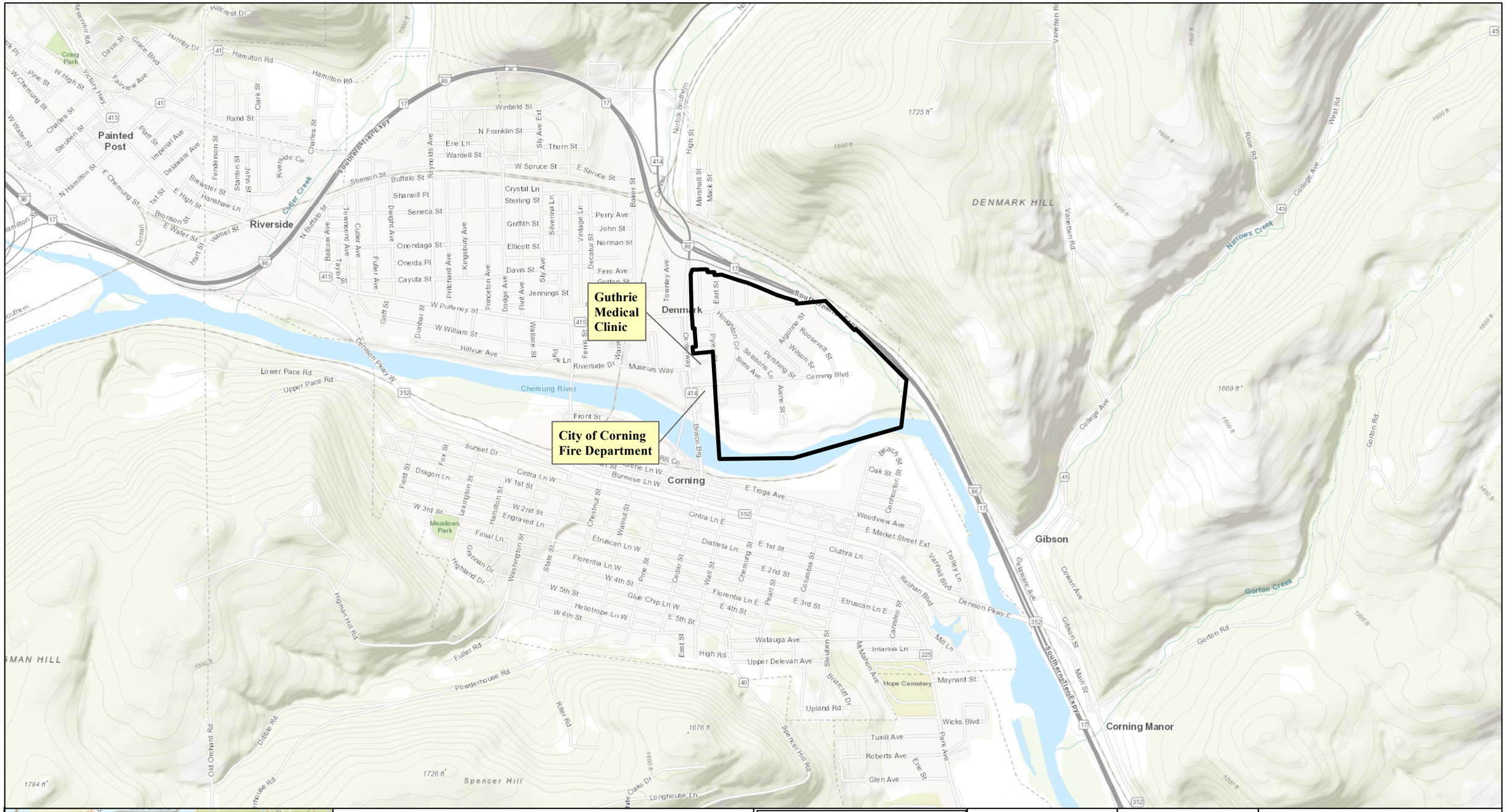
- Provide a mechanism for the ongoing control and evaluation of measurement data quality; and
- Provide measures of data quality in terms of selectivity, precision, accuracy, completeness, representativeness, and comparability to assess whether the data meet the project objectives and can be used for their intended purpose. The specific criteria for this assessment are discussed in Section 5.6 (Data Review/Validation) of this Appendix.

The primary application of analytical results will be to generate sufficient information to determine if the existing 1-foot soil cover meets the restricted residential SCOs within OU3 of the Study Area. The project data manager will track data from collection of samples through login at the laboratory to delivery by technical report and electronic data deliverable (EDD), oversee necessary validation, data usability summary report preparation (DUSR) and/or data applicability report preparation (DAR), and coordinate laboratory corrective actions.

The following sections discuss the steps to be taken to ensure the quality of data acquired. The representativeness of the measurement data is a function of the sampling strategy and will be achieved by following the procedures in the Soil Cover Sampling Plan. The quality of the analytical results is a function of the analytical system and will be achieved by using standard methods and the QC practices discussed in this section. The basis for assessing selectivity, precision, accuracy, representativeness, comparability, and completeness is discussed in Eurofins TestAmerica Laboratories, Inc.'s (ETA's) QA Manuals (QAM) found in Attachment A.

1.4 PROJECT SCHEDULE

The schedule for project activities is presented in Section 5.1 of the Soil Cover Sampling Plan.



NOTES: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P,

Study Area
Corning, NY

AECOM

Figure 1-1
Location of Study Area

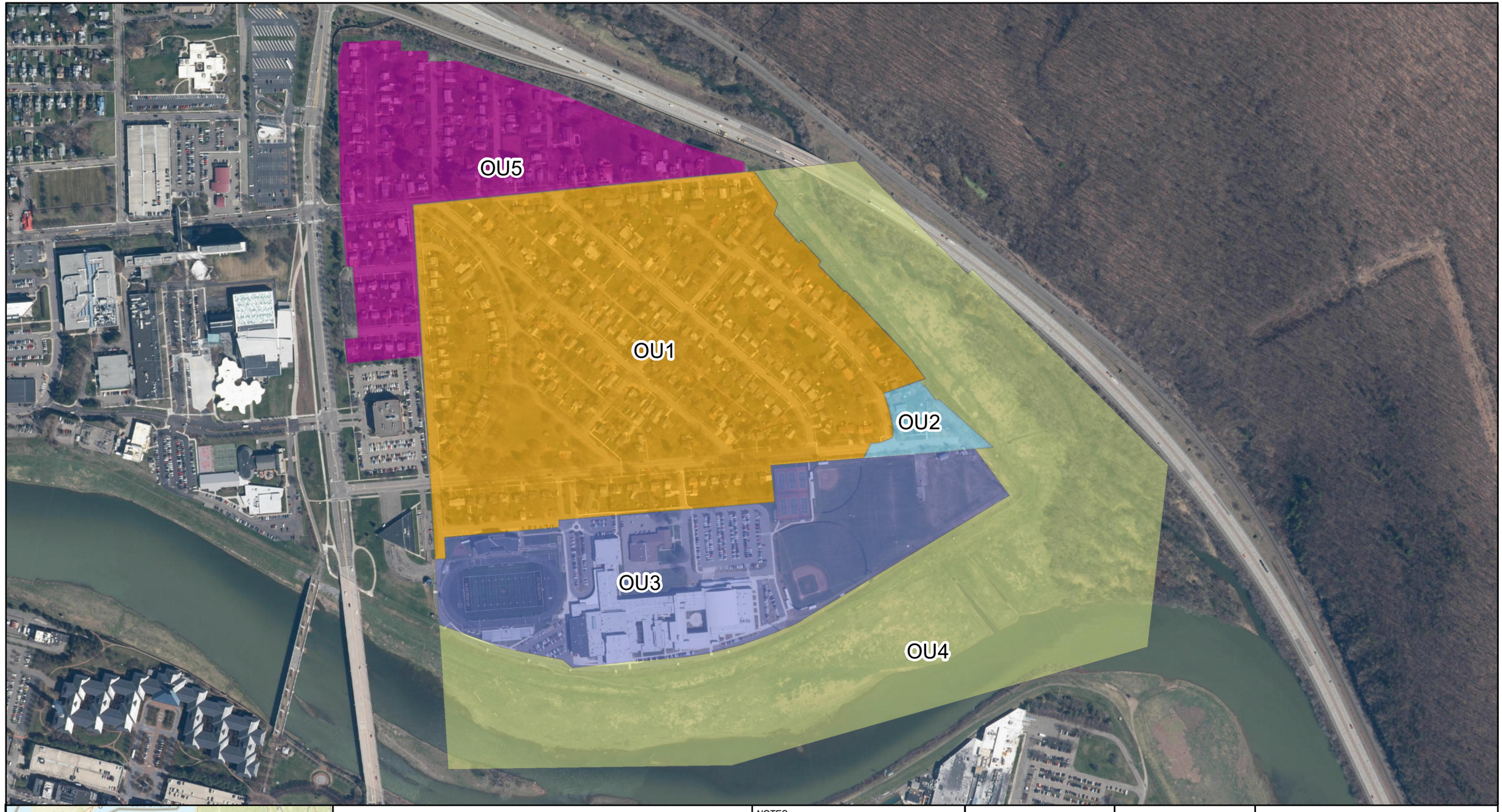
N

0 400 800 1,200 1,600 2,000 Feet

0 260 520 780 Meters

Document Name: F1-1 Topo.MXD

5/26/2020



Legend

- OU1 = Residential Area
- OU2 = Residential Area at the Eastern End of Corning Boulevard
- OU3 = School/Community Use Areas
- OU4 = Flood Control Areas
- OU5 = Residential Expansion Area

NOTES:
Base Imagery: Robinson Aerial Imagery, Dec 2015
Coordinate System: NAD 1983 State Plane New York Central Feet
Datum: NAD83. Units: Feet

Study Area
Corning, NY

AECOM

Figure 1-2
Study Area Operable Units

N

0 400 800 Feet

0 80 160 240 Meters

Document Name: F1-1 OUs.MXD

3/18/2020

2. PROJECT ORGANIZATION AND RESPONSIBILITIES

A general description of the organization and the responsibilities of key individuals for the project teams are provided in this section. This QAPP covers the work of Corning Incorporated, AECOM, and subcontractors. Responsibilities and authority may vary among subcontractors. The following sections give brief descriptions of the primary staff and the responsibilities of the management, QA/QC, and primary task leadership for the field and laboratory tasks. Project activities will be performed within the framework of the organization and functions described in this section.

The organization for the project is designed to provide clear lines of responsibility and authority. This control structure provides for the following:

- Identifying lines of communication and coordination;
- Monitoring project schedules and performance;
- Managing key technical resources;
- Coordinating support functions such as laboratory analysis and data management; and
- Rectifying deficiencies.

QA personnel will have sufficient authority, organizational freedom, and ability to act as follows:

- Identify QA problems;
- Initiate, recommend, or provide solutions to QA problems through designated channels;
- Ensure that program activities, including processing information deliverables, and installation or use of equipment, are reviewed in accordance with QA objectives;
- Ensure that deficiencies/non-conformances are corrected; and
- Ensure that further processing, delivery, or use of data is controlled until the proper disposition of a nonconformance, deficiency, or unsatisfactory condition has occurred.

The organizational structure will be reviewed and updated periodically by the AECOM Project Manager. Any necessary staff changes will be filled with qualified personnel and communicated to the Corning Incorporated Project Manager.

2.1 CORNING INCORPORATED COMPANY PERSONNEL

Mr. Greg Haack, will serve as the Corning Incorporated Project Manager for the project. Mr. Haack is responsible for primary contact with NYSDEC and for oversight of the project. Mr. Haack's responsibilities include defining project objectives, allocating resources, determining the chain-of-command, and evaluating the project outcome.

Greg Haack
Corning Incorporated
HP-ME-03-03
Corning, NY 14831

2.2 AECOM PERSONNEL

2.2.1 Project Manager

Ms. Aimee Ruiter will serve as the AECOM Project Manager for the project. Ms. Ruiter will be responsible for day-to-day activities on the project and planning, coordinating, integrating, monitoring, and managing project activities, including the activities of subcontractors to AECOM. Ms. Ruiter will also be responsible for the identification and ultimate resolution of technical problems and the technical coordination of the field efforts and subsequent data assessment.

Aimee Ruiter
AECOM Technical Services, Inc.
86 Guinea Ridge Road
Gilmanton, NH 03237
1-603-524-6004 (office)
1-978-580-7616 (cell)
aimee.ruiter@aecom.com

2.2.2 Data Validation and Quality Assurance

Mr. Greg Malzone and Ms. Ann Marie Kropovitch, will serve as the AECOM data validators. Mr. Malzone and Ms. Kropovitch will review the data packages and complete DUSRs in accordance with DER-10. The DUSRs will be reviewed by Mr. George Kisluk or Mr. Robert Davis. Resumes for the data validators and reviewers is provided in Attachment B.

Greg Malzone
AECOM Technical Services, Inc.
707 Grant Street, 5th Floor
Gulf Tower
Pittsburgh, Pennsylvania 15219
1-412-395-8888 (Office)
greg.malzone@aecom.com

Ann Marie Kropovitch
AECOM Technical Services, Inc.
257 West Genesee St Ste 400
Buffalo, New York 14202
1-716-923-1137 (Office)
ann.marie.kropovitch

George Kisluk
AECOM Technical Services, Inc.
257 West Genesee Street
Suite 400
Buffalo, New York, USA
1-716-923-1321 (Office)
george.kisluk@aecom.com

Robert Davis
AECOM Technical Services, Inc.
1360 Peachtree St NE
Atlanta, Georgia 30309
1-912-313-1790 (Office)
Robert.Davis@aecom.com

2.2.3 Field Team Project Manager/Health and Safety Officer

Ms. Aimee Ruiter and Ms. Claire Hunt will lead the Field Team, serve as Health and Safety Officers, and be responsible for oversight of activities in the field. They will be responsible for ensuring that procedures for the field activities related to soil sampling are executed in accordance with the Soil Cover Sampling Plan and are documented according to the procedures presented in this QAPP. The Health and Safety Officers will be responsible for: (1) having an up-to-date Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) in place, (2) ensuring that the AECOM and subcontractor personnel adhere to the HASP and CAMP protocols, (3) training personnel involved in health and safety procedures, (4) maintaining control and exercising proper responses in emergencies, and (5) keeping a logbook of activities.

Aimee Ruiter
AECOM Technical Services, Inc.
86 Guinea Ridge Road
Gilmanton, NH 03237
1-603-524-6004 (office)
1-978-580-7616 (cell)
aimee.ruiter@aecom.com

Claire Hunt
AECOM Technical Services, Inc.
100 Red Schoolhouse Road, Suite B-1
Chestnut Ridge, NY 10097
1-201-316-3728 (cell)
claire.hunt@aecom.com

2.2.4 Data Manager

Ms. Heather Wayne of AECOM will be responsible for managing the analytical data generated from the project activities.

Heather Wayne
AECOM Technical Services, Inc.
1601 Prospect Pkwy
Fort Collins, CO 80525
1-978-905-2451 (office)
Heather.Wayne@aecom.com

2.3 LABORATORY STAFFING

Analytical work required during the project activities will be performed by ETA. The primary ETA laboratory is located in Buffalo, NY. ETA Buffalo may subcontract work to the Edison, NJ laboratory as required to maintain project timelines. These ETA laboratories are New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratories (ETA Buffalo certification #10026 and ETA Edison certification #11452). If, for any reason, another laboratory is needed during the project activities, it will be required to comply with the requirements presented in this QAPP.

The ETA QAMs for each laboratory are included as Attachment A of this QAPP. The laboratory QAMs include detailed explanations of the staff organization and QA system, as well as personnel responsibilities, qualifications, and training.

It is the individual responsibility of analysts and technicians to perform their assigned tasks according to this QAPP, applicable standard operating procedures (SOPs) and the Soil Cover

Sampling Plan for the project. This includes responsibility for performing QC analyses as specified in the method SOP and for entering the QC data in the appropriate logbook, electronic database, or method control file system. The analyst will report out-of-control results to the Laboratory Quality Manager and will indicate corrective action for out-of-control events.

2.3.1 Laboratory Personnel and Responsibilities

Mr. John Schove will serve as ETA's Project Manager. The Project Manager is accountable for the oversight of the laboratory functions and operations, including coordination with/between AECOM and the Laboratory Quality Manager.

Mr. Brad Prinzi will serve as ETA's Laboratory Quality Manager. The Quality Manager's responsibilities include the oversight of the laboratory's Quality Systems and ensuring that the tasks performed by the laboratory and ETA field personnel are conducted in compliance with state, federal and industry standards, as well as the requirements of this QAPP.

John Schove –Project Manager
Eurofins TestAmerica Buffalo
10 Hazelwood Drive
Amherst, New York 14228
1-716-504-9838
john.schove@testamericainc.com

Brad Prinzi – Laboratory Quality Manager
Eurofins TestAmerica Buffalo
10 Hazelwood Drive
Amherst, New York 14228
1-716-504-9800

2.3.2 Subcontractors

If subcontractors are required, the AECOM Project Manager will coordinate with the AECOM Subcontractor Administrator to develop the scope of work (SOW) to be performed by the subcontractors. The Field Team Manager will direct the subcontractors in the field in accordance with their specific SOW.

2.4 TRAINING AND CERTIFICATION

2.4.1 Field Staff Training and Certification

Information pertaining to project-specific training and certification can be found in the HASP prepared for the sampling activity, including:

- medical monitoring;
- Occupational Safety and Health Administration (OSHA) training;
- first aid/cardiopulmonary resuscitation (CPR) certification; and
- equipment operation, and associated records and documentation.

Training records for field staff, including subcontractors, will be available to the AECOM Project Manager.

3. FIELD SAMPLING PROCEDURES

This section describes the components of the sampling procedures that will be performed at the Study Area. The matrix, parameters, and initial number of samples for characterization activities are presented in the sample summary table included in the Soil Cover Sampling Plan (see Table 4-1 in the Soil Cover Sampling Plan). Sampling locations, rationale, and analytical methods, as well as the sampling and decontamination procedures for this project are discussed in detail in the Soil Cover Sampling Plan and attached SOPs (Appendix B of the Soil Cover Sampling Plan).

Prior to the sampling activities, the Field Team Manager will ensure that the field personnel understand the purpose, objectives, and scope of the event. Topics for review and discussion with the team may include schedules, responsibilities, sampling locations, types of samples to be collected (both field samples and QC samples), number of samples and sample volumes to be collected, sample identification numbering schemes, preservation requirements, parameter(s) to be analyzed, sampling procedures, equipment decontamination procedures, and chain-of-custody requirements. The Field Team Manager will ensure that field personnel also have access to a copy of the Soil Cover Sampling Plan including the SOPs. Field activities must be conducted in accordance with the health and safety procedures described in the HASP.

3.1 PRE-SAMPLING PROCEDURES

Sampling equipment (i.e., drill rigs and supporting equipment, hand augers, and trowels) will be decontaminated prior to arrival or cleaned and decontaminated in accordance with the SOP (Appendix B of the Soil Cover Sampling Work Plan). In accordance with the Soil Cover Sampling Plan, dedicated disposable sampling equipment may also be used.

3.2 DRILLING PROCEDURES

Criteria for selecting soil boring(s), and soil sampling locations (i.e., drilling locations) are based on the specific objectives for each study area, as described in Section 4 of the Soil Cover Sampling Plan. As described in Section 4, final selection of sampling locations will depend on securing the

necessary clearances, written agreements for access, permits, and approvals. If necessary, electrical cable and pipe locator instruments will be used with underground utility maps, magnetometer readings, and ground penetrating radar (GPR) to determine if utilities underlie the drilling location. The driller is responsible for the 811 call.

Cores to be visually logged and samples to be collected for physical or chemical analysis will be collected and handled according to the procedures described in the Soil Cover Sampling Plan. Field screening instrument calibrations will be conducted according to the procedures present in this QAPP.

3.3 SUBSURFACE SOIL SAMPLING PROCEDURES

Soil samples will be collected in the Study Area in accordance with the Soil Cover Sampling Plan. Soil borings will be collected using a Geoprobe rig. If recovery is poor, a hand-held steel soil auger or a hand-held stainless steel scoop may be used. Additional details regarding the locations of the samples are described in Section 4 of the Soil Cover Sampling Plan.

The soil sampling procedure is described in the Soil Cover Sampling Plan and contains the following elements:

- Locations will be cleared by an underground utility survey (as needed).
- Soils will be visually logged and screened with photoionization detector (PID).
- Specific sampling intervals will be documented in the project field notebook and/or designated field sheets.
- Soil samples will be identified by location, sample type, sample location, QC type, and depth/location.
- Samples will be placed in an ice-filled cooler for shipment to the laboratory (as needed) depending on the laboratory method requirements.

The potential list for analysis of soil samples, including the soil sample container volume, type, holding times, and associated preservation method are summarized in Table 3-1. Additional information regarding the analytical methods is specified in the ETA QAM.

3.4 FIELD QUALITY CONTROL SAMPLES

QC samples will be collected and analyzed as stated in the following subsections. The frequency of sample collection will be as specified in the following subsections and in accordance with Table 4-1 of the Soil Cover Sampling Plan.

3.4.1 Equipment Rinsate Blanks

Analyses of equipment rinsate blanks will be used to assess the effectiveness of field equipment decontamination procedures in preventing cross-contamination between samples. De-ionized or distilled water will be poured into/through/over clean (decontaminated) sampling equipment used in the collection of investigative samples and then collected into prepared sample bottles. The rinsate blank will then be shipped with the environmental samples collected from the same parameter group. For each matrix, a rinsate blank will be collected and analyzed for every 20 samples (or less) collected. The rinsate blanks will be analyzed for the same parameters as the investigative samples.

3.4.2 Trip Blanks

No trip blanks will be collected under the direction of NYSDEC since only soil samples are being collected.

3.4.3 Field Duplicate Samples

A field duplicate sample is a second sample collected at the same location as the original sample. Blind field duplicate soil samples will be collected from the same sampling interval, where practical. Duplicate sample results will be used to assess precision, including variability associated with both the laboratory analysis and the sample collection process. For soil samples, duplicate samples also provide a measure of the heterogeneity of the soil matrix. Duplicate samples will be

collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation and analysis. One blind field duplicate sample will be collected for every 20 samples. If fewer than 20 samples are collected, one duplicate will still be collected. These duplicates will be analyzed for the same sample parameters that are specified for the original sample. Duplicate water samples for VOC analysis will not be alternately split among containers, but will be directly poured into the appropriate containers until filled (i.e., grab sample). Duplicate soil samples for non-VOC parameters will be collected from the homogenized sample from which the primary sample was collected. A duplicate soil sample for VOC parameters will be a grab sample.

3.4.4 Matrix Spike/Matrix Spike Duplicates (MS/MSDs)

Matrix spike/matrix spike duplicates (MS/MSDs) are samples in which known amounts of compounds are added in the laboratory before extraction and analysis. Two aliquots of the sample will be spiked for the duplicate analysis. The results of the duplicate spiked samples will be used to measure the percent recovery of each spiked compound and compare the recovery between samples, which will provide estimates of the accuracy and precision of the method. The solution of target analytes in MSs for organic analyses is based on SW-846 methods (U.S. EPA, 1983 [and subsequent amendments]) and does not include all target analytes, but is instead a representative subset. When reviewed in conjunction with other QC data, MS/MSDs data may indicate the need for reanalysis using a more appropriate method. For each matrix type, at least one spiked set of MS/MSDs will be analyzed for each batch of samples for every 20 (or fewer) samples received. The MS/MSD portion of the sample will be collected in a separate bottle for the routine sample to provide sufficient sample volume and to allow for the assessment of unspiked results for field precision.

3.5 SAMPLE HANDLING

Sampling and preservation procedures will be as mandated by each respective method. In order to preserve the integrity of the sample before it is analyzed, proper sample containment, shipping, and chain-of-custody procedures will be followed.

3.5.1 Sample Custody

This section includes a basic discussion of sample custody practices. The QC practices contained in this section are intended to address potential problems with labeling, transcription, and preservation. Overall, the QC checks included in this section are the mechanisms that detect and correct errors.

An overriding consideration for environmental data is the ability to demonstrate that samples were obtained from the locations stated and that they reached the laboratory without alteration. The sample custody procedures provide a mechanism for documentation of information related to sample collection and handling to achieve this objective. Evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal will be documented to accomplish this goal. Documentation will be accomplished through a chain-of-custody that records each sample and the individuals responsible for sample collection, shipment, and receipt. A standard chain-of-custody form has been provided by ETA (see Figure 3-1).

The samples that are collected will be accompanied by a chain-of-custody record. Information to be recorded on the laboratory supplied chain-of-custody form includes:

- Project name and number.
- Initials of sampler.
- Sample number, location, date and time collected, and sample type.
- Analyses requested.
- Any special instructions and/or sample hazards.
- Signature of sampler in the designated blocks, indicating date, time, and company.
- Condition of the sample upon receipt as reported by the analytical laboratory.

The purpose of sample custody procedures is to document the history of sample containers and samples from the time of sample collection through shipment and analysis. An item is considered to be in one's custody if one or more of the following conditions apply:

- It is in a person or company's actual possession.
- It is in view after being in physical possession.
- It is secured so that no one can tamper with it after having been in physical custody.

The following chain-of-custody procedures will be followed for samples submitted to the laboratory for chemical or physical properties analysis:

- Each individual field sampler is responsible for the care and custody of samples that he or she collects until the samples are properly transferred to temporary storage or for shipping.
- A chain-of-custody record will be completed by the sampler for samples collected and submitted to the laboratory.
- Each time the samples are transferred, the signatures of the persons relinquishing and receiving the samples, as well as the date and time, will be documented. If shipment is required, shipment records may be used to document receipt/relinquishment of the samples.
- The laboratory will record the condition of the sample containers upon receipt.
- Changes or corrections to the information documented by the chain-of-custody form (including, but not limited to, field sample ID or requested analyses) must be changed and initialed by the person requesting the change.
- A copy of the chain-of-custody form and any documented changes to the original will be returned from the laboratory as part of the final analytical report to the Project Manager. This record will be used to document sample custody transfer from the sampler to the laboratory and will become a permanent part of the project file.

As an essential part of project management, AECOM has established sample control procedures to ensure sample integrity. Sample containers and samples will be maintained throughout the project activities.

3.5.2 Sample Identification

A unique sample code, known as a field sample identifier or sample identification (ID), will be assigned to each sample collected. The field collection system will be set up to allow the Field

Team Manager, or designated sampling coordinator, to generate field sample identifiers prior to sample collection, if sufficient information is known (i.e., number of sampling locations and depths). Each unique identifier will be printed on the sample jar label, along with the date and time of sample collection. In addition, numeric or alphabetic values will be assigned to the type of sample (i.e., primary sample, field duplicate, and rinse blank) to distinguish samples that will be used for QC purposes.

Field sample identifiers will be generated so that there is no duplication and will be recorded on the chain-of-custody form. The format that will be followed for the field sample identifiers during the characterization activities at the Study Area is presented in Table 3-2.

3.5.3 Sample Labels

Each sample collected will be labeled with the assigned sample identification, which will be on the label attached to the sample container. Additional information recorded on the sample label includes where the sample was collected, when it was collected, the analysis required, preservative (if any), and identification of the sample(s).

Chain-of-custody records will be numbered to facilitate tracking of the shipment of individual samples. After the sample identification information is entered into the field logbook or on the designated sampling sheets, it will be entered on the chain-of-custody form and shipped with the samples.

3.5.4 Shipping Procedures

The objective of sample handling procedures is to ensure that samples arrive at the laboratory intact, at the proper temperature, and free of external contamination. It is anticipated that samples will be delivered to ETA via an AECOM employee or a laboratory courier service; however, samples may be shipped via FedEx or other third-party carriers as needed. Samples will be delivered to the laboratory within 24 to 48 hours of sample collection.

3.6 LABORATORY OPERATIONS

ETA will follow the most recent versions of QAMs and SOPs (see Attachment A of this QAPP for current versions) for laboratory custody procedures, handling, identification, control, and chain-of-custody procedures and to maintain the validity of the samples.

3.6.1 Sample Receipt

Upon receipt of the samples at the laboratory, a sample custodian, familiar with custody requirements and the potential hazards of handling environmental samples, will receive the samples. In addition, the sample custodian will also be responsible for documenting sample receipt, storage before and after sample analysis, and the proper disposal of samples. Upon sample receipt, the sample custodian will do the following:

- Sign the chain-of-custody form and place it in the project file.
- Inspect samples for condition upon receipt, type and status of refrigerant, holding times, and turnaround time requirements.
- Log in samples and assign each with a unique sample number.
- Assign each sample a unique barcode label and place the samples in the proper storage area until they are ready to be prepared/analyzed.

AECOM will be notified in the event that there are discrepancies or findings noted during sample receipt procedures.

3.6.2 Sample Storage

Samples will be stored in the proper environment as directed by the Laboratory Project Manager as described in Attachment A of this QAPP. To prevent mix-ups and cross-contamination, samples will be stored in areas as designated in the applicable SOP (provided in Attachment A of this QAPP). Room temperature, refrigerator temperature, and freezer temperatures in long-term and short-term sample storage will be monitored.

3.6.3 Sample Tracking

Persons requiring samples from storage may initiate a sample transfer request. The sample custodian retrieves the samples requested and places them in the short-term, environmentally controlled storage unit or location indicated on the request. Following analysis, or at the end of each day, the sample custodian will return the sample to the assigned environmentally controlled storage location.

3.6.4 Recordkeeping

Data related to sample preparation and analysis, as well as observations by laboratory analysts, will be recorded in bound laboratory notebooks or on designated laboratory sheets, as applicable. Raw data, in hard copy or electronic copy, will undergo a secondary data review process. Hard copy raw data, including, but not limited to, the original chromatograms, worksheets, correspondence, and results shall be included with the data package submitted to the Project Manager.

AECOM

Table 3-1
Analytical Methodologies
Soil Cover Sampling Work Plan

Analysis	Analytical Methods	Container	Preservation[7]	Hold Time
SOIL				
TAL ICP Metals	SW846 6010	10 grams, wide mouth glass w/Fluoropolymer Resin / Teflon®-lined lid	4°C	180 days
Mercury	SW846 7471	10 grams, wide mouth glass w/Fluoropolymer Resin / Teflon®-lined lid	4°C	28 days
TCL SVOCs	SW846 8270	30 grams, wide mouth glass w/Fluoropolymer Resin / Teflon®-lined lid	4°C	14 days[1]
Cyanide[3]	SW846 9012	4 oz soil jar	4°C	14 days
Chromium (VI)[3]	SW846 3060A/7196	4 oz soil jar	4°C	30/7 days[4]
Chromium (III)[3]	SM 3500 (calculation)	4 oz soil jar	None	NA
TAL PCBs	SW846 8082	30 grams, wide mouth glass w/Fluoropolymer Resin / Teflon®-lined lid	4°C	14 days[1]
VOCs[3]	SW846 8260	Wide mouth bulk jar, TerraCore® or EnCore® sampler[5]	4°C	14 days
PFAS	EPA Method 537.1 mod.	4 oz., High-density polyethylene (HDPE) or polypropylene containers with HDPE or polypropylene caps.	4°C	14/28 days[2]
Pesticides[3]	SW846 8081 & SW846 8151	2-4 oz wide mouth jars	4°C	14 days[1]
WATER				
TAL Metals	SW846 6010	250 mL, Polyethylene or Glass	4°C, $HN0_3$ to pH < 2	180 days
Mercury	SW846 7470	50 mL, Polyethylene or Glass	4°C, $HN0_3$ to pH < 2	28 days
TCL SVOCs	SW846 8270	2-250 mL, Glass with Teflon®-lined cap (amber)	4°C	7 days[6]
Cyanide[3]	SW846 9012	250 mL, Polyethylene	4°C, NaOH to pH > 12	14 days
Chromium (VI)[3]	SW846 7196	125 mL, Polyethylene	4°C	24 hours
Chromium (III)[3]	SM 3500 (calculation)	125 mL, Polyethylene	None	NA
TAL PCBs	SW846 8082	2-250 mL, Glass with Teflon®-lined cap (amber)	4°C	7 days[6]
VOCs[3]	SW846 8260	3-40 mL, Glass with Teflon®-lined septum	4°C, HCl to pH < 2	14 days
PFAS	EPA Method 537.1 mod.	2-250 mL, High-density polyethylene (HDPE) or polypropylene containers with HDPE or polypropylene caps.	4°C	14/28 days[2]
Pesticides[3]	SW846 8081 & SW846 8151	4-250 mL, Glass with Teflon®-lined cap (amber)	4°C	7 days[6]

Notes:
1. 14 days for extraction; 40 days after extraction for analysis
2. 14 days for extraction; 28 days after extraction for analysis
3. List of constituents under this analysis are from the DER-10 List (see Appendix 5, Allowable Constituent Levels for Imported Fill or Soil, Subdivision 5.4(3)).
4. 30 days for alkaline digestion, 7 days to instrumental analysis
5. There are a number of options for collecting soil samples for volatile analysis. The options include: EnCore® devices, TerraCore® devices, and wide mouth bulk jars. A separate 2 oz jar must be collected for dry weight determination.
6. 7 days for organic extraction, 40 days after extraction for analysis
7. All samples will be preserved on ice.

HDPE - High-density polyethylene
PCBs - Polychlorinated biphenyls
PFAS - Per- and Polyfluoroalkyl Substances
SVOCs - Semi-volatile organic compounds
TAL - Target Analyte List
TCLP - Toxicity Characteristic Leaching Procedure
TPH - Total petroleum hydrocarbons
VOCs - Volatile organic compounds

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Table 3-2
Field Sample Identifiers
Soil Cover Sampling Plan QAPP

Sample Area	Sample Number	QC Type	Depth/Date code
Soil Sample Identifiers			
CPP = Corning-Painted Post School District Property	SS### = Surface Soil Sample	0 - Primary Sample	### - Depth at Top of Sample
		1 - Duplicate Sample	(e.g. 2.0 feet is 020)
Example ID: CPPSS050-0-002 (Primary soil sample collected from surface soil sample #50 at the Corning-Pained Post School District Property at 0.2 feet below ground surface.)			
QA/QC Field Sample Identifiers			
CNY = Corning New York[1]	RB## = Rinse Blank	2 - Field Blank Sample	YYMMDD - Date of Sampling
			(e.g. 1/1/2016 feet is 160101)
Example ID: CNYRB01-2-160101 (First rinse blank collected on January 1, 2016.)			
Additional Field Sample Identifiers			
CNY = Corning New York[1]	IDW### = Investigative Derived Waste Sample	0 - Primary Sample	
	C### = Composite Sample	1 - Duplicate Sample	
	G### = Grab Sample		
Example ID: CNYIDW10-0- (Primary sample of Investigative Derived Waste sample number 10)			

Notes:
[1]CNY sample area identifier is only used for samples that are not specific to a specific sample area (i.e., rinse blank and/or IDW sample)

Eurofins TestAmerica, Buffalo
10 Hazelwood Drive

Amherst, NY 14228-2223
phone 716.691.2600 fax 716.691.7991

Chain of Custody Record

eurofins | Environment Testing TestAmerica

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc. d/b/a Eurofins TestAmerica

Client Contact	**Project Manager:**		COC No:
Your Company Name here	**Email:**	**Site Contact:**	**Date:**	_____ of _____ COCs
Address	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	TALS Project #:
City/State/Zip	**Analysis Turnaround Time**			Sampler:
(xxx) xxx-xxxx Phone	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(xxx) xxx-xxxx FAX	TAT if different from Below _____			Walk-in Client:
Project Name:	☐ 2 weeks			Lab Sampling:
Site:	☐ 1 week			
P O #	☐ 2 days			Job / SDG No.:
	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for _____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd:_____ Corr'd:_____		Therm ID No.:_____
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.30, dated 1/1/2020

FIGURE 3-1 Eurofins TestAmerica Chain-of-Custody

4. FIELD OPERATIONS

This section includes brief descriptions of field procedures used to conduct environmental evaluations in the project. Criteria or guidelines for choosing among alternatives are also included when more than one procedure can be used.

4.1 FIELD RECORDS

Documentation of field sampling will be performed to ensure data validity and facilitate analysis and evaluation. Examples of field documentation are provided in the following sections.

Field personnel are responsible for recording field activities in the appropriate field documentation logbooks or on dedicated sampling sheets in sufficient detail to allow the significant aspects of the event to be reconstructed without relying on memory. It is the responsibility of the Field Team Manager to ensure that documents are complete and legible.

The field documentation forms or equivalent records that will be used during this investigation typically include the following:

- Soil sampling and borehole log forms;
- Field logbooks;
- Air monitoring records;
- Subsurface utility clearance records;
- Annotated maps; and
- Sample chain-of-custody records.

4.1.1 Field Logbooks

Field logbooks will be used to record data collection activities. Activities will be described in as much detail as possible so that persons going to the facility can reconstruct a particular situation without relying on memory. Designated field sheets may also be used to record project activities.

A field logbook(s) will be maintained by the Field Team Manager or designated field team members present in the field to record information pertinent to daily activities, the field sampling program, and the equipment preparation efforts. Field logbooks will be bound, pages numbered, and entries made in permanent, waterproof ink. Field logbooks and field sheets will be scanned and transferred to the electronic project files or physically placed in the file at the end of field activities to provide a record of sampling.

Field logbooks and/or field sampling sheets will contain the following types of information, where applicable:

- Name and location of project.
- Date(s) and time(s) of sample collection.
- Name of Field Team Manager and/or other field team members.
- Field observations, including physical/environmental conditions during the field activity (i.e., weather).
- Summary of equipment preparation/decontamination procedures.
- Number, type, location, depth, and analysis required of samples taken and sample identification codes.
- A description of sampling methodologies or references to the Soil Cover Sampling Plan and this QAPP.
- A cross-reference to photographs, if photographs are taken.
- Sample containers/preservatives.

- A cross-reference of sample identification codes or sampling points on annotated project maps or sketches.
- Sample shipping dates and methods.
- Deviations from the Soil Cover Sampling Plan (if applicable).

Information recorded should also include comments and other relevant observations such as weather conditions or other factors that may affect sample results or interpretation of sampling techniques and any modifications to sampling procedures as well as other technical comments regarding color, odor, texture, moisture and other sample characteristics.

4.1.2 Soil Sampling and Borehole Log Forms

Certain descriptive and sample information will be recorded during the completion of each boring and the collection/logging of soil samples. The information will be recorded in the field logbook, on a soil description form, borehole log form, or other appropriate form.

4.1.3 Corrections to Documentation

Field measurements made and samples collected will be recorded. Corrections will be made by drawing a line through the incorrect entry and writing in the correct entry. The person making the correction will date and initial the correction. There will be no erasures or deletions from the field logbooks.

4.2 SURVEYING

Surface soil and soil boring locations will be surveyed by a New York State Licensed Surveyor.

4.3 ANNOTATION OF MAPS

Copies of Study Area base maps or sketches used by the field teams to record key Study Area conditions and to show approximate locations of soil borings, buildings and structures, utilities, and other appropriate project location information will be maintained (as needed) for the project files. The

maps or sketches will be maintained by the Field Team Manager during field activities and transferred to the project files for a record of sampling locations.

4.4 AIR MONITORING

In accordance with the CAMP, air monitoring will be conducted to evaluate air quality during project activities (as needed). The data provided by the air monitoring could be used to determine the appropriate control actions and personal protective equipment (PPE) requirements.

Equipment calibration of air monitoring equipment will be performed in accordance with the manufacturer instructions.

Air monitoring for dust particulates and dust control techniques will be performed during subsurface soil sampling activities. The selection of the dust monitor is discussed in Appendix E.

A PID equipped with a 10.6 eV or an 11.7 eV lamp, calibrated with isobutylene, will be used to monitor the general area and the breathing zone of workers during intrusive activities to assess the potential presence of organic vapors.

4.5 FIELD CALIBRATION

Field instrumentation will be calibrated in accordance with the manufacturer-supplied guidance manual to ensure that the instruments are operating properly and to produce data that can satisfy the objectives of the sampling program. Specific field instruments that will be used during the project, when appropriate, include the following:

- PID meter; and
- Dust Monitor for particulate matter 10 microns or less in diameter (PM_{10} Dust Monitor).

To ensure that the instruments are operating properly and are producing accurate and reliable data, routine calibration must be performed. Calibrations should be performed at a frequency recommended by the manufacturer. Calibration procedures are normally included with the

equipment. Field calibrations should be performed at the beginning of the day and should be checked throughout the sampling day.

PID meters and PM_{10} dust meters will be calibrated according to the instrument manufacturers' specifications. Daily calibrations will be performed by AECOM personnel. The recorded calibration information including date of calibration, standards used, and calibration results will be recorded in the field logbook or designated field calibration sheets.

If field calibration reveals that an instrument is outside of the established accuracy limits, the instrument will be serviced in the field according to the manufacturer's specifications, if possible. If necessary, the instrument will be returned to the manufacturer for repair and servicing.

5. LABORATORY ANALYSIS

To generate analytical data of known and defensible quality, adherence to established QA protocols will be used. To ensure that the samples obtained in the field represent the particular environment from which they are collected and are of satisfactory quality, laboratory analysis will be performed in accordance with the Soil Cover Sampling Plan SOPs as well as in accordance with ETA SOPs established in ETA's QAM (provided in Attachment A of this QAPP).

5.1 LABORATORY REQUIREMENTS

ETA (certified New York laboratory #10026 and certified New Jersey laboratory #11452) will perform analysis on environmental samples where certification exists. The laboratory will follow QA/QC procedures specified by the analytical methods.

5.2 METHOD DETECTION LIMITS

To generate data that meets the project-specific data quality objectives, the laboratory will demonstrate that the sensitivities of the methodologies used for sample analyses will be at or below the method detection limits (MDLs). Tables 5-1 summarize the laboratory MDLs. The laboratory will define MDLs in accordance with the 2017 Clean Water Act Method Update Rule, September 27, 2017. Laboratory MDLs should also meet clean up objectives when feasible.

The MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than non-detect (ND) and is determined from analysis of a sample in a given matrix containing the analyte. The MDL is estimated in an interference-free matrix, typically reagent water for water methods and a purified solid matrix (e.g., sand) for soil methods, and shall be estimated for each compound/analyte of interest using the procedures presented in 40 CFR, Part 136, Appendix B. The MDLs are extraction/digestion method-specific and include clean-up methods used. The laboratory performs MDL studies whenever the basic chemistry of the procedures changes. If any of the target analytes are not

recovered, the MDL study will be repeated for the failed target analytes. The MDL study is performed, at a minimum, on an annual basis.

5.3 ANALYTICAL METHODS AND HOLDING TIMES

Table 3-1 summarizes the analytical methods to be used and the maximum holding times for soil samples. Sample holding times are calculated from the time of collection.

Samples collected under this QAPP will be analyzed using procedures of U.S. Environmental Protection Agency (USEPA) SW-846, 3rd Edition, Final Update V, 2015 (U.S. EPA, 1983 [and subsequent amendments]), USEPA Methods for Chemical Analyses of Waters and Wastes (MCAWW), or American Society of Testing and Materials (ASTM).

5.4 QUALITY CONTROL AND QUALITY ASSURANCE

Sample analyses will include a method blank, a method blank spike, a matrix spike, a laboratory duplicate for inorganic analyses (or matrix spike duplicate for organic analyses), and a laboratory control standard (inorganic analysis only) in each batch of 20 or fewer samples. In addition, appropriate surrogate compounds (organic analysis only) will be spiked into each sample. Recoveries from matrix spikes and surrogate compounds are calculated and recorded on control charts to maintain a history of system performance. The laboratory-performance-based acceptable limits for each compound/analyte will be established and provided by the laboratory.

Any blanks and/or other QC parameters not meeting the established acceptance criteria will prompt sample re-extraction/re-digestion and/or reanalysis as detailed in the laboratory SOPs that are included with ETA's QA Manuals included in Attachment A of this QAPP.

Before any instrument is used as a measurement device on the project samples, the instrument responses to known reference materials will be determined. The manner in which various instruments are calibrated is dependent upon the particular type of instrument and its intended use. Sample measurements are made within the calibrated range of the instrument. Preparation of reference materials used for calibration will be documented in the standards preparation notebook.

Instrument initial calibration will be performed to the pertinent method specifications or the manufacturing manual. Continuing calibration or calibration verification will be performed at frequencies outlined in the pertinent analytical methods. The acceptance criteria will be met before any samples are analyzed.

Details on ETA's quality control/quality assurance program are provided in their QAMs (included in Attachment A of this QAPP).

5.5 DATA REPORTING

Laboratory data deliverables will consist of analytical data in tabulated forms as well as the complete laboratory data deliverable package. ETA will produce laboratory data packages which meet the requirements of NYSDEC Analytical Services Protocol (ASP) Category B (DER-10 Appendix 2B Section 1.0b).

Additionally, ETA will provide a NYSDEC EQuIS EDD version 4 for all samples with QC sample data to be utilized during the data review/validation/report production activities.

5.6 DATA REVIEW/VALIDATION

All laboratory data deliverable packages will be reviewed for completeness, adherence to holding times, comparison with chain-of-custody, etc. Laboratory data package reviews may include the following activities:

- Review of laboratory-supplied data packages for completeness
- Review of chain-of-custody documents to verify sample identities.
- Review of sample log-in documents to identify potential problems with custody seals, container integrity, sample preservation, labeling, etc.
- Review of sample analysis methods and holding times.
- Review of field blank and trip blank data to identify potential problems with sampling devices contamination, sample container contamination, preservative contamination,

laboratory reagent water contamination, or cross-contamination between samples during transport.

- Review of method preparation blank data to determine the potential presence of sources of contamination in the analytical process, where applicable.

- Review of MS/MSD data to evaluate the potential for matrix effects as a measure of analytical accuracy and sample homogeneity as a measure of analytical precision. MS/MSD data will be compared to laboratory acceptance criteria for the maximum relative percent difference (RPD), where applicable.

- Review of laboratory control sample and laboratory control sample duplicate (LCS/LCSD) data as a measure of analytical accuracy and as a measure of analytical accuracy, where applicable. LCS/LCSD data will be compared to laboratory acceptance criteria for the maximum RPD to evaluate analytical precision.

- Review of laboratory control sample reference material (LCSRM) data as a measure of analytical accuracy, where applicable. LCSRM data will be compared to the certified acceptable ranges of analytical values

- Review of instrument calibrations, serial dilutions for metals analysis, internal standard responses for volatiles and semivolatiles, 4,4'-DDT/endrin breakdown for pesticides, chromatogram quality where applicable, and verification of a percentage of analytical results with instrument data.

- Review of sample and sample duplicate data as a measure of sample homogeneity and as a measure of analytical precision.

- Review of surrogate recovery data to assess analytical performance, where applicable. Surrogate recoveries will be compared to laboratory acceptance criteria to determine if they are within or outside of acceptable limits. The criteria used to assess the surrogate recovery data will be based upon USEPA Region 2 modifications to the USEPA National Functional Guidelines and Region 2 SOPs.

- Determine completeness as a percentage of measurements made which are judged to be valid measurements compared to the total number of measurements planned, where applicable. The goal for usability is 90-100%.

- Review data summary sheets and qualifiers for consistency with raw data and qualifier definitions.

- Data will be reviewed and evaluated based upon method specifications and qualifiers are applied using the USEPA Region 2 modifications to the USEPA National Functional Guidelines and Region 2 SOPs as they apply to the analytical methods employed; how the data will be qualified will be based upon this review since laboratory qualifiers may be different than validation qualifiers.

To account for non-homogeneity in soil samples, in accordance with USEPA Region II validation guidance, a ≤ 30% RPD criterion will be used for analytes whose concentrations in both the samples and the corresponding duplicate samples are greater than or equal to five times the RL. Where the sample and/or duplicate result(s) are less than five times the RL, the criterion used will be that the absolute difference between the sample and duplicate results are less than two times (2x) the RL.

The data will be evaluated for conformance to method specifications and laboratory statistical control limits and qualifiers will be applied using USEPA Region 2 SOPs and the validation criteria set forth in the USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic Superfund Methods Data Review, EPA-540-R-2017-002, January 2017 and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review, EPA-540-R-2017-001, January 2017, as they apply to the analytical methods employed.

Field duplicate relative percent difference (RPD) review and applicable control limits are taken from the USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, December 1996 and USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, June 1988.

USEPA-defined data qualifiers will supersede laboratory flags and qualifiers. A data validation report will be prepared by the Project Chemist that details the validation findings for each sample delivery group. The data validation report will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain-of-custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.

For each of the organic analytical methods, the following parameters will be assessed:

- Holding times
- Instrument tuning
- Instrument calibrations
- Blank results
- System monitoring compounds or surrogate recovery compounds (as applicable)
- Internal standard recovery results
- MS and MSD results
- Field duplicate results
- Target compound identification
- Result calculations
- Pesticide cleanup (if applicable)
- Compound quantitation and reported detection limits
- System performance
- Results verification

For each of the inorganic compounds, the following will be assessed:

- Holding times
- Calibrations
- Blank results
- Interference check sample
- Laboratory check samples
- Duplicates

- Matrix Spike(s)
- Furnace atomic absorption analysis QC
- Inductively coupled plasma (ICP) serial dilutions
- Results verification and reported detection limits
- Result calculations

Data verification and/or validation will be performed by a qualified scientist, and a DAR or DUSR will be prepared in accordance with DER-10 Appendix 2B. The DAR or DUSR will provide the assessment included in the initial data review discussed above, with further related QA/QC information consideration, enabling evaluation of the analytical data's usability and quality as per DER-10 Appendix 2B requirements.

The data validation/review process will be documented through DARs/DUSRs and submission of the analytical data packages and DARs/DUSRs to the NYSDEC. Final and validated/reviewed analytical data, including applicable qualifiers will be summarized in tables for associated project summary reports.

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Table 5-1
Reporting Limits and Method Detection Limits

	Soil	Soil	
	Restricted Residential SCOs	RL	MDL
TAL Metals [Method SW846 6010]	**mg/kg**	**mg/Kg**	
Aluminum	NS	10.0	4.40
Antimony	NS	15.0	0.400
Arsenic	16	2.00	0.400
Barium	400	0.500	0.110
Beryllium	72	0.200	0.0280
Boron	NS	2.00	0.190
Cadmium	4.3	0.200	0.0300
Calcium	NS	50.0	3.30
Chromium	180	0.500	0.200
Cobalt	NS	0.500	0.0500
Copper	270	1.00	0.210
Iron	NS	10.0	1.10
Lead	400	1.00	0.240
Magnesium	NS	20.0	0.927
Manganese	2000	0.200	0.0320
Nickel	310	5.00	0.230
Potassium	NS	30.0	20.0
Selenium	180	4.00	0.400
Silver	180	0.600	0.200
Sodium	NS	140	13.0
Thallium	NS	6.00	0.300
Vanadium	NS	0.500	0.110
Zinc	10000	2.00	0.153
Mercury [Method SW846 7471B/7470A]		**mg/Kg**	
Mercury	0.81	0.0200	0.00810
Semi-Volatile Organic Compounds (SVOCs) [Method SW846 8270]		**µg/Kg**	
Biphenyl	NS	170	28.2
bis (2-chloroisopropyl) ether	NS	170	34.0
2,4,5-Trichlorophenol	NS	170	46.0
2,4,6-Trichlorophenol	NS	170	34.0
2,4-Dichlorophenol	NS	170	18.0
2,4-Dimethylphenol	NS	170	72.7
2,4-Dinitrophenol	NS	1660	784
2,4-Dinitrotoluene	NS	170	35.0
2,6-Dinitrotoluene	NS	170	20.0
2-Chloronaphthalene	NS	170	28.0
2-Chlorophenol	NS	170	31.0
2-Methylphenol	100	170	20.0
2-Methylnaphthalene	NS	170	34.0
2-Nitroaniline	NS	330	25.0
2-Nitrophenol	NS	170	48.0
3,3'-Dichlorobenzidine	NS	330	200
3-Nitroaniline	NS	330	47.0
4,6-Dinitro-2-methylphenol	NS	330	170
4-Bromophenyl phenyl ether	NS	170	24.0
4-Chloro-3-methylphenol	NS	170	42.0
4-Chloroaniline	NS	170	42.0
4-Chlorophenyl phenyl ether	NS	170	21.0
4-Methylphenol	100	330	20.0
4-Nitroaniline	NS	330	89.0
4-Nitrophenol	NS	330	159
Acenaphthene	100	170	25.0
Acenaphthylene	100	170	22.0
Acetophenone	NS	170	23.0
Anthracene	100	170	42.0
Atrazine	NS	170	59.0
Benzaldehyde	NS	170	135
Benzo[a]anthracene	1	170	27.6
Benzo[a]pyrene	1	170	25.0
Benzo[b]fluoranthene	1	170	27.0

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Table 5-1
Reporting Limits and Method Detection Limits
(continued)

	Soil	Soil	
	Restricted Residential SCOs	RL	MDL
Semi-Volatile Organic Compounds (SVOCs) [Method SW846 8270] (continued)		µg/Kg	
Benzo[g,h,i]perylene	100	170	19.0
Benzo[k]fluoranthene	3.9	170	22.0
Bis(2-chloroethoxy)methane	NS	170	36.0
Bis(2-chloroethyl)ether	NS	170	22.0
Bis(2-ethylhexyl) phthalate	NS	170	58.0
Butyl benzyl phthalate	NS	170	28.0
Caprolactam	NS	170	51.0
Carbazole	NS	170	20.0
Chrysene	3.9	170	38.0
Dibenz(a,h)anthracene	0.33	170	30.0
Di-n-butyl phthalate	NS	170	29.0
Di-n-octyl phthalate	NS	170	20.0
Dibenzofuran	59	170	20.0
Diethyl phthalate	NS	170	22.0
Dimethyl phthalate	NS	170	20.0
Fluoranthene	100	170	18.0
Fluorene	100	170	20.0
Hexachlorobenzene	1.2	170	23.0
Hexachlorobutadiene	NS	170	25.0
Hexachlorocyclopentadiene	NS	170	23.0
Hexachloroethane	NS	170	22.0
Indeno[1,2,3-cd]pyrene	0.5	170	22.0
Isophorone	NS	170	36.0
N-Nitrosodi-n-propylamine	NS	170	29.0
N-Nitrosodiphenylamine	NS	170	138
Naphthalene	100	170	22.0
Nitrobenzene	NS	170	30.0
Pentachlorophenol	6.7	330	170
Phenanthrene	100	170	25.0
Phenol	100	170	26.0
Pyrene	100	170	20.0
Chromium [Method SW846 7196A & SM 3500_CR3_D]		mg/Kg	
Chromium, Hexavalent	110	2.00	0.395
Chromium Trivalent	180	1.50	0.630
Cyanide [Method SW846 9012B]		mg/Kg	
Cyanide	27	0.100	0.0270
Volatile Organic Compounds (VOCs) [Method SW846 8260 per DER-10 [1]]		ug/Kg	
1,1,1-Trichloroethane	100	5.00	0.363
1,1-Dichloroethane	26	5.00	0.610
1,1-Dichloroethene	100	5.00	0.612
1,2,4-Trimethylbenzene	52	1.00	0.340
1,2-Dichlorobenzene	100	5.00	0.391
1,2-Dichloroethane	3.1	5.00	0.251
1,2-Dichloroethene (cis)	100	1.00	0.220
1,2-Dichloroethene (trans)	100	1.00	0.390
1,3-Dichlorobenzene	49	5.00	0.257
1,3,5-Trimethylbenzene	52	1.00	0.130
1,4-Dichlorobenzene	13	5.00	0.700
1,4-Dioxane	13	20.0	6.39
2-Butanone (MEK)	100	25.0	1.83
Acetone	100	25.0	4.21
Benzene	4.8	5.00	0.245
Butylbenzene	100	1.00	0.210
Carbon tetrachloride	2.4	5.00	0.484
Chlorobenzene	100	5.00	0.660
Chloroform	49	5.00	0.309
Ethylbenzene	41	5.00	0.345
Methyl tert-butyl ether	100	5.00	0.491
Methylene Chloride	100	5.00	2.30
n-Propylbenzene	100	1.00	0.180
sec-Butylbenzene	100	1.00	0.170
Tetrachloroethene	19	5.00	0.671
Tert-Butylbenzene	100	1.00	0.340
Toluene	100	5.00	0.378
Trichloroethene	21	5.00	1.10
Vinyl chloride	0.9	5.00	0.610
Xylenes, Total	100	10.0	0.840

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Table 5-1
Reporting Limits and Method Detection Limits
(continued)

	Soil	Soil	
	Restricted Residential SCOs	RL	MDL
Polychlorinated Biphenyls (PCBs) [Method SW846 8082]		mg/Kg	
PCB-1016	NS	0.0167	0.00326
PCB-1221	NS	0.0167	0.00326
PCB-1232	NS	0.0167	0.00326
PCB-1242	NS	0.0167	0.00326
PCB-1248	NS	0.0167	0.00326
PCB-1254	NS	0.0167	0.00782
PCB-1260	NS	0.0167	0.00782
Total PCBs	1	0.250	0.117
Per-and Polyfluoroalkyl Substances (PFAS) [Method 537.1 mod.]		ug/kg	
6:2 FTS	NS	2.00	0.150
8:2 FTS	NS	2.00	0.250
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	NS	2.00	0.370
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	NS	2.00	0.390
Perfluorobutanesulfonic acid (PFBS)	NS	0.200	0.0250
Perfluorobutanoic acid (PFBA)	NS	0.200	0.0280
Perfluorodecanesulfonic acid (PFDS)	NS	0.200	0.0390
Perfluorodecanoic acid (PFDA)	NS	0.200	0.0220
Perfluorododecanoic acid (PFDoA)	NS	0.200	0.0670
Perfluoroheptanesulfonic Acid (PFHpS)	NS	0.200	0.0350
Perfluoroheptanoic acid (PFHpA)	NS	0.200	0.0290
Perfluorohexanesulfonic acid (PFHxS)	NS	0.200	0.0310
Perfluorohexanoic acid (PFHxA)	NS	0.200	0.0420
Perfluorononanoic acid (PFNA)	NS	0.200	0.0360
Perfluorooctanesulfonamide (FOSA)	NS	0.200	0.0820
Perfluorooctanesulfonic acid (PFOS)	NS	0.500	0.200
Perfluorooctanoic acid (PFOA)	NS	0.200	0.0860
Perfluoropentanoic acid (PFPeA)	NS	0.200	0.0770
Perfluorotetradecanoic acid (PFTeA)	NS	0.200	0.0540
Perfluorotridecanoic acid (PFTriA)	NS	0.200	0.0510
Perfluoroundecanoic acid (PFUnA)	NS	0.200	0.0360
Pesticides [Method SW846 8081 & Method SW846 8151 per-DER10[1]]		µg/Kg	
2,4,5-TP Acid (Silvex)	100	17.0	11.4
4,4'-DDD	13	6.70	0.880
4,4'-DDE	8.9	6.70	0.970
4,4'-DDT	7.9	6.70	0.690
Aldrin	0.097	6.70	0.810
Alpha-BHC	0.48	2.00	0.610
Chlordane (alpha)	4.2	6.70	1.09
Beta-BHC	0.36	2.00	0.650
Delta-BHC	100	2.00	0.730
Dieldrin	0.2	2.00	0.870
Endosulfan I	24	6.70	0.930
Endosulfan II	24	6.70	1.05
Endosulfan sulfate	24	6.70	0.780
Endrin	11	6.70	0.850
gamma-BHC (Lindane)	1.3	2.00	0.600
Heptachlor	2.1	6.70	0.860

Notes:
[1] - List of constituents under this analysis are from the DER-10 List (see Appendix 5, Allowable Constituent Levels for Imported Fill or Soil, Subdivision 5.4(3)).
mg/Kg - milligram per kilogram
µg/Kg - microgram per kilogram
RL - Reporting Limit
MDL - Method Detection Limit
NS - No Standard
SCO - Soil Cleanup Objective
Listed limits are the highest current MDL and RL inclusive of Eurofins TestAmerica Buffalo and Edison laboratories for standard analytical testing.

6. REFERENCES

U.S. EPA, 1983 (and subsequent amendments). *EPA Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, EPA Publication SW-846.* Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), and V (2015).

AECOM

ATTACHMENT A

EUROFINS TESTAMERICA'S QUALITY ASSURANCE MANUAL AND STANDARD OPERATING PROCEDURES

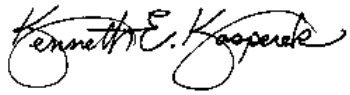
Cover Page:

Quality Assurance Manual

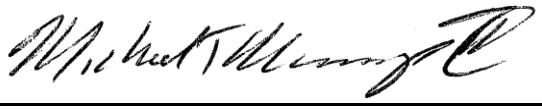
Eurofins TestAmerica Buffalo
10 Hazelwood Drive
Amherst, New York 14228
716.504.9800
716.691.7991

www.testamericainc.com

Title Page:
Quality Assurance Manual
Approval Signatures



Laboratory Director – Kene' Kasperek — 3/21/2018 Date

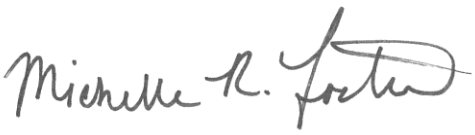


Quality Assurance Manager - Michael Mosscrop — 3/21/2018 Date

Inorganics Operations Manager – Jennifer Pierce — 3/21/2018 Date

Organic Operations Manager – Gary Rudz — 3/21/2018 Date

Organic Preparation Manager – Vikrambhai Patel — 3/21/2018 Date



Wet Chemistry Manager – Michelle Foster — 3/21/2018 Date

Metals Manager – Jason Kacalski — 3/21/2018 Date

GC/MS Semivolatiles – Michelle Page — 3/21/2018 Date

GC/MS Volatiles – Leah Hill — 3/21/2018 Date

Facilities Manager – Ken Kinecki — 3/21/2018 Date

SECTION 2

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-I-P-002	Electronic Reporting and Signature Policy

CA-L-P-002	Contract Compliance Policy
CW-L-S-004	Subcontracting Procedures
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-006	Detection Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health & Safety Manual
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigation
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Data Recall Process
CA-C-S-001	Work Sharing Process

REFERENCED LABORATORY SOPs

SOP Reference	Title
BF-GP-001	Calibration of Autopipettes and Repipetters
BF-GP-002	Support Equipment: Maintenance, Record Keeping and Corrective Actions
BF-GP-005	Sample Homogenization and Subsampling
BF-GP-012	Technical Data Review
BF-GP-013	Manual Integration
BF-GP-015	Record Storage and Retention
BF-GP-018	Strict Internal Chain or Custody
`BF-GP-019	Standard Traceability and Preparation
BF-GP-020	Thermometer Calibration

BF-PM-001	Project Information Requirements
BF-PM-003	Bottle Order Set-up
BF-PM-005	Correctness of Analysis
BF-PM-008	Massachusetts DEP Notification Procedures
BF-QA-001	Determination of Method Detection Limits
BF-QA-002	Quality Control Limits
BF-QA-003	Procedure for Writing, Reviewing and Revising Controlled Documents
BF-QA-004	Laboratory Personnel Training
BF-QA-005	Preventative and Corrective Action
BF-QA-006	Data Quality Review
BF-SR-001	Cooler Shipping - Bottle Kits and Samples
BF-SR-002	Receipt of Analytical Samples

- The full list of Laboratory SOPs is maintained in the Quality Assurance Department
- The full list of analytical methods performed in the Laboratory is can be exported from the Laboratory Information Management System's Total Access Database

SECTION 3

INTRODUCTION, SCOPE AND APPLICABILITY

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Buffalo'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 2003 National Environmental Laboratory Accreditation Conference (NELAC) standards, 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:

- ANSI/ASQC, E4-1994, "Specifications and Guidelines for Quality Management Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995, or most recent version)
- "EPA Requirements for Quality Management Programs" (QA/R-2) (EPA/240/B-01/002, May 31, 2006).
- 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 II A, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008; Final Update V, August 2015
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261. New York State Analytical Services Protocol, July 2005
- Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005).
- Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th, and on-line Editions. 21st.

- *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 Order 414.1D, Quality Assurance, Aril, 25, 2011.*
- 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 and soils. 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 used by the laboratory can be found in Section 19.0. 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 every two years 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 by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & updating procedures (refer to BF-QA-003)

SECTION 4

MANAGEMENT REQUIREMENTS

4.1 OVERVIEW

TestAmerica Buffalo 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 and Chief Executive Officer (CEO), Chief Operating Officer (COO), Executive VP Operations, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Buffalo 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 Buffalo laboratory.

4.2.2 Laboratory Director

TestAmerica Buffalo's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their respective GM. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

The Laboratory Director has the authority to affect those policies and procedures to ensure that only data of the highest level of excellence are produced. As such, the Laboratory Director is responsible for maintaining a working environment which encourages open, constructive problem solving and continuous improvement.

Specific responsibilities include, but are not limited to:

- Provides one or more department managers for the appropriate fields of testing. If the Department Manager is absent for a period of time exceeding 15 consecutive calendar

days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Department Manager to temporarily perform this function. If the absence exceeds 65 consecutive calendar days, the primary NELAP accrediting authority must be notified in writing.

- Ensures that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensures that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensures TestAmerica's human resource policies are adhered to and maintained.
- Ensures that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Ensures that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Reviews and approves all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.
- Pursues and maintains appropriate laboratory certification and contract approvals. Supports ISO 17025 requirements.
- Ensures client specific reporting and quality control requirements are met.
- Leads the management team, consisting of the QA Manager, the Technical Manager, and the Operations Manager as direct reports.

4.2.3 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 their Corporate Quality Director. This position is able to evaluate data objectively and perform assessments without outside (i.e., 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 the QA department 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, data authenticity 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 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 subset 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, evaluate manual 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.
- Leads 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.

4.2.4 Technical Manager or Designee

The Technical Manager(s) report(s) directly to the Laboratory Director. He/she is accountable for all analyses and analysts under their experienced supervision and for compliance with the ISO 17025 Standard. The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- 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.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- 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.
- Coordinates audit responses with the QA Manager.

4.2.5 Operations Manager

The Operations Manager manages and directs the analytical production sections of the laboratory. He/She reports directly to the Laboratory Director. He/She assists the Technical Manager in determining the most efficient instrument utilization. More specifically, he/she:

- Evaluates the level of internal/external non-conformances for all departments.
- Continuously evaluates production capacity and improves capacity utilization.
- Continuously evaluates turnaround time and addresses any problems that may hinder meeting the required and committed turnaround time from the various departments.
- Develops and improves the training of all analysts in cooperation with the Technical Manager and QA Manager and in compliance with regulatory requirements.
- Is responsible for efficient utilization of supplies.
- Constantly monitors and modifies the processing of samples through the departments.
- Fully supports the quality system and, if called upon in the absence of the QA Manager, serves as his substitute in the interim.

4.2.6 Department Managers

Department Managers report to the Operations Manager. The Department Managers serve as the technical experts on assigned projects, provide technical liaison, assist in resolving any technical issues within the area of their expertise; and implement established policies and procedures to assist the Operations Manager in achieving section goals. Each one is responsible to:

- Ensure that analysts in their department adhere to applicable SOPs and the QA Manual. They perform frequent SOP and QA Manual review to determine if analysts are in compliance and if new, modified, and optimized measures are feasible and should be added to these documents.
- With regard to analysts, participates in the selection, training, and development of performance objectives and standards of performance, appraisal (measurement of objectives), scheduling, counseling, discipline, and motivation of analysts and documents these activities in accordance with systems developed by the QA and Human Resources

Departments. They evaluate staffing sufficiency and overtime needs. Training consists of familiarization with SOP, QC, Safety, and computer systems.

- Encourage the development of analysts to become cross-trained in various methods and/or operate multiple instruments efficiently while performing maintenance and documentation, self-supervise, and function as a department team.
- Provide guidance to analysts in resolving problems encountered daily during sample prep/analysis in conjunction with the Technical Manager, Operations Manager, and/or QA Manager. Each is responsible for 100% of the data review and documentation, non-conformance and CPAR issues, the timely and accurate completion of performance evaluation samples and MDLs, for his department.
- Ensure all logbooks are maintained, current, and properly labeled or archived.
- Report all non-conformance conditions to the QA Manager, Technical Manager, Operations Manager, and/or Laboratory Director.
- Ensure that preventive maintenance is performed on instrumentation as detailed in the QA Manual or SOPs. He is responsible for developing and implementing a system for preventive maintenance, troubleshooting, and repairing or arranging for repair of instruments.
- Maintain adequate and valid inventory of reagents, standards, spare parts, and other relevant resources required to perform daily analysis.
- Achieve optimum turnaround time on analyses and compliance with holding times.
- Conduct efficiency and cost control evaluations on an ongoing basis to determine optimization of labor, supplies, overtime, first-run yield, capacity (designed vs. demonstrated), second- and third-generation production techniques/instruments, and long-term needs for budgetary planning.
- Develop, implement, and enhance calibration programs.
- Provide written responses to external and internal audit issues.

4.2.7 Hazardous Waste Coordinator

The Hazardous Waste Coordinator reports directly to the Laboratory Director. The duties consist of:

- Staying current with the hazardous waste regulations.
- Continuing training on hazardous waste issues.
- Reviewing and updating annually the Hazardous Waste Contingency Plan in the Environmental Health & Safety Manual.
- Auditing the staff with regard to compliance with the Hazardous Waste Contingency Plan.
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.

4.2.8 Environmental Health & Safety Coordinator

The Environmental Health and Safety Coordinator reports to the Laboratory Director and ensures that systems are maintained for the safe operation of the laboratory. The Safety Officer is responsible to:

- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Safety Data Sheet (SDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is “reasonable” and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by TestAmerica’s medical consultants.

4.2.9 Laboratory Analysts

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the group leader or supervisor. The responsibilities of the analysts are listed below:

- Perform analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Document standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on worklists, benchsheets, lab notebooks and/or the Non-Conformance Database.
- Report all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, the Technical Manager, and/or the QA Manager or member of QA staff.

- Perform 100% review of the data generated prior to entering and submitting for secondary level review.
- Suggest method improvements to their supervisor, the Technical Manager, and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Work cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.

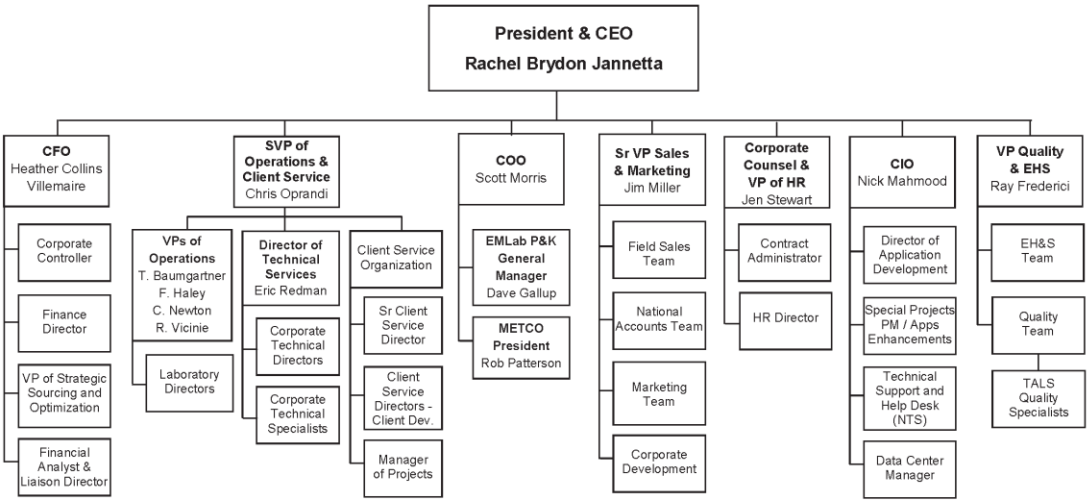
4.3 DEPUTIES

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy	Comment
Laboratory Director	Operations Manager (1) Technical Manager (2)	
QA Manager	QA Specialist (1) Operations Manager (2)	
Technical Manager	Laboratory Director (1) Operations Manager (2)	
Operations Manager	Department Manager (1) Department Manager (2)	Selected based on availability
Manager of Project Management	Project Manager (1) Client Services Director (2)	Selected based on availability
Project Manager	Project Manager (1) Project Management Asst. (2)	(1) 2° team PM (2) Team PMA
Organic Department Manager	Analyst (1) Analyst (2)	Selected based on department, experience and availability
Inorganic Department Manager	Analyst (1) Analyst (2)	Selected based on department, experience and availability
Data Validation / Data Packaging Manager	Data Validation Specialist Data Packaging Specialist	Selected based on department and availability
EHS Coordinator	Laboratory Director (1) EHS Manager (2)	
Sample Management Manager	Sample Custodian (1) EHS Coordinator (2)	
Bottle Preparation / Shipping Manager	Bottle Prep Technician (1) Sample Mng't Manager (2)	

Figure 4-1.
Corporate and Laboratory Organization Charts

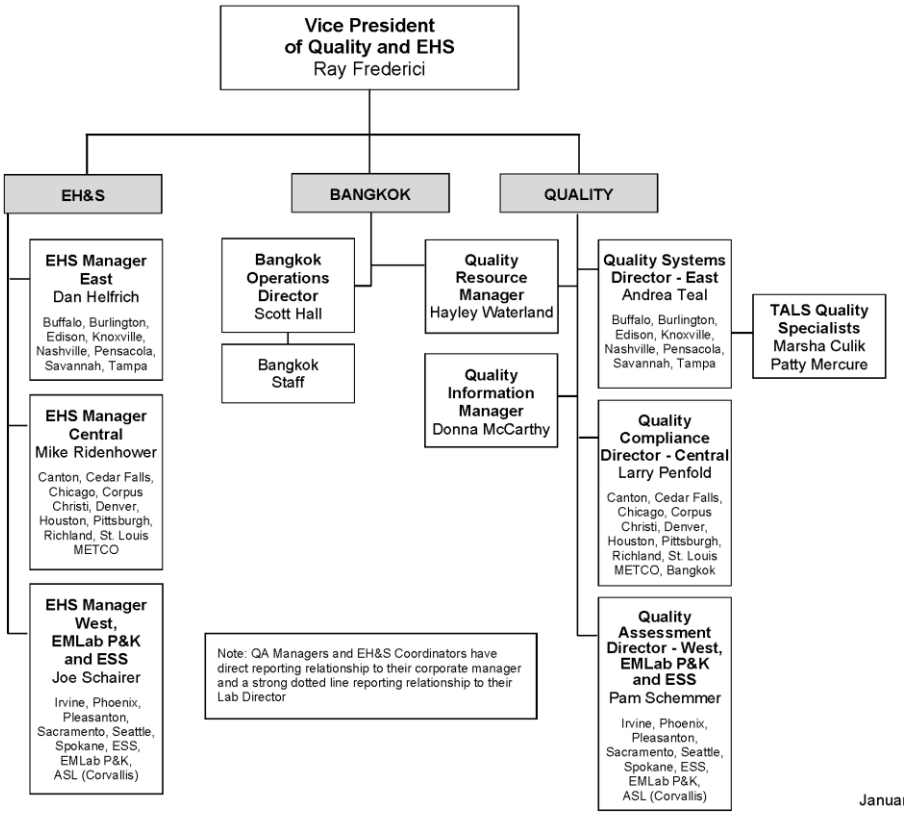
TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING



7 February 2018

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

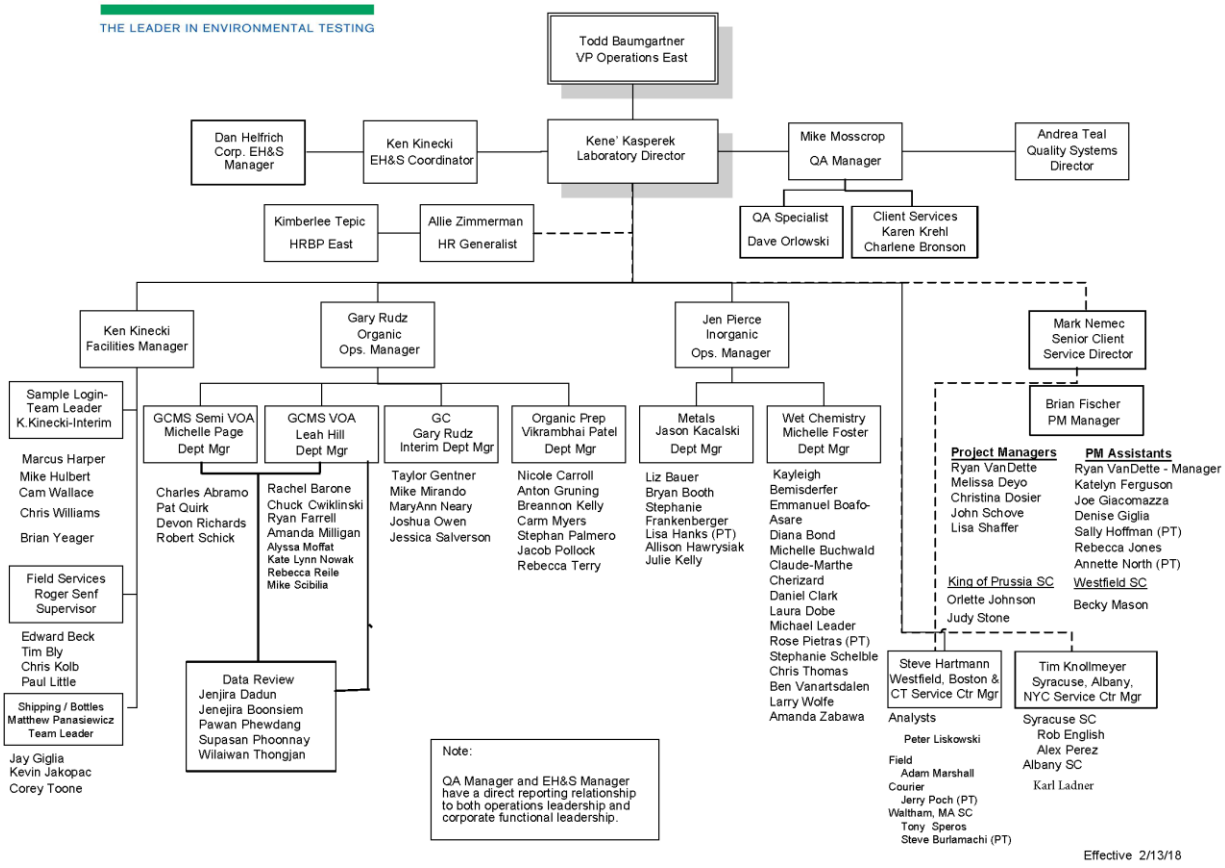
Quality, EHS, Bangkok



January 3, 2018

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Buffalo Laboratory Organization



Note: Organizational Charts are current at the date of publication of this manual. Updated charts may be obtained by contacting the TestAmerica Buffalo Quality Department.

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 NELAC Standards (2003), 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 7 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-Q-S-005).

- 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 laboratories 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 the QAPP. 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 being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

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 is 90% (or as specified by a particular project), 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 (Method Detection Limit) or quantified (Reporting Limit).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory maintains Quality Control Limit Data in their LIMS system. A summary report is generated from LIMS to check the precision and accuracy acceptability limits for performed analyses on request. The summary report is generated and is managed by the laboratory's QA department. Some acceptability limits 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. Criteria for development of control limits are contained in Section 24.

5.6 STATISTICAL QUALITY CONTROL

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs [such as the Ohio Voluntary Action Plan (VAP)]. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The procedure for determining the statistical limits may be found in SOP BF-QA-002, Quality Control Limits. The analysts are instructed to use the current limits in the laboratory (dated and approved the QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory through date sensitive tables within the LIMS System. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Surrogate recoveries are determined for a specific time period as defined above. The resulting ranges are entered in LIMS.

Current QC limits are entered and maintained in the LIMS analyte database. 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 QA Manager periodically evaluates these to determine if adjustments need to be made or for corrective actions to methods (SOP No. BF-QA-002). All findings are documented and kept on file.

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 No. BF-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 maintains control of records for raw analytical data and 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 notices. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

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 Quality personnel are responsible for the maintenance of the system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a 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 retain that document as the official document on file. That document is then provided to all applicable operational units. Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved 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 at a minimum of every two years for the majority of procedures. Exceptions include review every 1 year for Drinking Water programs and the Kentucky CWA program. 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 No. BF-QA-003, "Writing, Reviewing and Revising Controlled Documents". Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA department. A controlled electronic copy of the current version is maintained on the laboratory public storage server (L: drive) or through the TALS File Share menu within the LIMS, and is available to all personnel.

For changes to SOPs, refer to SOP No. BF-QA-003, "Writing, Reviewing and Revising Controlled Documents".

Forms, worksheets, work instructions and information are organized by department and are maintained electronically by QA. There is a table of contents. As revisions are required, a new version number and revision date is assigned. Controlled electronic copies are made available on a public server for laboratory staff to access.

6.4 OBSOLETE DOCUMENTS

When revisions are implemented for an SOP, form or work instruction, the previous document becomes obsolete and is archived. 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 destroyed. At least one copy of the obsolete document is archived according to SOPs No. BF-GP-015 and BF-QA-003. All archived SOPs, manuals, forms or work instructions are considered obsolete.

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

Appropriate personnel will review the work request 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 Client Relations Manager or Proposal Team, 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 (not necessarily in the order below):

- Contact Administrator
- VP of Operations
- Laboratory Project Manager
- Laboratory and/or Corporate Technical Managers
- Corporate Information Technology Managers/Directors
- Regional and/or National Account representatives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

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 Contracts Department maintains copies of all signed contracts. The Project Managers at the TestAmerica Buffalo facility also maintains copies of these documents.

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.

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 and the Laboratory Director.

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. The PM keeps a phone log of conversations with the client.

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 a PM is assigned to each client. The PM is the first point of contact for the 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. QA department involvement may be needed to assist in the evaluation of custom QC requirements. Specific information related to project planning may be found in SOP BF-PM-001, Project Information Requirements.

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 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 management 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 the laboratory during production meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Department Manager. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

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).

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/Designees 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 (CW-L-S-004) 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 TNI/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-TNI accredited work where required.

Project Managers (PMs), Client Service Managers (CSM), or Account Executives (AE) for the Export Lab (TestAmerica laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting 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. Standard TestAmerica Terms & Conditions include the flexibility to subcontract samples within the TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies, such as the Department of Energy and the USDA, may require notification prior to placing such work**.**

Approval may be documented through reference in a quote / contract or e-mail correspondence.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM, Account Executive (AE) or Client Service Manager (CSM) 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.
- Subcontractors specified by the client - In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor. 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.
- Subcontractors reviewed by TestAmerica – Firms which have been reviewed by the company and are known to meet standards for accreditations (e.g., State, TNI); technical specifications; legal and financial information.

A listing of vendors is available on the TestAmerica intranet site.

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).

8.2.1 When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs 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/Designee begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-004, Subcontracting Procedures.

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. Once all documents are reviewed for completeness, the Corporate QIM will forward the documents to the Purchasing Manager for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified 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.

8.3 OVERSIGHT AND REPORTING

8.3.1 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Corporate 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 (Form No. CW-F-WI-009)**.**
- 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 CSO personnel will notify all TestAmerica laboratories and 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 CSO Personnel, Laboratory Directors/Managers, QA Managers and Sales Personnel.

Prior to initially 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 within the project records.

8.3.2 For continued use of a subcontractor, verification of certification is placed upon the subcontractor for the defined project. Samples are subcontracted under Chain of Custody with the program defined as 'Accreditation Required' and the following statement for verification upon sample receipt:

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under Chain of Custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analytes/tests/matrix being analyzed, the samples must be shipped back to the TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to TestAmerica Laboratories, Inc.

For TestAmerica laboratories, certifications can be viewed on the company TotalAccess Database.

8.3.3 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 be available in TALS for 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

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Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilities successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI 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 are 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 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 use of any emergency subcontractor will require the PM to complete a JDE New Vendor Add Form in order to process payment to the vendor and add them to TALS. This form requires the user to define the subcontractor's category/s of testing and the reason for testing.

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 Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Company-Wide 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, consumables 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 and TestAmerica Buffalo SOP on Solvent Purity, SOP BF-OP-013. Approval information for the solvents and acids tested under SOP CA-Q-S-001 is stored on the TestAmerica Sharepoint, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location.

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. Purchase requisitions are placed into the J.D. Edwards system by designated departmental personnel. The listing of items available in the J.D. Edwards system has been approved for use by the corporate purchasing staff. Each purchase requisition receives final approval by the laboratory Operations Manager or purchasing coordinator before the order is submitted.

The analyst may also check the item out of the on-site consignment system that contains items approved for laboratory use.

9.3.2 Receiving

It is the responsibility of the purchasing manager/designee to receive the shipment. It is the responsibility of the department that ordered the materials to document the date the materials were received. Once the ordered reagents or materials are received, the department that submitted the order compares the information on the label or packaging to the original order to ensure that the purchase meets quality level specified. This is documented through the addition of the received date and initials to the information present on the daily order log.

The purchasing manager/designee verifies the lot numbers of received solvents and acids against the pre-approval lists. If a received material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained on the shared “public” folder on the computer network.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented.

Safety Data Sheets (SDSs) 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 SOP expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date cannot not 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 meets CCV limits. The comparison studies are maintained along with the calibration raw data for which the reagent was used.

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. To prevent a tank from going to dryness or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. 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- umho/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 Department Managers/Supervisors 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 the LIMS system, files or binders 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 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 Technical Manager and/or 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, is 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 the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. 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 Department Managers. The service providers that perform the

services are approved by the Department Managers, Operations Manager and/or Technical Manager.

Analytical balances are serviced and calibrated annually in accordance with SOP BF-GP-002,. The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. When the calibration certificates are received (usually within two weeks of the service), they are reviewed, and documentation of the review is filed with the certificates. If the calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as NIST thermometers, weight sets, etc, are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory

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 Procurements & 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 (available on the intranet site).

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 Technical Manager 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 with 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 in the laboratory SOP related Corrective Action (BF-QA-005).

10.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to BF-QA-005.

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 likely hood 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 13. In addition, Corporate Management, Sales and Marketing and Information Technology (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 Quality 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 standard procedures, 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. When an analyst encounters such a situation, the problem is presented to the department manager for resolution. The department manager may elect to discuss it with the Technical Manager, QA Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratory's non-conformance and corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative 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. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Laboratory Director, Technical Manager, Operations Manager or QA Manager, documented and included in the project folder. Deviations must also be noted on the final report with a statement that the compound is not reported in compliance with the analytical method requirements and the reason.

11.2 RESPONSIBILITIES AND AUTHORITIES

Under certain circumstances the Laboratory Director, the Technical Manager, the Operations Manager or a member of the QA team may exceptionally 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 well documented using the laboratory's non-conformance and corrective action procedures described in Section 12. This information may also need to be documented in logbooks and/or data review checklists as appropriate. 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 laboratory management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, Technical Manager, and QA Manager. Suspected misrepresentation issues may also be reported to any member of the corporate staff as identified in Ethics Policy, CW-L-P-004. The data integrity hotline (1-800-736-9407) may also be used. 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), (e.g., the VP-QA/EHS) 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, Executive VP of Operations 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.

Corporate SOP entitled Data Recalls (CW-Q-S-005) is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

Corporate SOP entitled Internal Investigations (CW-L-S-002) is the procedure to be followed for investigation and correction of situations involved alleged incidents of misconduct or violation of the company's ethics policy.

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-Q-S-005.

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 VP of Operations 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 (i.e., 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, Operations Manager, QA Manager, Department 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 Memo (NCM) 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 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 Memo (NCM) - 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
- Project Management concerns regarding specific analytical results
- 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 monthly review of NCMs.
- Issues found while reviewing NCMs that warrant further investigation.

- Internal and External Audit Findings
- 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. A 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 Department Manager, Operations Manager, Technical Manager, 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. Corporate SOP Root Cause Analysis (No. CA-Q-S-009) describes the procedure.

Systematically analyze and document the Root Causes of the more significant problems that are reported. 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 Department Manager, Operations 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. Department Managers and the Operations Manager are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM is entered into the Laboratory Information Management System (LIMS) and each CAR is entered into the Incident and Corrective Action Tracker (iCAT) database for tracking and trending purposes for review to aid in ensuring that the corrective actions have taken effect.
- TestAmerica laboratories began using the Incident/Corrective Action Tracker (iCAT) database developed by the company in 2015. (Previously, a local spreadsheet database served this purpose.) An incident is an event triggering the need for one or more corrective actions as distinct from a corrective action, a potential deficiency stemming from an incident that requires investigation and possibly fixing. The database is independent of TALS, available to all local and corporate managers, and capable of notifying and tracking multiple corrective actions per event, dates, and personnel. iCAT allows associated document

upload, categorization (such as, external/internal audit, client service concerns, data quality issues, proficiency testing, etc.), and trend analysis. Refer to Figure 12-1.

- The QA Manager reviews monthly NCMs and CARs 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 a NCM or CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

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 – iCAT Corrective Action Notice

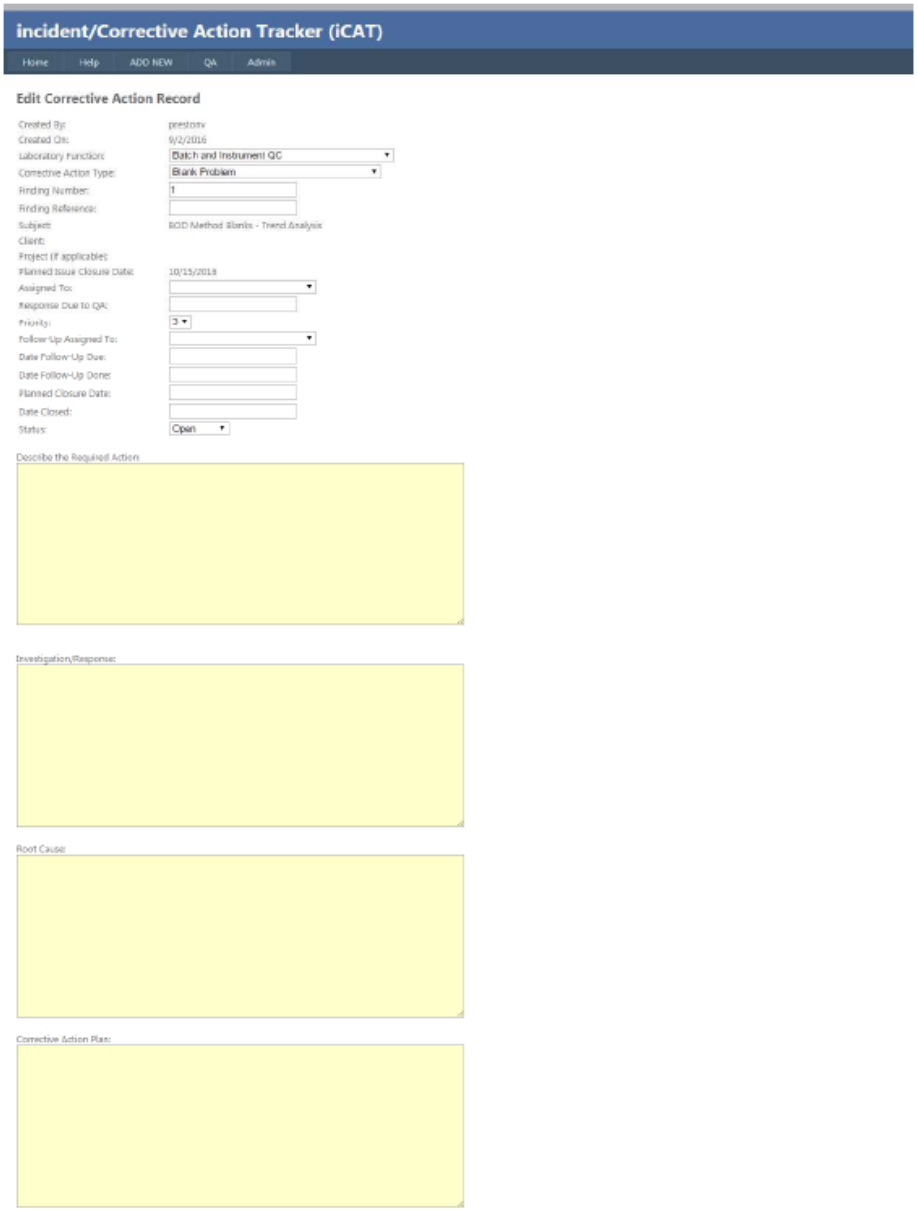

Table 12-1. Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards *(Analyst, Department Manager)*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Department Manager)*	- % Recovery within control limits.	- 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)*	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in LIMs.	- 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 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 specified in LIMs.	- 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 of method or within three standard deviations of the historical mean.	- 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 [1]	- 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, Department Manager)*	- 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.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Internal / External Audits *(QA Manager, Department Manager, Operations Manager, Technical Manager, 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.
Reporting / Calculation Errors *(Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Department Manager, QA Manager, Corporate QA, Corporate Management)*	- SOP CW-Q-S-005, Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CW-Q-S-005 or lab SOP BF-QA-005
Client Complaints *(Project Managers, Lab Director, Sales and Marketing, QA Manager)*	-	- 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 17 for an example) *(QA Manager, Lab Director, Operations Manager Department Managers)*	- 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 *(EH&S Coordinator, Lab Director, Operations Manager, Department Manager)*	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through EH&S office.

Note: 1. Except as noted below for certain compounds, the method blank should be below the reporting limit. Concentrations up to five times the reporting limit will be allowed for the

ubiquitous laboratory and reagent contaminants: methylene chloride, acetone, 2-butanone and phthalates provided they appear in similar levels in the reagent blank and samples. This allowance presumes that the reporting limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur. For benzene and ethylene dibromide (EDB) and the other analytes for which regulatory limits are extremely close to the detection limit, the method blank must be below the method detection limit.

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SECTION 13.0

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, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- review of the monthly QA Metrics Report,
- trending NCMs,
- review of control charts and QC results,
- trending proficiency testing (PT) results,
- performance of management system reviews,
- trending client complaints,
- review of processing operations, or
- staff observations.

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. The metrics report is reviewed monthly be the laboratory management, Corporate QA and TestAmerica's Executive Committee. 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.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

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 and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action system/process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvment.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/Process Improvement is incorporated into the monthly QA reports, corrective action process and management review

13.1.2 Any Preventive Actions/Process Improvements undertaken or attempted shall be taken into account during the Annual Management Systems Review (Section 17). A highly detailed report is not required; however a summary of success and failure 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. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of changes covered under this system include: Facility Changes, Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation, Key Personnel Changes, Laboratory Information Management System (LIMS) changes.

SECTION 14.0

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. Exceptions for programs with longer retention requirements are discussed in Section 14.1.2. TestAmerica Buffalo SOP BF-GP-015, Record Storage and Retention, specifies additional storage, archiving and retention procedures.

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. . More detailed information on retention of specific records is provided in CW-L-P-001, Records Retention Policy and CW-L-WI-001, TestAmerica Records Retention/Storage Schedule. Quality records are maintained by the QA department in a database which is backed up as past of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Hardcopy technical records are maintained by the Laboratory Director and the QA Department while electronic technical records are maintained by the IT Administrator.

14.1.1 All records are stored and retained according to BF-GP-015 and in such a way that they are secure and readily retrievable at the laboratory facility 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.

If records are archived off-site they are to be stored in a secure location where a record is maintained of any entry into the storage facility. Records are maintained for a minimum of five years unless other wise 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.

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 - Policy Memorandums - SOPs - Manuals - Published Methods	Indefinitely
QA Records	- Certifications - Method & Software Validation / Verification Data	Indefinitely
	- Internal & External Audits/Responses - Corrective/Preventive Actions - Management Reviews - 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 Documents - Contracts and Amendments - Correspondence - QAPP / SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Administrative Records	Financial and Business Operations	Refer to CW-L-WI-001
	EH&S Manual, Permits	Indefinitely
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	All HR docs have different retention times: Refer to HR Manual
	Administrative Policies	Indefinitely
	Technical Training Records	7 years
	Legal Records	Indefinitely
	HR Records	Refer to CW-L-WI-001
	IT Records	Refer to CW-L-WI-001
	Corporate Governance Records	Refer to CW-L-WI-001
	Sales & Marketing	5 years
	Real Estate	Indefinitely

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard & sample), Standard & Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

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. Specific Information related to archival of data for greater than 5 years may be found in TestAmerica Buffalo SOP BF-GP-015.

Table 14-2. Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	10 years (lab reports and raw data) 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)	5 years
NY Potable Water NYCRR Part 55-2	10 years
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement
OSHA	30 years

[1]Note: Extended retention requirements are noted with the archive documents or addressed in TestAmerica Buffalo facility-specific records retention procedure BF-GP-015.

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. TestAmerica Buffalo SOP BF-GP-015 also contains specific information for archival of scanned data.

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 (any records stored off site should be accessible within 2 business days of a request for such records). 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. The laboratory's copy of the chain of custody is stored with the project file and the Job Number in TALS. The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.

- 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 purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set). Instrument data is stored sequentially by instrument. Calibration data for a given sequence are maintained in the order of the analysis. Sample data are stored on a job number basis in the project file or as part of the daily batch or sequence. Run logs are maintained for each instrument or method; a copy of each day's run log or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks, bench sheets or excel spreadsheets are used to record and file data. Standard and reagent information is recorded in logbooks or on the raw data for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. 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. The procedure for this verification can be found in TestAmerica SOP BF-GP-015.

- 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. The

records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing of results.

14.2.2 Observations, data and calculations are recorded real-time.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. 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 bench sheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in the method specific SOPs, in the instrument method detail records or the instrument maintenance logs where available.
- analysis type**;**
- all manual calculations and manual integrations**;**
- analyst's or operator's initials/signature**;**
- sample preparation including cleanup, separation protocols, incubation periods, ID codes, volumes, weights, instrument printouts, meter readings, temperatures, calculations, reagents**;**
- 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.
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats**.**

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

14.5.1 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.

14.5.2 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.

14.5.3 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**.**

14.5.4 The laboratory has a record management system (also known as document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per instrument or analysis basis, and are numbered sequentially as they are issued. No instrument or analysis has more than one active notebook at a time, so all data are recorded sequentially within a series of sequential notebooks. Bench sheets and raw data sequence files are filed sequentially by date. Standard and reagent information is maintained in LIMS and logbooks which are maintained on a departmental basis and are numbered sequentially as they are issued or as they are archived by QA.

14.5.5 Records are considered archived when noted as such in the records management system (also known as document control). Access to archived hard-copy information is documented with an access log and in/out records is used to note data that is removed and returned.

14.5.6 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.

14.5.7 Records Disposal

14.5.7.1 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).

14.5.7.2 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. CW-Q-S-003. 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 QA Technical Data Audits SOP Compliance Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	QA Methods Audits Frequency: All methods are reviewed annually. 50% of methods receive a QA Technical Audit 50% of methods receive a SOP Method Compliance Audit
Special	QA Department or Designee	Surveillance or spot checks performed as needed to monitor specific issues
Performance Testing	Coordinated by Corporate QA	Two successful per year for each TNI - NELAP field of 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, TNI quality systems, 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 assess data authenticity and analyst integrity. These 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, Chrom AuditMiner is used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period. All analysts should be reviewed over the course of a two year period through at least one QA Technical Audit

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 Technical Manager or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

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: Drinking Water, Non-potable Water, Soil, and 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 using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and 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, Technical Managers, their Quality Director as well as the VP of Operations. 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 Director prepares 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 VPs of Operations.

16.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team (Laboratory Director, Technical Manager, Operations Manager, 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. Corporate Operations and Corporate QA personnel may be included in this meeting at the discretion of the Laboratory Director. 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. CW-Q-S-004 & Work Instruction No. CW-Q-WI-003) 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 VP of Operations 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.

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. The TestAmerica Corporate Internal Investigations 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 President and CEO, COO, Technical & Operations Support, VP of Client and Technical Services, VPs of Operations and Quality Directors receive a monthly report from the VP QA/EHS summarizing any current data integrity or data recall investigations. The VPs of Operations 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 staff that possesses 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 in the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, pipette, quantitation techniques, etc. are also considered).

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)
CVAA, 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
Technical Managers/Department Managers – **General**	Bachelors Degree in an applied science or engineering with 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 analyst, peer reviewer or Department Manager, 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 20).
- 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.
- The Human Resource office maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Further details of the laboratory's training program are described in TestAmerica Buffalo SOP BF-QA-004, Laboratory Personnel Training.

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 No. CW-L-P-004 and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics 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

TestAmerica Buffalo is a 32,000 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 field operations, bottle kit preparation, 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. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory. Key equipment has been provided with back-up power supply in the event of a power outage.

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 pass cards and alarm codes are distributed to all facility employees.

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. [The reason for this is that it is important to know who is in the building in case of a safety emergency. The visitors logbook is used to ensure that everyone got out of the building safely.] 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.

SECTION 19.0

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 CW-Q-S-002, Writing a Standard Operating Procedure (SOP) and Laboratory SOP BF-QA-003, Procedure for Writing, Reviewing and Revising Controlled Quality Documents (QAM, SOP, etc)
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water SOPs), and where necessary, 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, etc.), 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.

19.4.1.1 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:

- *Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM); Non-polar Material) by Extraction and Gravimetry, EPA-821-R-98-002, February 1999*
- *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; Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule; May 18, 2012 and/or August 28 , 2017 (depending on state implementation timelines).*
- *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.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th / 21st/ 22nd/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; Final Update V, August 2015.*
- *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)* ***(DW labs only)***
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*
- *New York State DEC Analytical Services Protocol, 2005*
- *New York State DOH Methods Manual*
- *Massachusetts Contingency Plan 310 CMR 40, April 25, 2014*
- *Connecticut Reasonable Confidence Protocol, July 2006*

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.

19.4.2.1 A demonstration of capability (BF-QA-004) is performed whenever there is a significant change in instrument type (e.g., new instrumentation), method or personnel.

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

19.4.2.2 The initial demonstration of capability must be thoroughly documented and approved by the Operations Manager/Designee and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

19.4.2.3 The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct a method detection limit 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

Procedures for generation of IDOCs are detailed below and in laboratory SOP BF-QA-004, Laboratory Personnel Training.

19.4.3.1 The spiking standard used must 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 (see Figure 19-1) 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 can be differentiated from blanks. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, regulations, whenever there is a significant change in the procedure or equipment, or based on project specific requirements (refer to 19.7.10). 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 several days to provide a more realistic MDL. In addition, a larger number of data points may be used if the appropriate t-value multiplier is used. Where required by 40 CFR Part 136, Appendix B, continuing MDLs will be calculated from a minimum of 7 spiked replicates analyzed quarterly and compared to statistical method blank data to determine the final updated MDL.

Refer to the Corporate SOP No. CA-Q-S-006 or the laboratory's SOP No. BF-QA-001 for details on the laboratory's MDL process.

19.8 INSTRUMENT DETECTION LIMITS (IDL)

19.8.1 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.

19.8.2 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. (For CLP procedures, the IDL is determined using the standard deviation of 7 replicate spike analyses on each of 3 non-consecutive days.)

19.8.3 If IDL is > than the MDL, it may be used as the reported MDL.

19.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

19.9.1 Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, CVAA, etc.) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified or see section 20.7.9 for other options. This verification does 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 MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually.

19.9.2 When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 the reporting limit and annually thereafter. The annual requirement is waved for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirement.

19.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis 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. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory's 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, 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 uncertainties at approximately the 99% confidence level with a coverage factor of k = 3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 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 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 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.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Department Supervisor or Laboratory Director/Manager if unsure.

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. The laboratory is currently running the 'TALS Data System' which is a LIMS system that 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 a SQL server 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, and 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, 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 protection 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.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The data review sheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP CA-Q-S-002, *Acceptable Manual Integration Practices*.

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 project job folder, computer file, and/or run log. 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, final inorganic results are reported to 2 significant figures for values less than 10 and 3 significant figures for values greater than 10 on the final report. Organic results are generally reported to 1 significant figure for values less than 10 and 2 significant figures for values greater than 10 on the final report. The number of significant figures may be adjusted based on client or project requirements.

19.14.2.4 For those methods that do not have an instrument printout, an instrumental output or a calculation spreadsheet upload compatible with the LIMS System, the final results and dilution factors are entered directly into LIMS by the analyst, and the software formats 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 automatically transferred to the network server and, eventually, to a back-up 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 Technical Manager/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are out lined in several laboratory SOPs (e.g. BF-SR-002, "Receipt of Analytical Samples", BF-GP-012, "Technical Data Review", and BF-PM-001, "Project Information Requirements") 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 discussing Manual Integrations to ensure the authenticity of the data (BF-GP-013, Manual Integration). The general review concepts are discussed below, more specific information can be found in the SOPs.

19.14.4.1 Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

19.14.4.2 First Level Data Review –The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's analytical run, evaluation of QC data, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

19.14.4.3 Second Level Data Review – All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

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

19.14.4.4 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Director/Manager, Technical Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.14.4.5 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

19.14.4.6 As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and 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 COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met. The Project Manager may also evaluate the validity of results for different test methods given expected chemical relationships.

19.14.4.7 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 and creates the invoice. When complete, the report is issued 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 SOP CA-Q-S-002 as the guidelines.

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 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 principles 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

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

BF-QA-DOC-004
DOC Cert. Statement
Rev. 3 9/28/2016

TESTAMERICA LABORATORIES, INC.

DEMONSTRATION OF CAPABILITY CERTIFICATION STATEMENT

Employee Name (print): _____

Method Number: _____ Matrix (circle): water / soil / air

Parameters or Analytes: _____

Date Submitted: _____

Initial Demonstration of Capability:

SOP Number: _____Revision # _____ Date Read_____

Trained By (print name): _____

Date training began: _____

Date training completed: _____

Continued Demonstration of Capability:

SOP Number: _____Revision # _____ Date Read_____

Demonstration of Capability Reviewed and Analyst Authorized to Perform Method:

_____ _____ _____
Department Manager/Designee Signature Date

_____ _____ _____
QA Manager/Designee Signature Date

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 equipment and instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 PREVENTIVE MAINTENANCE

20.2.1 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.

20.2.2 Routine preventive maintenance procedures and frequency, such as lubrication, 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.

20.2.3 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 also be outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

20.2.4 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.

20.2.4.1 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.

20.2.4.2 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 instrumentation records.

20.2.4.3 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.

20.2.5 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

20.2.6 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.

At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) 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 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.

Laboratory SOPs BF-GP-001,"Calibration of Autopipettes and Repipetters" and BF-GP-002, "Support Equipment: Maintenance, Record Keeping and Corrective Actions of Analytical Balances, Temperature Control Devises and Reagent Water" provide additional detail on the monitoring and record keeping for support equipment.

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 reusable thermometers are calibrated on an annual basis with a NIST-traceable thermometer.

- If the temperature measuring device is used over a range of 10°C or less, then a single point verification within the range of use is acceptable;
- If the temperature measuring device is used over a range of greater than 10°C, then the verification must bracket the range of use.

IR thermometers should be calibrated over the full range of use, including ambient, iced (4 degrees) and frozen (0 to -5 degrees), per the Drinking Water Manual. The IR thermometers are verified daily and calibrated quarterly. Digital probes and thermocouples are calibrated

quarterly. Disposable thermometers are discarded upon expiration and replaced with newly purchased thermometers.

The NIST Mercury 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 digital thermometer is recalibrated every one year (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 method-specific logbooks. More information on this subject can be found in the laboratory SOP BF-GP-020, “Thermometer Calibration”.

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 working 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 Daily Temperature Logbooks and method-specific logbooks.

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 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.

20.3.6 Field Sampling Devices (Isco Auto Samplers)

Each Auto Sampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is also recorded on the sampling documentation.

The Auto Sampler is calibrated monthly (or if not utilized monthly, immediately prior to its usage) by setting the sample volume to 100ml and recording the volume received. The results are filed in a logbook/binder. The Auto Sampler is programmed to run three (3) cycles and each of the three cycles is measured into a graduated cylinder to verify 100ml are received.

If the RSD (Relative Standard Deviation) between the 3 cycles is greater than 10%, the procedure is repeated and if the result is still greater than 10%, then the Auto Sampler is taken out of service until it is repaired and calibration verification criteria can be met. The results of this check are kept in a logbook/binder.

Additional calibration and use information is detailed in laboratory SOP BF-FS-006, "Calibration of Field Meter".

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 initially and as needed after that and at least annually.

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 will be used.

20.4.1.1 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.

20.4.1.2 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).

20.4.1.3 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 (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exceptions to these rules is ICP and ICPMS methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration standards.

20.4.1.4 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 would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.2 Calibration Verification

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and 2009 TNI Std. EL-V1M4, section 1.7.1. 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 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 NELAC (2003) Standard, Section 5.5.5.10 and 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 then bracketing calibration verification 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 under the following special conditions:

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.

20.4.2.1 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. See laboratory SOP's BF-MB-005 and BF-MV-007 for guidelines for making tentative identifications

Note:
For general reporting if TICs are requested, the ten (10), largest non-target analyte peaks whose area count exceeds 10% of the nearest internal standard will be termed "Tentatively Identified Compounds" (TICs). More or fewer TICs may be identified based on client requirements.

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. Laboratory Equipment and Instrumentation
TestAmerica Buffalo, rev. 11-3-2017

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS Instrumentation	Agilent	5975	US83110163	2013	good
GC/MS Instrumentation	Agilent	5973	US02450141	2012	good
GC/MS Instrumentation	Agilent	5975	US83130241	2013	good
GC/MS Instrumentation	Agilent	5975	US80838844	2008	good
GC/MS Instrumentation	Agilent	5973	US44621446	2005	good
GC/MS Instrumentation	Agilent	5973	US52420646	2005	good
GC/MS Instrumentation	Agilent	5973	US41720721	2004	good
GC/MS Instrumentation	Agilent	5973	US35120354	2004	good
GC/MS Instrumentation	Agilent	5973	US41720707	2004	good
GC/MS Instrumentation	Agilent	5973	US21854062	2003	good
GC/MS Instrumentation	Agilent	5973	US30965634	2003	good
GC/MS Instrumentation	Agilent	5973	US03965692	2003	good
GC/MS Instrumentation	Agilent	5973	US05605976	2001	good
GC/MS Instrumentation	Agilent	5973	US05060084	2001	good
GC/MS Instrumentation	Agilent	5973	US03950346	2001	good
GC/MS Instrumentation	Agilent	5973	US82321636	2001	good
GC Instrumentation	Perkin Elmer	Clarus 608 dual uECD	680S10101807	2013	good
GC Instrumentation	Perkin Elmer	Clarus 600 dual FID	665S10020401	2012	good
GC Instrumentation	Agilent	6890 dual uECD	CN10839003	2005	good
GC Instrumentation	Agilent	6890 dual uECD	CN10833020	2005	good
GC Instrumentation	Agilent	6890 dual uECD	CN10448015	2005	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53126	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A63465	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53464	1994	good

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53463	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A54409	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A54408	1994	good
GC Instrumentation	Hewlett Packard	5890II FID/FID	3115A34892	1994	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3336A60622	1994	good
GC Instrumentation	Hewlett Packard	5890II Hall/PID	3235A54089	1994	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3336A53465	1994	good
GC Instrumentation	Hewlett Packard	5890II dual FID	3336A53727	1994	good
GC Instrumentation	Hewlett Packard	580II FID/FID	3336A53729	1994	good
GC Instrumentation	Hewlett Packard	580II FID/FID	3336A53728	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3310A47661	1993	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53325	1993	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3133A37157	1993	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3203A42206	1992	good
GC Instrumentation	Hewlett Packard	5890II dual FID	3019A28433	1991	good
GC Instrumentation	Hewlett Packard	5890II Hall/PID	3121A35782	1990	good
Metals Instrumentation	Perkin Elmer	Elan 9000 ICP-MS	P0230202	2002	good
Metals Instrumentation	Leeman	PS200 II	HG9045	2000	good
Metals Instrumentation	Leeman	PS200 II	HG0033	2000	good
Metals Instrumentation	Thermo	ICAP 6000 Duo	ICP-20094603	2010	good
Metals Instrumentation	Thermo	ICAP 6000 Duo	ICP-20094602	2010	good
Metals Instrumentation	Environmental Express	AutoBlock Plus	AB4001-1213-042	2013	good
Water Quality Instrumentation	ManTech	PC Titrator	PCM-PSDT/CA	2015	good
Water Quality Instrumentation	Metrohm	IC Model 881	4111	2013	good

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Water Quality Instrumentation	Konelab	Aqua20	SEA032	2009	good
Water Quality Instrumentation	Flash Point Analyzer	HFP 339	73390092	2007	good
Water Quality Instrumentation	Flash Point Analyzer	Optiflash 104002	Herzog PAC 000334	2015	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	A549730578	2006	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	E616730030	2006	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	P410730479	2003	good
Water Quality Instrumentation	Thermo	ECA 1200 TOX	2006.0373	2006	good
Water Quality Instrumentation	Horizon	Speed Vap	03-0415	2005	good
Water Quality Instrumentation	Konelab	20XT	E3719731	2005	good
Water Quality Instrumentation	Thermo	ECA 1200 TOX	2004.901	2004	good
Water Quality Instrumentation	Metrohm	881 Compact IC Pro	36756	2014	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	20126	2004	good
Water Quality Instrumentation	Konelab	20	S5019455	2004	good
Water Quality Instrumentation	Glastron	CN Midi-distillation	2502	2003	good
Water Quality Instrumentation	Glastron	Phenol Midi-distillation	2069	2003	good
Water Quality Instrumentation	Glastron	Phenol Midi-distillation	2053	2003	good
Water Quality Instrumentation	Mantech	BOD Autoanalyzer	MS-1LO-157	2004	good
Water Quality Instrumentation	Mantech	BOD Autoanalyzer	MT-0B4-215	2015	good
Water Quality Instrumentation	Mantech	PC Titrator	MS-OK2-607	2003	good
Water Quality Instrumentation	HACH	Spectrophotometer #DR/2500	30200004886	2003	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	2060196	2002	good
Water Quality Instrumentation	Spectronic	Genesis 4001/4	3SGC199091	2000	good
Water Quality Instrumentation	Lachat	Quickchem 8000 Autoanalyzer	A83000-1527	2000	good
Water Quality Instrumentation	Lachat	Quickchem 8500 Autoanalyzer	40300001665	2014	good

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Water Quality Instrumentation	Lachat	Quickchem 8500 Autoanalyzer	11060001336	2013	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	99010157	1999	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	99110569	1999	good
Water Quality Instrumentation	BOD chamber		Revco	1994	good
Sample Preparation Equipment	CEM	Microwave MARS	MD3978	2013	good
Sample Preparation Equipment	Gilson	Fractionator Model GX-274	40579	2013	good
Sample Preparation Equipment	TurboVap	II	TV0529N12427	2006	good
Sample Preparation Equipment	TurboVap	II	TV0529N12428	2006	good
Sample Preparation Equipment	TurboVap	II	TV9445N5816	1996	good
Sample Preparation Equipment	TurboVap	II	TV9427N4133	1996	good
Sample Preparation Equipment	TurboVap	II	TV944N5819	1996	good
Sample Preparation Equipment	TurboVap	II	TV944N5820	1996	good
Sample Preparation Equipment	TurboVap	II	TV0024N9623	2000	good
Sample Preparation Equipment	TurboVap	II	TV0022N9604	2000	good
Sample Preparation Equipment	TurboVap	II	TV0312N11592	2003	good
Sample Preparation Equipment	TurboVap	II	TV0312N11591	2003	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G1647/C5659	1994	good

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2665/C5674	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2620/C5660	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2245/C6328	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2621/C6733	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2713/C6732	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G1643/C6837	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2742/C6842	1995	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	169902	1999	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16907	1999	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16913	1999	good

Note: The Equipment List is current at the date of publication of this manual. An updated list may be obtained by contacting the TestAmerica Buffalo Quality Department.

Table 20-2.

Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Leeman Mercury Analyzer	Check tubing for wear Fill rinse tank with 10% HCl Change dryer tube Fill reductant bottle with 10% Stannous Chloride	Daily Daily As Needed Daily
ICP & ICP/MS	Check pump tubing Check liquid argon supply Check fluid level in waste container Check re-circulator levels Clean or replace filters Check torch Check sample spray chamber for debris Clean and align nebulizer Change pump oil Change Cones Change printer cartridge Replace pump tubing	Daily Daily Daily Monthly As required Daily Monthly Monthly Monthly As required As required As required
UV-Vis Spectrophotometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check	As required As required Annually
Auto Analyzers	Clean sampler Check all tubing Clean inside of colorimeter Clean pump well and pump rollers Clean wash fluid receptacle Oil rollers/chains/side rails Clean optics and cells	Daily Daily Daily Quarterly Weekly Weekly Quarterly
Agilent GC/MS	Pump oil-level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment COMPUTER SYSTEM AND PRINTER: Air filter cleaning Change data system air filter Printer head carriage lubrication Paper sprocket cleaning Drive belt lubrication	Monthly Annually As required As required As required As required As required As required As required As required

Instrument	Procedure	Frequency
Gas Chromatograph	Compare standard response to previous day or since last initial calibration	Daily
	Check carrier gas flow rate in column	Daily via use of known compound retention
	Check temp. of detector, inlet, column oven	Daily
	Septum replacement	As required
	Glass wool replacement	As required
	Check system for gas leaks with SNOOP	W/cylinder change as required
	Check for loose/frayed power wires and insulation	As Required
	Bake injector/column	As Required
	Change/remove sections of guard column	As Required
	Replace connectors/liners	As Required
	Change/replace column(s)	
Electron Capture Detector (ECD)	Detector wipe test (Ni-63)	Semi-annually
	Detector cleaning	As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Photoionization Detector (PID)	Change O-rings	As required
	Clean lamp window	As required
HPLC	Change guard columns	As required
	Change lamps	As required
	Change pump seals	Semi-annually or as required
	Replace tubing	As required
	Change fuses in power supply	As required
	Filter all samples and solvents	Daily
	Change autosampler rotor/stator	As required
Vacuum Pumps/ Air Compressor	Drained	Weekly
	Belts checked	Monthly
	Lubricated	Semi-annually
Centrifuge	Check brushes and bearings	Every 6 months or as needed

Table 20-3.

Periodic Calibration

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using "S" NIST traceable weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually.	Daily, when used Annual	± 0.2%	Clean, check level, insure lack of drafts, and that unit is warmed up, recheck. If fails, call service.
Top Loading Balance	Accuracy determined using "S" NIST traceable. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually.	Daily, when used Annual	± 0.5%	Clean. Replace.
NIST Certified Weights	Accuracy determined by accredited weights and measurement laboratory.	1 year	As per certificate.	Replace.
NIST-Traceable Thermometer-Mercury	Accuracy determined by accredited measurement laboratory.	3 years	As per certificate.	Replace.
NIST-Traceable Thermometer-Digital	Accuracy determined by accredited measurement laboratory.	1 year	As per certificate	Replace.
Thermometer	Against NIST-traceable thermometer	Yearly at appropriate temperature range for intended use	± 2.0°C	Replace
Minimum-Maximum Thermometers	Against NIST-traceable thermometer	Yearly	± 2.0°C	Replace

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
InfraRed Temperature Guns	Against NIST-traceable thermometer Accuracy determined by accredited measurement laboratory.	Daily at appropriate temperature range for intended use. Annual	± 2.0°C	Repair/replace
Dial-type Thermometers	Against NIST-traceable thermometer	Quarterly at appropriate temperature range for intended use.	± 2.0°C	Replace
Refrigerator	Temperature checked using NIST-traceable thermometer.	Daily. If out of range, check again in two hours.	0-6°C	Adjust. Repair. While waiting for repair, seal door, attach “Out of Service” sign, move items to functional unit. Notify supervisor.
Freezer	Temperature checked using NIST-traceable thermometer	Daily. If out of range, check again in two hours.	(-10)-(-20)°C	Adjust. Repair. While waiting for repair, seal door, attach “Out of Service” sign, move items to functional unit. Notify supervisor.
Oven	Temperature checked using NIST-traceable thermometer.	When in use.	104 ± 1°C (drying) 180 ± 2°C (TDS)	Adjust. Replace.
Water Bath	Temperature checked using NIST-traceable thermometer.	When in use.	± 2°C	Adjust. Replace.
Volumetric Dispensing Devices (Eppendorf ® pipette, automatic dilutor or dispensing devices)	One delivery by weight. Using DI water or solvent of use, dispense into tared vessel. Record weight with device ID number. Calibrate using 4 replicate gravimetric measurements	Each day of use Quarterly	± 2% Calculate accuracy by dividing weight by stated volume times 100 for percent.	Adjust. Replace.

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Glass Microliter Syringes	None	Accuracy must be initially demonstrated if syringe was not received with a certificate attesting to established accuracy.	± 1%	Not applicable.
Deionized Water	Check in-line conductivity meter on system with conductivity meter in Inorganics Department.	Daily	<1.0 µmho at 25°C	Record on log. Report discrepancies to QA Manager, Operations Manager or Technical Manager.

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. For certain programs Microsyringes are verified semi-annually or disposed of after 6 months of use. 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), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory accreditation Cooperation) or APLAC (Asia – Pacific Laboratory Accreditation Cooperation)..A certificate and scope of accreditation is kept on file at the laboratory.

The calibration report or certificate submitted to ***TestAmerica Buffalo*** contains, in a well designed format, a traceability statement, the conditions under which the calibrations were made in the context of any potential influence, a compliance statement with an identified metrological specification and the pertinent clauses, a clearly identified record of the quantities and functional test results before and after re-calibration, and no recommendation on the calibration interval. Opinions and interpretations of results are presented along with the basis upon which they were made and identified as such. The report may be submitted by facsimile or other electronic means as long as the requirements of the International Standard are achieved. If significant amendments are made to a calibration certificate, a supplemental certificate for the serial-number-specified piece of equipment is so identified. When a new certificate is offered, it uniquely identifies and references the one it replaces. All calibration reports are filed in the QA Office.

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 accredited by ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method
- Concentration with associated uncertainties
- 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. Method specific information may also be found in the laboratory method SOPs in the "Standards and Reagents" sections. 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 SOP No. 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 by each department in bound or electronic folders. 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 laboratory SOP BF-GP-019, “Standard Traceability and Preparation” and also to the 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. Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

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 or department’s chemical history log and are assigned a unique identification number. Preparation of working standards or reagents prepared from the stock is documented in the laboratory Department’s Standard Preparation Log. The following information is typically recorded in the electronic database within the LIMS:

- Standard ID
- Description of Standard
- Department
- Preparer’s name
- Final volume and number of vials prepared
- Solvent type and lot number

- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- 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 section

Records are maintained 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
- Standard ID from LIMS.
- 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 in the LIMS system.

21.4.3 In addition, the following information may be helpful:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- 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)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an 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 preparation/analytical batch records.

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 SOPs.

SECTION 22.0

SAMPLING

22.1 OVERVIEW

The laboratory provides sampling services. Sampling procedures are described in the following SOPs:

BF-FS-001	Chain of Custody Documentation
BF-FS-003	Groundwater Sampling Field Data Collection
BF-FS-004	Equipment Decontamination
BF-FS-005	Groundwater/Surface Water Sampling
BF-FS-006	Calibration of Field Meter
BF-FS-007	Low Flow Sampling Procedures
BF-FS-008	Surface and Subsurface Soil/Sediment Sampling

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. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory online.

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 chain-of-custody (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. 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. These programs will be addressed on a case-by-case basis.

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, this info is in the SOP 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.

The following information provides general guidance for homogenization and subsampling. For laboratory specific procedures refer to SOP BF-GP-005, "Sample Homogenization and Subsampling".

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 includes 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. 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 shipping documents are retained with the project files.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC or in the project notes, sample management will initiate Strict Chain of Custody procedures as defined in SOP BF-GP-018, "Strict Internal Chain-of-Custody".

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.

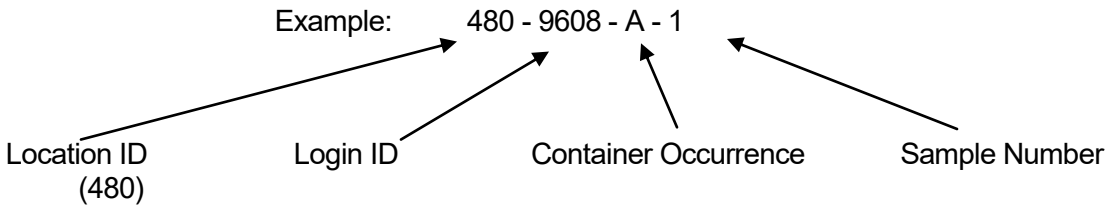
23.2.1 Laboratory Receipt

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 on the Sample Login Form – 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 Buffalo Laboratory (Location 480). 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 COC filled out completely;
- 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);

- every sample cooler is given a radiation screen with a standardized Radiation Monitor (Monitor 4 model). This screen has no analytical repercussions; it is just a gross screen for employee safety purposes. Contact TestAmerica Buffalo's Technical Manager, Environmental Health and Safety Coordinator or Sample Control Manager immediately if screening indicates radioactivity in excess of 0.02 mR/hr.;
- 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.

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 described in Section 23.1.1.1 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 SOP No. BF-SR-002.

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. Aqueous samples designated for metals analysis are stored at ambient temperature. 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 at a minimum of every two weeks.

Analysts and technicians provide a request form to the cooler custodian who then retrieves the requested samples. In the absence of the cooler custodian, the analysts may personally retrieve the sample containers allocated to their analysis from the designated refrigerator. The samples are placed on carts, transported the analytical area and analyzed. Following analysis

the remaining sample is returned to the refrigerator from which it originally came. All unused portions of samples are returned to the secure sample control area. All samples are kept in the refrigerators for two to four weeks after analysis, which meets or exceeds most sample holding times. After two to four weeks the samples are moved to dry room temperature, sample archive area where they are retained a minimum of 2 weeks after the final report has been issued to the client at which time disposal occurs. Special arrangements may be made to store samples for longer periods of time. Extended archival periods allow additional metal analyses to be performed on the archived sample and assists clients in dealing with legal matters or regulatory issues.

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, samples which are known or suspected to be hazardous are segregated and a notification is issued to all laboratory personnel.

All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm. All soil samples, including foreign soil samples are heat treated or incinerated in accordance with USDA permit requirements and are transported / disposed by USEPA approved facilities.

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.

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). For sample shipments which include water/solid volatile organic analyses (see Note), a trip blank is enclosed when required by method specifications or state or regulatory programs. 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 analyze the trip blanks that were supplied.

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: BF-WM-001, "Waste Management".) All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than six weeks 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 may request to 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 and nature of disposal (such as sample depletion, hazardous waste facility disposal, and return to client). All disposal of sample containers is accomplished through incineration. A Waste Disposal Record should be completed.

Figure 23-1.

Example: Chain of Custody (COC)

Chain of Custody Record XXXXXX TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
Company Name:	Tel/Fax:	Lab Contact:	Carrier:	_____ of _____ COCs
Address:	Analysis Turnaround Time			Sampler:
City/State/Zip:	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone:	TAT if different from Below _____			Walk-in Client:
Fax:	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for_____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd:_____ Corr'd:_____ Therm ID No.:_____

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

Figure 23-2. Example: Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
   - *Client name, address, phone number and fax number (if available)*
   - *Project name and/or number*
   - *The sample identification*
   - *Date, time and location of sampling*
   - *The 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.*
   - ***The date and time of receipt must be recorded between the last person to relinquish the samples and the person who receives the samples in the lab, and they must be exactly the same.***
   - **Information must be legible**

2) Every sample cooler is given a radiation screen with a standardized Radiation Monitor (Monitor 4 model). This screen has no analytical repercussions; it is just a gross screen for employee safety purposes. Contact TestAmerica Buffalo's Technical Manager, Environmental Health and Safety Coordinator or Sample Control Manager immediately if screening indicates radioactivity in excess of 0.02 mR/hr.

3) Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any TestAmerica facility or courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

4) Samples must be properly labeled.
   - Use durable labels (labels provided by TestAmerica are preferred)
   - Include a unique identification number
   - Include sampling date and time & sampler ID
   - Include preservative used.
   - Use indelible ink
   - **Information must be legible**

5) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested.

6) Samples must be preserved according to the requirements of the requested analytical method. See lab Sampling Guide.

   Note: Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

   - Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.

   - For Volatile Organic analyses in drinking water (Method 524.2). Residual chlorine must be neutralized prior to preservation. If there is prior knowledge that the samples are not chlorinated, state it on the COC and use the VOA vials pre-preserved with HCl. The following are other options for a sampler and laboratory where the presence of chlorine is not known:
     - 1. Test for residual chlorine in the field prior to sampling.
       - If no chlorine is present, the samples are to be preserved using HCl as usual.
       - If chlorine is present, add either ascorbic acid or sodium thiosulfate prior to adding HCl.
     - 2. Use VOA vials pre-preserved with sodium thiosulfate or ascorbic acid and add HCl after filling the VOA vial with the sample.

   - **FOR WATER SAMPLES TESTED FOR CYANIDE – for NPDES samples by Standard Methods or EPA 335**
     - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample must be treated with Cadmium Chloride and filtered prior to the addition of NaOH.

       - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements

or the laboratory can analyze the samples as delivered and qualify the results in the final report.

- It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.

- The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

7) Sample Holding Times

- TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (2 working days) remaining on the holding time to ensure analysis.

- Analyses that are designated as “field” analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for “field” analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day after receipt (Monday unless a holiday). Samples will remain refrigerated and sealed until the time of analysis.

8) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. TestAmerica will supply this blank with the bottle order.

9) The project manager will be notified if any sample is received in damaged condition. TestAmerica will request that a sample be resubmitted for analysis.

10) Recommendations for packing samples for shipment.

- Pack samples in Ice rather than “Blue” ice packs.

- Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top and do not seal very well and are prone to intrusion from the water from melted ice.

- Water samples would be best if wrapped with bubble-wrap or paper (newspaper, or paper towels work) and then placed in plastic zip-lock bags.

- Fill extra cooler space with bubble wrap.

Figure 23-3.
Example: Cooler Receipt Form (Optional)

BF-SC-LF-003
Rev.2 8/28/2017

SAMPLE LOGIN

Project_____Event _____

Analysis Groups_____

TAT ____ # **SAMPLES**: _____ **TRIP BLANK? Y/N** ___ **#/date** _____

Custody Seal Intact Y/N NONE **Rad Check <0.02 mR/hr Y/N**

Residual Chlorine Check Y/N/ NA **Pres Checked Y/N/NA**

_____

_____

_____

_____

Workshare/Subcontract Y/N Lab_____ _____ **SO/ICOC #**_____

Received out of hold: Samples _____**Analysis**_____

Checklist/NCM's_____

_____

_____

_____

_____

Temperature(s) **#of coolers**_____ **IR Gun** **1** **2** **3**

_____

_____

_____

_____

SECTION 24.0

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. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. 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.

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.

Table 24-1.

Control Type	Details
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.
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)

24.4.1.1 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.

24.4.1.2 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 may be 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.

24.4.1.3 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.).

24.4.1.4 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.

24.4.1.5 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). In order to meet this requirement, TestAmerica Buffalo spikes with the Corporate Standard Standards primary mix for each analysis. 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.

24.4.1.5.1 For methods that have 1-10 target analytes, spike all components.

24.4.1.5.2 For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.

24.4.1.5.3 For methods with more than 20 target analytes, spike at least 16 components.

24.4.1.5.4 Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

24.4.1.5.5 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 24-5. 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;
	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)

24.6.1 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.

24.6.2 Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis 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.

24.6.3 Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

24.6.3.1 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).

24.6.3.2 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.

24.6.3.3 The lowest acceptable recovery limit will be 10% (the analyte must be detectable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable.

24.6.3.4 The maximum acceptable recovery limit will be 150%.

24.6.3.5 The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

24.6.3.6 If either the high or low end of the control limit changes by $\leq$ 5% from previous, the data points are inspected and, using professional judgment, the limits may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.4 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. This process is outlined in BF-QA-002.

24.6.4.1 The control limits are maintained in the laboratory LIMS system. The limits for each analyte/method/matrix combination are assigned effective and expiration dates. The QA department is able to query the LIMS system and print an active list of control limits based on this database. The most current laboratory limits (based on the effective/expiration dates) are reflected on the laboratory worksheets and final reports unless superseded by project specific limits.

24.6.5 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 13) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

24.6.5.1 The analyte results are below the reporting limit and the LCS is above the upper control limit.

24.6.5.2 If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

24.6.6 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.

24.6.7 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). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

24.7.1 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.

24.7.2 A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

24.7.3 Use of formulae to reduce data is discussed in the method SOPs and in Section 20.

24.7.4 Selection of appropriate reagents and standards is included in Section 9 and 22.

24.7.5 A discussion on selectivity of the test is included in Section 5.

24.7.6 Constant and consistent test conditions are discussed in Section 19.

24.7.7 The laboratories sample acceptance policy is included in Section 23.

SECTION 25.0

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. A variety of report formats are available to meet specific needs. 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.

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.

The laboratory complies with any state reporting requirements. An example is located in BF-PM-008 – Massachusetts DEP Notification Procedures.

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) with a "sample results" column header.

25.2.2 Each report cover page is printed on company letterhead which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. job number) 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.

Note: Page numbers of report are represented as # / ##. Where the first number is the page number and the second is the total number of pages.

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 Laboratory Practical quantitation limits or client 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 (if requested).

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). Sample temperatures are recorded in the report case narrative and on the COC. Deviations from normal conditions (e.g., preservation, breakage) are recorded in the report case narrative.

25.2.17 A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Authorized signatories are qualified Project Managers appointed by the Manager of Project Managers.

25.2.21 When NELAP accreditation is required, the lab shall certify that the test results meet all requirements of NELAP or provide reasons and/or justification if they do not.

25.2.22 The laboratory includes a cover letter.

25.2.23 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.

25.2.24 When Soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

25.2.25 Appropriate laboratory certification number for the state of origin of the sample if applicable.

25.2.26 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). A complete report must be sent once all of the work has been completed.

25.2.27 Any non-TestAmerica subcontracted analysis results are provided as an addendum to the 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 Certification Summary report, where required, will document that unless otherwise noted, all analytes tested and reported by the laboratory were covered by the noted certifications.

25.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica Buffalo offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level 1 is a report with all of the elements outlined in Section 25.2 above, excluding 25.2.15 (QC data)
- Level II is a Level I report plus summary information, including results for the method blank, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level III contains all the information supplied in Level II, but presented on CLP-like summary forms, and relevant calibration information. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. Procedures used to ensure client confidentiality are outlined in Section 26.7.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services in addition to the test report as described in section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD . TestAmerica Buffalo offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), 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

25.4.1 Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

25.4.2 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 TNI sample acceptance requirements such as improper container, holding time, or temperature.

25.4.3 Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

25.4.4 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.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by 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 Section 8.

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.

Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are to meet all requirements of this document, include cover letter.

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". The revised report will have the word "revised" appended to the cover letter.

When the report is re-issued, a notation of "revised" is placed on the cover/signature page of the report. A brief explanation of reason for the re-issue is included in the report case narrative.

25.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

25.9.1 Policy on Data Omissions or Reporting Limit Increases

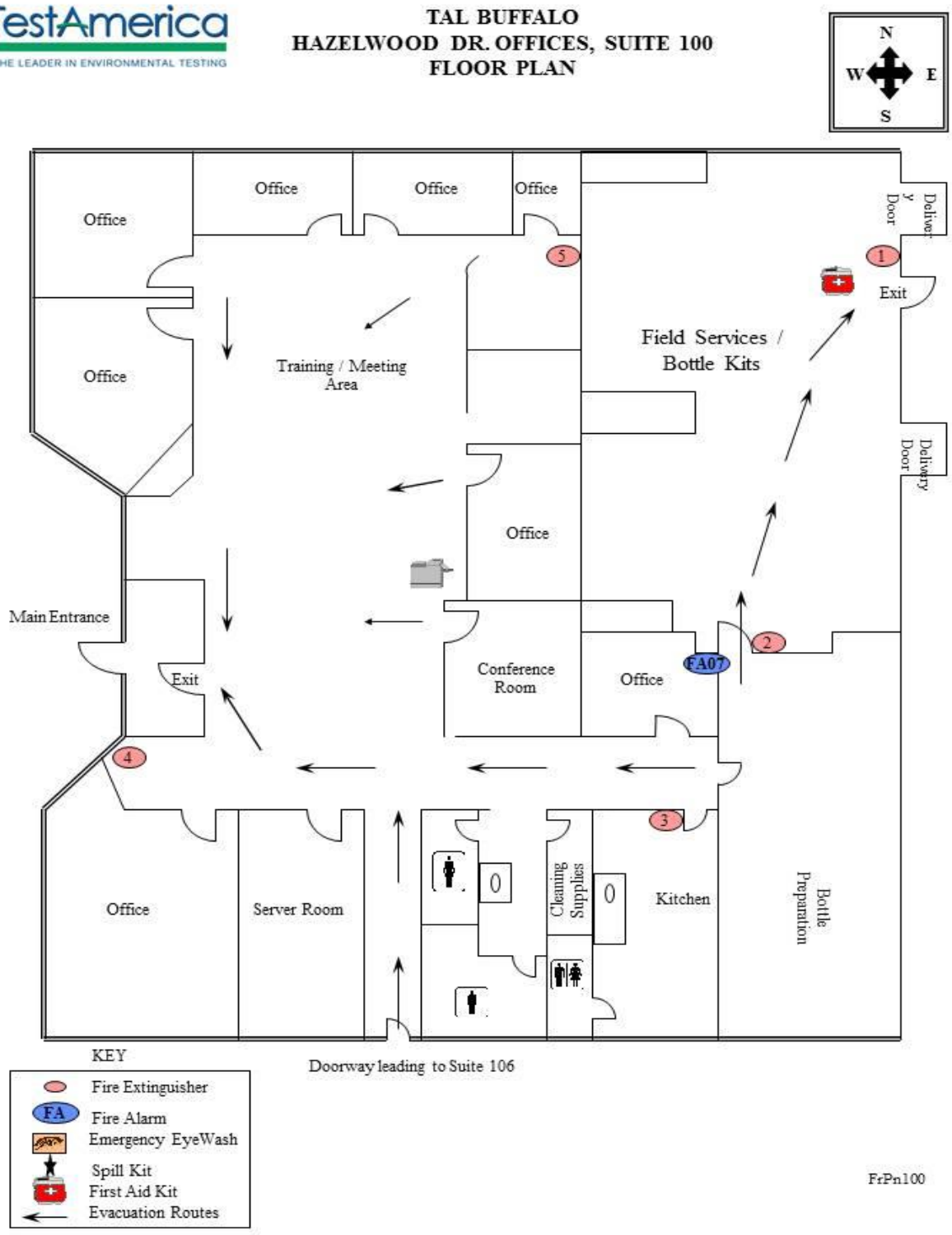
Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- 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

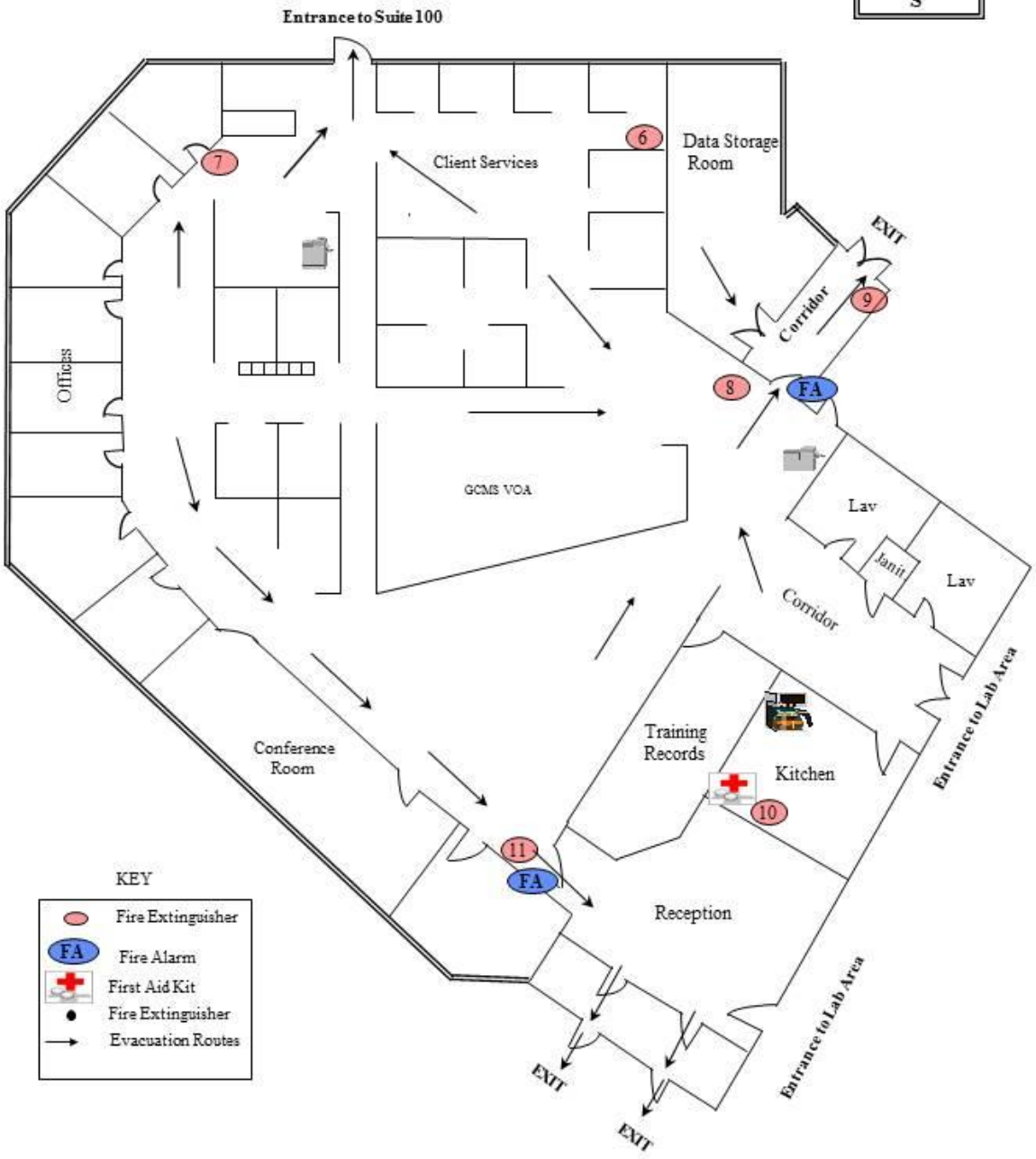
TestAmerica does not issue multiple reports for the same workorder where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 106
CLIENT SERVICES/REPORT PREP
FLOOR PLAN



FrP1106L
3/2005

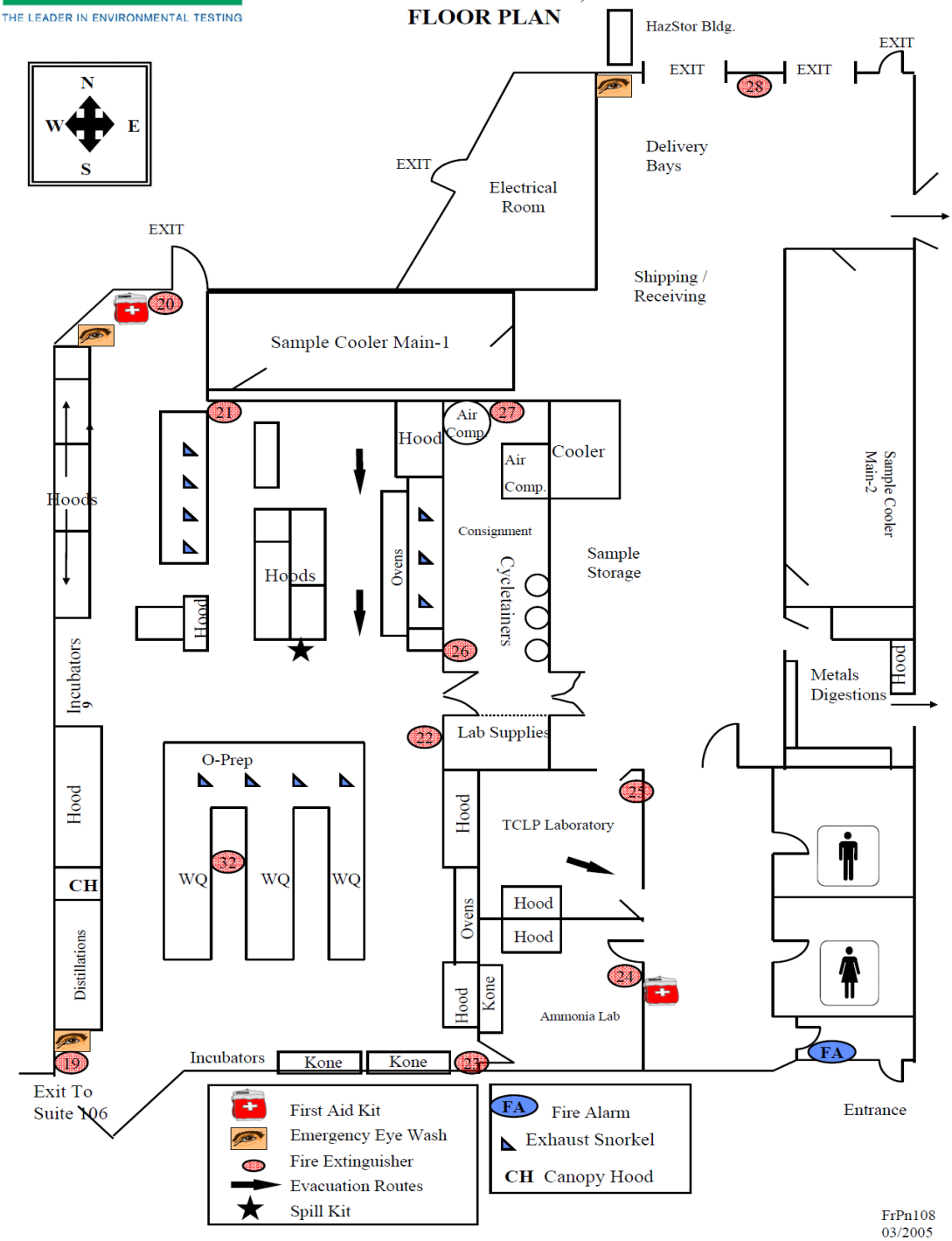
TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL BUFFALO
HAZELWOOD DR. NY OFFICES, SUITE 106
LABORATORY AREA
FLOOR PLAN

FrPn106r
03/2005

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 108
FLOOR PLAN



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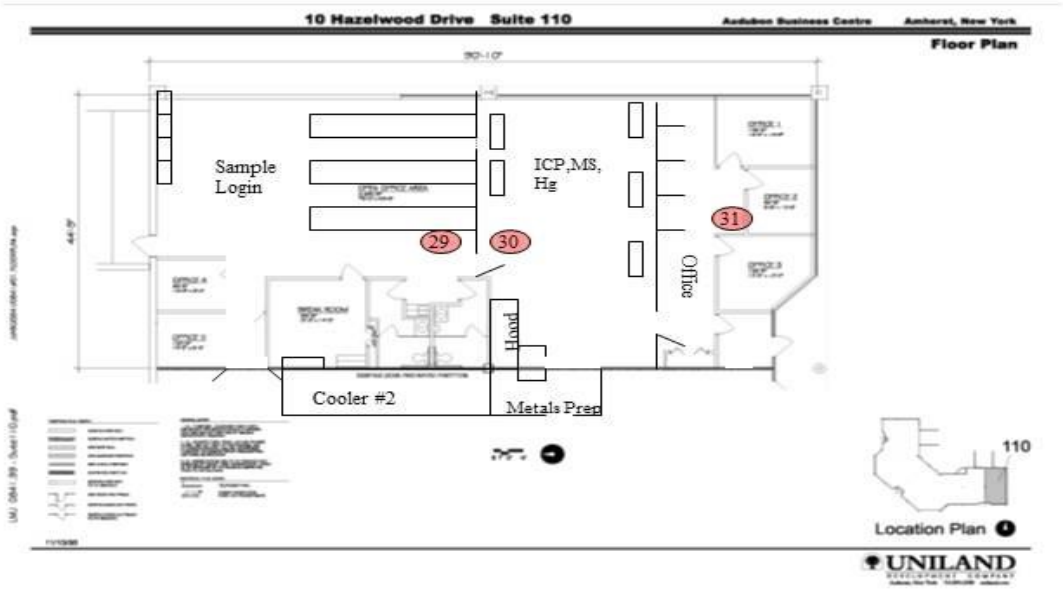
03/2005


10 Hazelwood Drive Suite 110
Audubon Business Centre
Amherst, New York
Floor Plan
Sample Login
ICP,MS, Hg
29
30
31
Office
Hood
Cooler #2
Metals Prep
110
Location Plan
UNILAND

Appendix 2. Glossary/Acronyms

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. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (TNI)

Accrediting Authority: The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (TNI)

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. (TNI)

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

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 which 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 to 20 environmental samples of the same 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 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) and /or those samples not requiring preparation, which are analyzed

together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples. (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 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. (TNI)

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. TNI 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
Derivitization
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). (TNI)

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item (ASQC), whether in the laboratory's control or not.

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. (TNI)

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: Those matrix, technology/method, and analyte combinations for which the 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 matrix or Saline/Estuarine source. 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. (TNI)

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. (TNI)

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

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. (TNI)

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. (TNI)

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) [2.1]

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 analyst/laboratory 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, 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 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 and which is accepted as the method 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)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

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)

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
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
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
SDS - Safety Data Sheet
SOP: Standard Operating Procedure
TAT – Turn-Around-Time
TNI – The NELAC Institute
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Buffalo maintains accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Certifications

Laboratory	Program	Authority	Identification	Expiration Date
TestAmerica Buffalo	Federal	USDA	P330-11-00386	02/06/2021
TestAmerica Buffalo	NELAP	Florida	E87672	06/30/2018
TestAmerica Buffalo	NELAP	Illinois	200003	09/30/2018
TestAmerica Buffalo	NELAP	Kansas	E-10187	01/31/2019
TestAmerica Buffalo	NELAP	Louisiana	02031	06/30/2018
TestAmerica Buffalo	NELAP	Minnesota	036-999-337	12/31/2018
TestAmerica Buffalo	NELAP	New Hampshire	2337	11/17/2018
TestAmerica Buffalo	NELAP	New Hampshire	2973	09/11/2018
TestAmerica Buffalo	NELAP	New Jersey	NY455	06/30/2018
TestAmerica Buffalo	NELAP	New York	10026	03/31/2018
TestAmerica Buffalo	NELAP	Oregon	NY200003	06/09/2018
TestAmerica Buffalo	NELAP	Pennsylvania	68-00281	07/31/2018
TestAmerica Buffalo	NELAP	Texas	T104704412-15-6	07/31/2018
TestAmerica Buffalo	NELAP	Virginia	460185	09/14/2018
TestAmerica Buffalo	State Program	Arkansas DEQ	88-0686	07/06/2018
TestAmerica Buffalo	State Program	California	2931	04/01/2018
TestAmerica Buffalo	State Program	Connecticut	PH-0568	09/30/2018
TestAmerica Buffalo	State Program	Georgia	10026 (NY)	03/31/2018
TestAmerica Buffalo	State Program	Georgia	956	03/31/2018
TestAmerica Buffalo	State Program	Iowa	374	03/01/2019
TestAmerica Buffalo	State Program	Kentucky (DW)	90029	12/31/2018
TestAmerica Buffalo	State Program	Kentucky (UST)	30	03/31/2018
TestAmerica Buffalo	State Program	Kentucky (WW)	90029	12/31/2018
TestAmerica Buffalo	State Program	Maine	NY00044	12/04/2018
TestAmerica Buffalo	State Program	Maryland	294	03/31/2018
TestAmerica Buffalo	State Program	Massachusetts	M-NY044	06/30/2018
TestAmerica Buffalo	State Program	Michigan	9937	03/31/2018
TestAmerica Buffalo	State Program	North Dakota	R-176	03/31/2018
TestAmerica Buffalo	State Program	Oklahoma	9421	08/31/2018
TestAmerica Buffalo	State Program	Rhode Island	LAO00328	12/30/2018
TestAmerica Buffalo	State Program	Tennessee	TN02970	03/31/2018
TestAmerica Buffalo	State Program	Washington	C784	02/10/2019
TestAmerica Buffalo	State Program	Wisconsin	998310390	08/31/2018

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* Certification Valid - Laboratory is Pending Renewal with the Program Authority

For more information, or to contact a local TestAmerica representative nearest you, please visit our website at www.testamericainc.com

The certificates and accredited parameter lists are available for each State/Program at www.testamericainc.com under Analytical Services Search – Certifications.

Quality Assurance Manual Cover Page

Eurofins TestAmerica Edison
777 New Durham Road
Edison, NJ 08817
Phone No. 732-549-3900
Fax No. 732-549-3679

www.TestAmericainc.com

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Quality Assurance Manual
Approval Signatures

Laboratory Director – Mark Acierno	07/08/2019 Date
Quality Manager - Carl Armbruster	07/08/2019 Date
Technical Manager, Organics – Sylvanus Klusey	07/08/2019 Date.
Technical Manager, Inorganics – Donald Evans	07/08/2019 Date

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REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CW-L-S-004	Subcontracting
CA-Q-M-002	Corporate Quality Management Plan
CA-Q-S-001	Acid and Solvent Lot Testing and Approval Programs
CA-Q-S-002	Manual Integrations
CA-Q-S-006	Detection and Quantitation Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Corporate Environmental Health & Safety Manual
CW-F-P-002	Company-Wide Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Fixed Asset Acquisition, Retention and Safeguarding
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigation
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Data Recall Process
CA-C-S-001	Work Sharing Process

REFERENCED LABORATORY SOPs

SOP Reference	Title
ED-GEN-002	Document Control
ED-GEN-026	Evaluation of Analytical Accuracy and Precision Through The Use of Control Charts
ED-GEN-010	Calibration of Analytical Balances
ED-GEN-003	Control of Non-Conformances and Corrective Action
ED-GEN-024	Record Storage and Retention
ED-GEN-022	Training
ED-GEN-001	Data Management and Handling Procedures
ED-GEN-021	Data Review
ED-SPM-001	Login
ED-RP-001	Reports Production
ED-GEN-014	Thermometer Calibration

SOP Reference	Title
ED-GEN-011	Calibration and Use of Lab Pipettes
ED-FLD-008, -009	Groundwater Sampling and Flow Monitoring
ED-FLD-014	Wastewater Sampling
ED-FLD-001 thru -010	Field Analytical Parameters
ED-GEN-007	Subsampling
ED-SPM-007	Disposal of Samples and Associated Laboratory Waste
ED-SPM-006	Procedure for Acceptance and Handling of Regulated Domestic and Foreign Soils

SECTION 3. INTRODUCTION, SCOPE AND APPLICABILITY

3.1 Introduction and Compliance References

Eurofins TestAmerica Edison's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving Eurofins 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. In addition, the policies and procedures outlined in this manual are compliant with Eurofins TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of Eurofins TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all Eurofins TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- ANSI/ASQC, E4-1994, "Specifications and Guidelines for Quality Management Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995, or most recent version)
- "EPA Requirements for Quality Management Programs" (QA/R-2) (EPA/240/B-01/002, May 31, 2006).
- 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; Final Update V, August 2015.*
- 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)*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- APHA, *Standard Methods for* the Examination of Water and Wastewater, 18th Edition, 19th, 20th, 21st, and on-line Editions.
- 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 Eurofins 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 and soils. 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 used by the laboratory can be found Eurofins TestAmerica Edison Work Instruction No. EDS-WI-009 (Analytical Capabilities). 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. This manual itself is reviewed every two years 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 by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & Updating procedures (refer to SOP No. ED-GEN-002, Document Control).

SECTION 4. MANAGEMENT REQUIREMENTS

4.1 Overview

Eurofins TestAmerica Edison is a local operating unit of Eurofins TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the corporate staff of Eurofins TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President and Chief Executive Officer (CEO), Chief Operating Officer (COO), Executive Vice President (VP) Operations, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & Eurofins TestAmerica Edison 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 Eurofins TestAmerica's Edison laboratory.

4.2.2 President and Chief Executive Officer (CEO)

The President and CEO is a member of the Board of Directors and is ultimately responsible for the quality and performance of all Eurofins TestAmerica facilities. The President and CEO establishes the overall quality standard and data integrity program for the Analytical Business,

providing the necessary leadership and resources to assure that the standard and integrity program are met.

4.2.3 Chief Operation Officer (COO)

The COO reports directly to the President and CEO of Eurofins TestAmerica. The COO~~VPO~~ oversees the operations of all Eurofins TestAmerica laboratories and the EMLab P&K business unit. The VP's of Operations report directly to COO

4.2.4 Vice President of Operations

Each VP of Operations reports directly to the Executive VP of Operations and is a part of the Executive Committee. Each VP of Operations is responsible for the overall administrative and operational management of their respective laboratories. The VP's responsibilities include allocation of personnel and resources, long-term planning, goal setting, and achieving the financial, business, and quality objectives of Eurofins TestAmerica. The VP's ensure timely compliance with Corporate Management directives, policies, and management systems reviews. The VP's are also responsible for restricting any laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual.

4.2.5 Vice President of Quality and Environmental Health and Safety (VP-QA/EHS)

The Vice President (VP) of QA/EHS reports directly to the President and CEO. With the aid of the Executive Committee, Laboratory Directors, Quality Directors, Safety Manager, EH&S Coordinators and QA Managers, the VP-QA/EHS has the responsibility for the establishment, general overview and Corporate maintenance of the Quality Assurance and EH&S Programs within Eurofins TestAmerica. Additional responsibilities include:

- Review of QA/QC and EHS aspects of Corporate SOPs & Policies, national projects and expansions or changes in services.
- Work with various organizations outside of Eurofins TestAmerica to further the development of quality standards and represent Eurofins TestAmerica at various trade meetings.
- Preparation of a monthly report that includes quality metrics across the analytical laboratories and a summary of any quality related initiatives and issues.
- Preparation of a monthly report that includes EH&S metrics across the analytical laboratories and a summary of any EH&S related initiatives and issues.
- Work with various organizations outside of Eurofins TestAmerica to further the development of quality standards and represent Eurofins TestAmerica at various trade meetings.
- With the assistance of the Corporate Senior Management Teams and the EHS Director~~s~~, development and implementation of the Eurofins TestAmerica Environmental, Health and Safety Program.

4.2.6 Vice President of Client Service

The VP of Client Services leads the Client Service Organization (CSO) and is responsible for client satisfaction, driving operational excellence and improving client responsiveness. The VP provides direction to the Client Service Directors, Programs Managers and Project Managers.

4.2.7 Quality Assessment Director

The Quality Assessment Director reports to the VP-QA/EHS. The Quality Assessment Director has QA oversight of laboratories; responsible for the internal audit system, schedule and procedure; monitors laboratory internal audit findings; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Compliance Director, the Quality Systems Director, and the VP-QA/EHS, the Quality Assessment Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within Eurofins TestAmerica.

4.2.8 Quality Compliance Director

The Quality Compliance Director reports to the VP-QA/EHS. The Quality Compliance Director has QA oversight of laboratories; monitors and communicates DoD / DoE requirements; develops corporate tools for ensuring and improving compliance; develops corporate assessment tools; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Systems Director and the VP-QA/EHS, the Quality Compliance Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within Eurofins TestAmerica.

4.2.9 Quality Systems Director

The Quality Systems Director reports to the VP-QA/EHS. The Quality Systems Director has QA oversight of laboratories; develops quality policies, procedures and management tools; monitors and communicates regulatory and certification requirements; identifies common laboratory weaknesses; and monitors corrective action closures. Together with the Quality Assessment Director, Quality Compliance Director and the VP-QA/EHS, the Quality Systems Director has the responsibility for the establishment, general overview and maintenance of the Analytical Quality Assurance Program within Eurofins TestAmerica.

4.2.10 Quality Information Manager

The Quality Information Manager is responsible for managing all company official documents (e.g., Policies, Procedures, Work Instructions), the company's accreditation database, intranet websites, external laboratory subcontracting, regulatory limits for clients on the company's TotalAccess website; internal and external client support for various company groups (e.g., Client Services, EH&S, Legal, IT, Sales) for both quality and operational functions. The Quality Information Manager reports to the VP-QA/EHS; and works alongside the Quality Assessment, Quality Compliance and Quality System Directors and EHS Managers to support both the Analytical Quality Assurance and EHS Programs within Eurofins TestAmerica.

4.2.11 Technical Services Director

The Technical Services Director is responsible for establishing, implementing and communicating Eurofins TestAmerica's Analytical Business's Technical Policies, SOPs, and

Manuals. Other responsibilities include conducting technical assessments as required, acting as a technical resource in national contracts review, coordinating new technologies, establishing best practices, advising staff on technology advances, innovations, and applications.

4.2.12 Ethics and Compliance Officers (ECOs)

Eurofins TestAmerica has designated two senior members of the Corporate staff to fulfill the role of Ethics and Compliance Officer (ECO) – Corporate Counsel & VP of Human Resources and the VP-QA/EHS. Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. Each ECO has a direct line of communication to the entire senior Corporate and lab management staff.

The ECOs ensure that the organization distributes the data integrity and ethical practices policies to all employees and ensures annual trainings and orientation of new hires to the ethics program and its policies. The ECO is responsible for establishing a mechanism to foster employee reporting of incidents of illegal, unethical, or improper practices in a safe and confidential environment.

The ECOs monitor and audit procedures to determine compliance with policies and to make recommendations for policy enhancements to the President and CEO, VPOs, Laboratory Director or other appropriate individuals within the laboratory. The ECO will assist the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratories regular internal auditing function.

The ECOs will also participate in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.

4.2.13 Chief Information Officer (CIO)

The CIO is responsible for establishing, implementing and communicating Eurofins TestAmerica's Information Technology (IT) Policies, SOPs and Manuals. Other responsibilities include coordinating new technologies, development of electronic communication tools such as Eurofins TestAmerica's intranet and internet sites, ensuring data security and documentation of software, ensuring compliance with the NELAC standard, and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various Eurofins TestAmerica facilities.

4.2.14 Environmental Health and Safety Managers (Corporate)

The EHS Managers report directly to the VP-QA/EHS. The EHS Managers are responsible for the development and implementation of the Eurofins TestAmerica Environmental, Health and Safety program. Responsibilities include:

- Consolidation and tracking all safety and health-related information and reports for the company, and managing compliance activities for Eurofins TestAmerica locations.

- Coordination/preparation of the corporate Environmental, Health and Safety Manual Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/ CHP.
- Preparation of information and training materials for laboratory EHS Coordinators.
- Assistance in the internal and external coordination of employee exposure and medical monitoring programs to insure compliance with applicable safety and health regulations.
- Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management.
- Serving as Hazardous Waste Management main contact and providing technical assistance to location management.

4.2.15 Laboratory Director/Lead Technical Manager

Eurofins TestAmerica Edison's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their respective VPO. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

Specific responsibilities include, but are not limited to:

- Serves as lead Technical Manager for all fields of testing.
- Ensures that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensures that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensures Eurofins TestAmerica's human resource policies are adhered to and maintained.
- Ensures that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Ensures that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Monitors standards of performance in quality control and quality assurance.
- Monitors the validity of analyses performed and data generated in the lab to assure reliable data.
- Reviews and approves all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.
- Interfaces with Project Management and Customer Service to forecast receipts, provide quality analytical data to clients and meet on-time delivery dates.

- Ensures that the facility has appropriate Information Technology resources and that they are used effectively to support operational requirements.
- Actively participates in the process of sharing and adopting best practices within Eurofins TestAmerica. Provides technical assistance to other Eurofins TestAmerica laboratories as needed to improve productivity and customer service.
- Ensures client specific reporting and quality control requirements are met.
- Captains the management team, consisting of the QA Manager, the Operations Manager, the Laboratory Client Services Manager, the Client Services Manager, the Service Center Manager, the Environmental, Health and Safety Manager and the Support Services Manager as direct reports.

4.2.16 Quality Assurance (QA) Manager

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 their Corporate Quality Director. 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 the QA officers 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)

4.2.17 Quality Assurance (QA) Specialist

The Quality Assurance (QA) Specialist is responsible for performing data audits, special audits, assisting with external and systems audits, overseeing the maintenance of QC records, certifications, Standard Operating Procedures (SOPs), training records, DOCs, arranging and managing PT samples. Additional responsibilities may include assisting with systematic problems within the laboratory, assisting in reviewing and/or writing of Quality Assurance Project Plans, and technical and QC specifications in contracts and other functions in support of the QA Manager's responsibilities as assigned.

- Assist QA Manager in conducting QA training courses, including ethics training.
- Performs data audits.

- Assist in performing special audits as deemed necessary by data audits, client inquiries, etc.
- Assisting in, conducting and responding to external audits conducted by clients and regulatory agencies.
- Assisting in reviewing and/or writing of Quality Assurance Project Plans, and technical and QC specifications in contracts.
- Maintaining all necessary laboratory certifications.
- Arranging and managing PT samples.
- Reviewing laboratory SOPs. Writing SOPs as needed.
- Maintaining historical indices of all technical records including SOPs, QC records, laboratory data, etc.
- Ensuring maintenance of records archives.
- Assisting in and monitoring laboratory's method compliance.
- Ensuring maintenance of DOCs for all analysts.
- Ensuring maintenance of training records for all employees.
- Assisting in identification of systematic problems within laboratories.
- Recommends resolutions for ongoing or recurring nonconformance.
- Providing statistical feedback to Departments on error rates, and assisting in identifying systematic improvements to minimize errors.
- Assists in tracking of customer complaints, providing statistical feedback to the laboratory, and assisting in identifying improvements.
- Overseeing and reviewing MDL studies.
- Ensuring control charts are generated; oversees and approves setting of control limits.
- Assists in monitoring new regulations and communicating them to the laboratory.

4.2.18 Operations/Technical Manager(s)

The Organics and Inorganics Operations/Technical Managers report directly to the Laboratory Director (throughout this text the term 'Technical Manager' refers to these individuals).. He/she is accountable for all analyses and analysts under their experienced supervision The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs

to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.

- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- 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.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- 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.
- Coordinates audit responses with the QA Manager.

4.2.19 Department Manager(s)

The Department Managers manage and direct the analytical production sections of the laboratory and act as Technical Manager of their department. He/She reports directly to either the Organics or Inorganics Operations/Technical Manager (as applicable). He/She assists the Operations/Technical Manager in determining the most efficient instrument utilization. More specifically, he/she:

- Evaluates the level of internal/external non-conformances for all departments.
- Continuously evaluates production capacity and improves capacity utilization.
- Continuously evaluates turnaround time and addresses any problems that may hinder meeting the required and committed turnaround time from the various departments.

- Develops and improves the training of all analysts in cooperation with the Operations/Technical Manager and QA Manager and in compliance with regulatory requirements.
- Ensures that scheduled instrument maintenance is completed.
- Is responsible for efficient utilization of supplies.
- Constantly monitors and modifies the processing of samples through the departments.
- Fully supports the quality system and, if called upon in the absence of the QA Manager, serves as his substitute in the interim.

4.2.20 Environmental, Health and Safety Manager

The Environmental, Health and Safety Manager reports directly to the VP of Quality, Environmental, Heath and Safety. The duties of this position consist of:

- Supervises the Environmental, Health and Safety/Facilities Team.
- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Material Safety Data Sheet (MSDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is “reasonable” and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by Eurofins TestAmerica’s medical consultants.
- Staying current with the hazardous waste regulations.
- Continuing training on hazardous waste issues.
- Reviewing and updating annually the Hazardous Waste Contingency Plan in the Environmental Health & Safety Manual.

- Auditing the staff with regard to compliance with the Hazardous Waste Contingency Plan.
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.

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4.2.21 EH&S/Facilities Coordinator

The EH&S/Facilities Coordinator reports directly to the Laboratory Director with a dotted line to the Environmental, Health and Safety Manager. The duties of this position consist of:

- Monitors laboratory for unsafe conditions or acts to keep lab in compliance with the Chemical Hygiene Plan, EH&S Procedures, and company policies.
- Ensures the proper personal protective equipment is available and personnel are properly trained in its use.
- Assists the Environmental, Health and Safety Manager in the investigation of accidents, incidents, and near misses and identifies and eliminates root cause.
- Conducts monthly facility inspections for compliance with health, safety and environmental regulations and procedures. Completes and forwards monthly inspection report to safety committee and laboratory management for corrective actions.
- Conducts safety equipment checks to ensure proper working order and sufficient inventory.
- Plans and tracks completion of monthly general awareness training sessions and compliance training, including new employee EH&S orientation.
- Coordinates emergency response team to provide prompt medical attention and stabilize emergency situation. After emergency is over, assists in determining appropriate clean up procedures.
- Conducts the monthly EH&S committee meeting.
- Participates in monthly EH&S conference call.
- Reviews and maintains MSDS's for laboratory materials.
- Coordinates the management and disposal of laboratory wastes.
- Assists in the preparation and maintenance of the laboratory Integrated Contingency Plan.
- Monitors air quality in facility, including monitoring fume hoods for proper operation and ventilation.
- Maintains overall building facilities and equipment as well as administers prevention maintenance measures.
- Contacts outside contractors as necessary to repair/maintain items outside the realm of reasonable maintenance.
- Performs miscellaneous errands, buying parts for labs, janitorial supplies.
- Oversees storage facilities, files and outside storage.

4.2.22 Laboratory Analysts and Technicians

Laboratory analysts and technicians are responsible for conducting analysis and performing all tasks assigned to them by the group leader or supervisor. The responsibilities of the analysts are listed below:

- Perform analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Document standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on worklists, benchsheets, lab notebooks and/or the Non-Conformance Database.
- Report all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, the Technical Manager, and/or the QA Manager or member of QA staff.
- Perform 100% review of the data generated prior to entering and submitting for secondary level review.
- Suggest method improvements to their supervisor, the Technical Manager, and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Work cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.
- Adhere to all environmental, health and safety protocols and attend safety meetings as required.
- Attend and participate in all staff meetings.

4.2.23 Sample Control Manager

The Sample Control Manager reports to the Inorganics Operation Manager. The responsibilities are outlined below:

- Direct the logging of incoming samples into the LIMS.
- Ensure the verification of data entry from login.
- Manages the preparation and shipment of bottle kits to clients.
- Oversees the responsibilities of all Sample Control Technicians.
- Supervises the storage and disposal of all samples.

4.2.24 Senior Client Services Director

The Senior Client Services Director reports to the Vice President of Operations and Client Services with a dotted line to the laboratory director and serves as the primary interface between the laboratory and the Sales and Marketing staff. Responsibilities include:

- Laboratory's primary client representative.
- Ensures client complaints are handled professionally, and resolved in a timely manner.
- Compiles and interprets receipts forecast to show near term business trends.
- Manages a minimal list of projects/programs for key client accounts. (Note: sufficient time is needed to manage the PM group and the CSM must not be overwhelmed with project management.)
- Prepares proposals for new business opportunities.
- Compiles and interprets Bid Activity Report.
- Compiles and interprets receipts forecast to show near term business trends.
- Prepares proposals for new business opportunities.
- Provides general sales support to Account Executives for business development activities started in the field.
- Develops and maintains business materials and organized information resource files that include project descriptions, resumes, original proposals, boilerplates, and company qualifications materials.

4.2.25 Manager of Project Managers

The Manager of Project Managers reports to the Senior Client Services Director and serves as the interface between the laboratory's technical Departments and the laboratory's clients. The staff consists of the Project Management team. With the overall goal of total client satisfaction, the functions of this position are outlined below:

- Technical training and growth of the Project Management team.
- Technical liaison for the Project Management team.
- Human resource management of the Project Management team.
- Responsible for ensuring that clients receive the proper sampling supplies, as appropriate.
- Accountable for response to client inquiries concerning sample status.
- Responsible for assistance to clients regarding the resolution of problems concerning COC.
- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notifying the supervisors of incoming projects and sample delivery schedules.
- Accountable to clients for communicating sample progress in daily status meeting with agreed-upon due dates.
- Responsible for discussing with client any project-related problems, resolving service issues, and coordinating technical details with the laboratory staff.

- Responsible for staff familiarization with specific quotes, sample log-in review, and final report completeness.
- Monitor the status of all data package projects in-house to ensure timely and accurate delivery of reports.
- Inform clients of data package-related problems and resolve service issues.
- Coordinate requests for sample containers and other services (data packages).

4.2.26 Project Manager (PM)

The Project Managers report directly to the Director of Project Management and serve as liaisons between the laboratory and its clients. The Project Manager's responsibilities include:

- Ensure client specifications are met by communicating project and quality assurance requirements to the laboratory.
- Notify laboratory personnel of incoming projects and sample delivery schedules.
- Monitor the status of all projects in-house to ensure timely delivery of reports.
- Inform clients of project-related problems, resolving service issues and coordinating technical issues with the laboratory staff.
- Accountable for response to client inquiries concerning sample status.
- Responsible for assistance to clients regarding the resolution of problems concerning COC.
- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notifying the supervisors of incoming projects and sample delivery schedules.
- Coordinate client requests for sample containers and other services.
- Schedule sample pick-ups from client offices or project sites and notifying the laboratory staff of incoming samples.
- Coordinate subcontract work.
- Respond to client inquiries concerning sample status.
- Generates final laboratory reports and has signature authority for those reports (as designated and approved by the Laboratory Director).
- Performs final completeness review of data packages prior to release to client.

4.2.27 Project Management Assistant

The Project Management Assistant coordinates and monitors scheduling, timely completion and maintenance of project documentation files and completion of project set up and final report review, invoicing, and EDD's. Assists the Project Manager in servicing the client's needs. Specific responsibilities include:

- Reviews login confirmation reports for accuracy and corrects as needed.

- Generates diskettes for electronic data deliverables (EDD's) for electronic delivery to clients.
- Enters data that was subcontracted to other laboratories.
- Monitors report due dates for timely delivery.
- Assists Project Manager in changing compound lists, TAT, deliverables and other client specific requirements in the LIMs project and/or job database.
- Invoices completed data packages and generates credit or debit invoices to ensure proper payment.

4.2.28 Service Center Manager

The Service Center Manager (SCM) manages the service center and acts as a liaison between the laboratory and the local client base. The SCM is in charge of maintaining the Service Center facility, managing service center couriers, samplers and other personnel, and working with sales to develop, maintain and grow the client base in the area.

- Local area primary client representative for service center location.
- May head project start up meetings to ensure project objectives are successfully met and hands off project detail to assigned Project Manager(s).
- Works with the Quality Assurance Manager and Account Executives (AE) to evaluate and establish project requirements for the service center area.
- Ensures client complaints are handled professionally, and resolved in a timely manner.
- Is in charge of scheduling service center couriers and samplers, preparing bottle orders for delivery, scheduling sample pick ups and shipping samples to the designated laboratory for analysis.
- May manage a minimal list of projects/programs for key client accounts.
- Maintains the facilities at the service center and is responsible for all EH&S policies of Eurofins TestAmerica at the service center.
- Responsible for all company vehicles that operate out of the service center.
- Provides general sales support to AEs for business development activities started in the field.

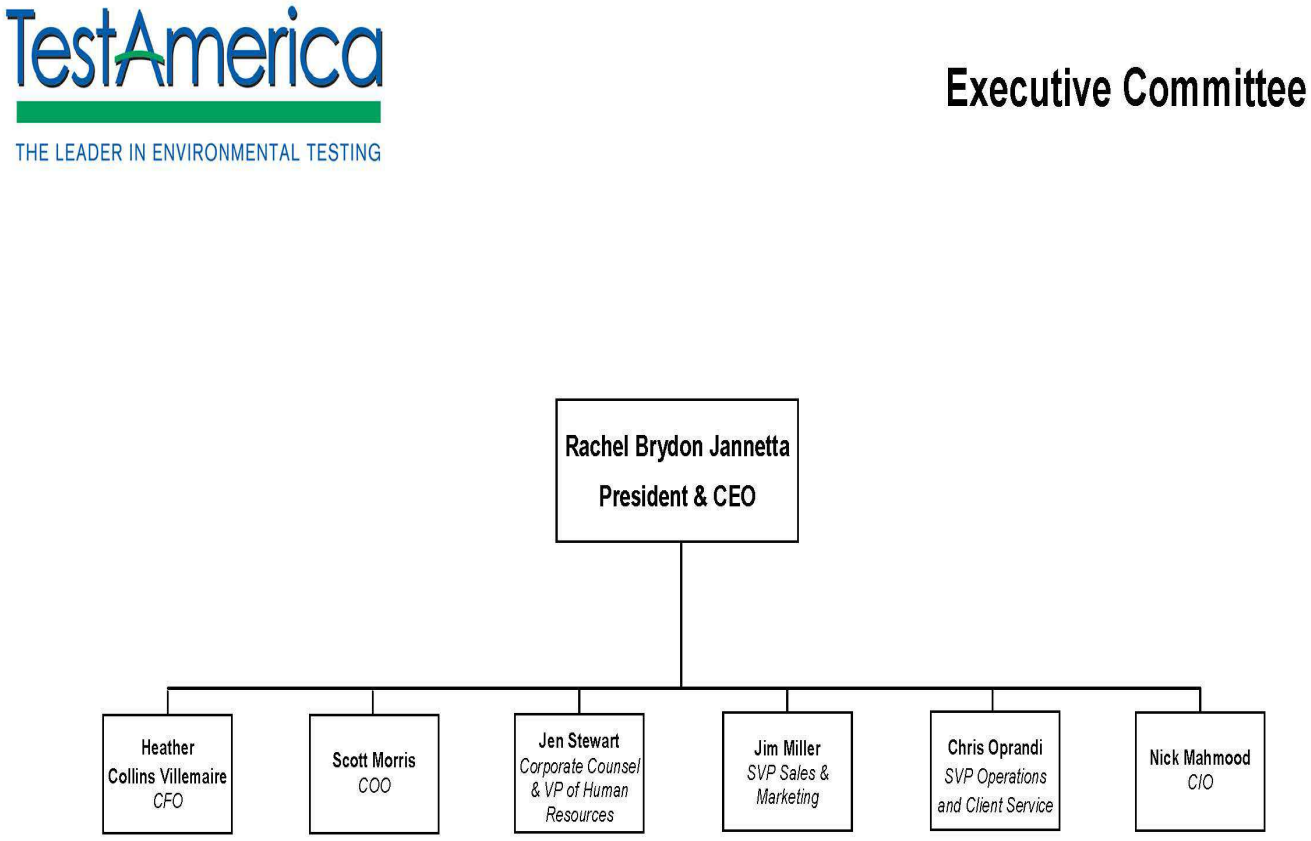
4.3 Deputies

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Mark Acierno Laboratory Director	In the event of absence the Laboratory Director's responsibilities are shared by the Laboratory Operations Manager, the Quality Assurance Manager and the Client Services Manager, as appropriate

Key Personnel	Deputy
Carl Armbruster Quality Assurance Manager	Emmylou Digiacomo Quality Assurance Specialist Mark Acierno Laboratory Director
Sylvanus Klusey Organic Technical Manager	Donald Evans Inorganic Technical Manager
Donald Evans Inorganic Technical Manager	Sylvanus Klusey Organic Technical Manager
VOA, SVOA & Organic Prep Technical Managers	Sylvanus Klusey Organic Technical Manager
Wet Chemistry, Metals and Sample Control Managers	Donald Evans Inorganic Technical Manager
Dan Helfrich EH&S Manager	Edward Roche EH&S Coordinator
Mark Nemec Client Services Manager	Kristyn Tempe Manager of Project Managers
John Kates (acting) South Jersey/King of Prussia Service Center Manager	Alonzo Hall, Sample Control Tech. South Jersey Service Center Jeffery Keehn, Sample Control Tech. King of Prussia Service Center
John Kates Fields Services Manager	Stephen Schulze Thomas Lesinski Field Specialists – Edison Rick Toogood Dustin Miller Field Specialists – South Jersey

Figure 4-1. Corporate and Laboratory Organization Charts



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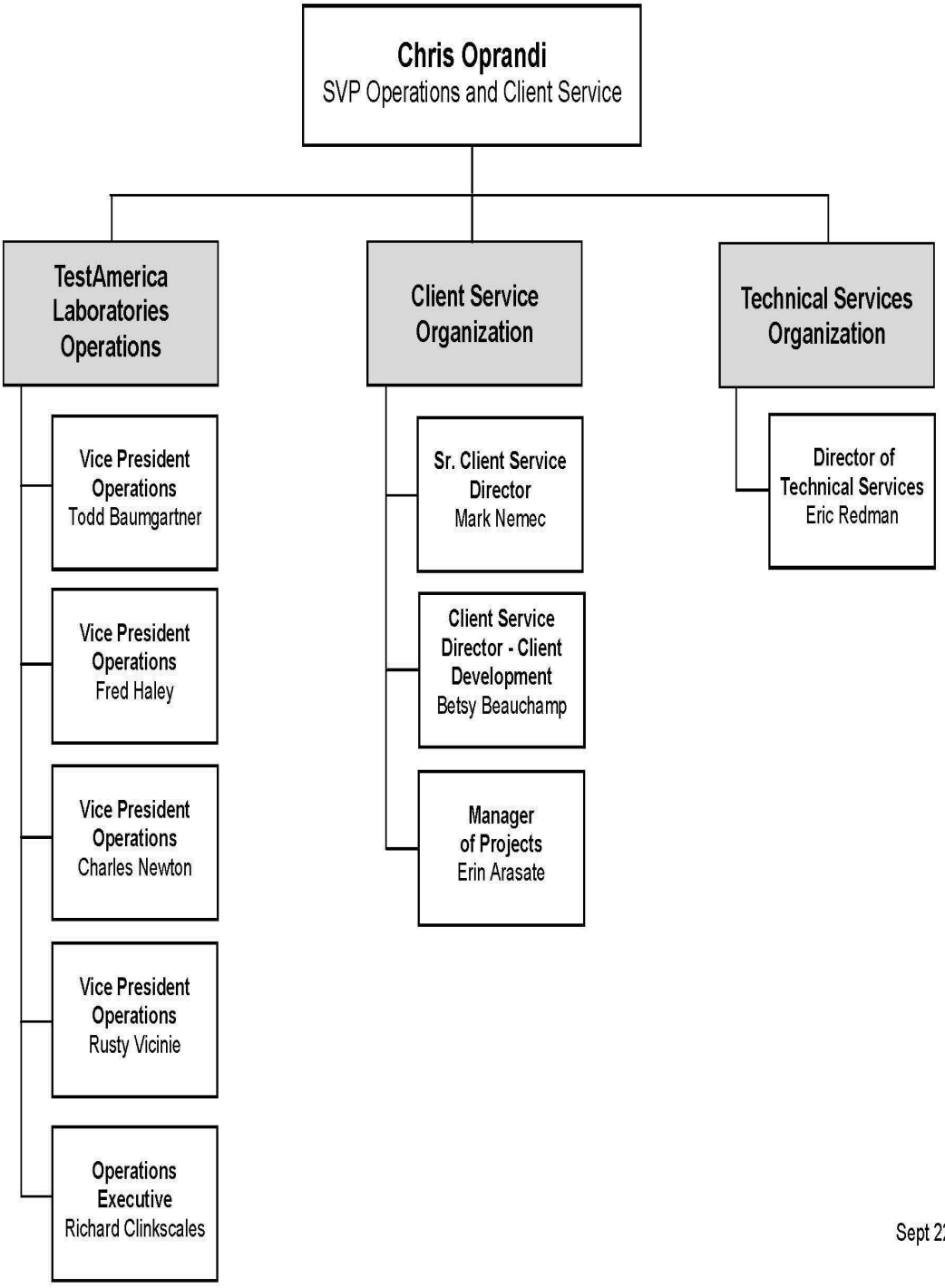
TestAmerica Laboratories Operations and Client Service



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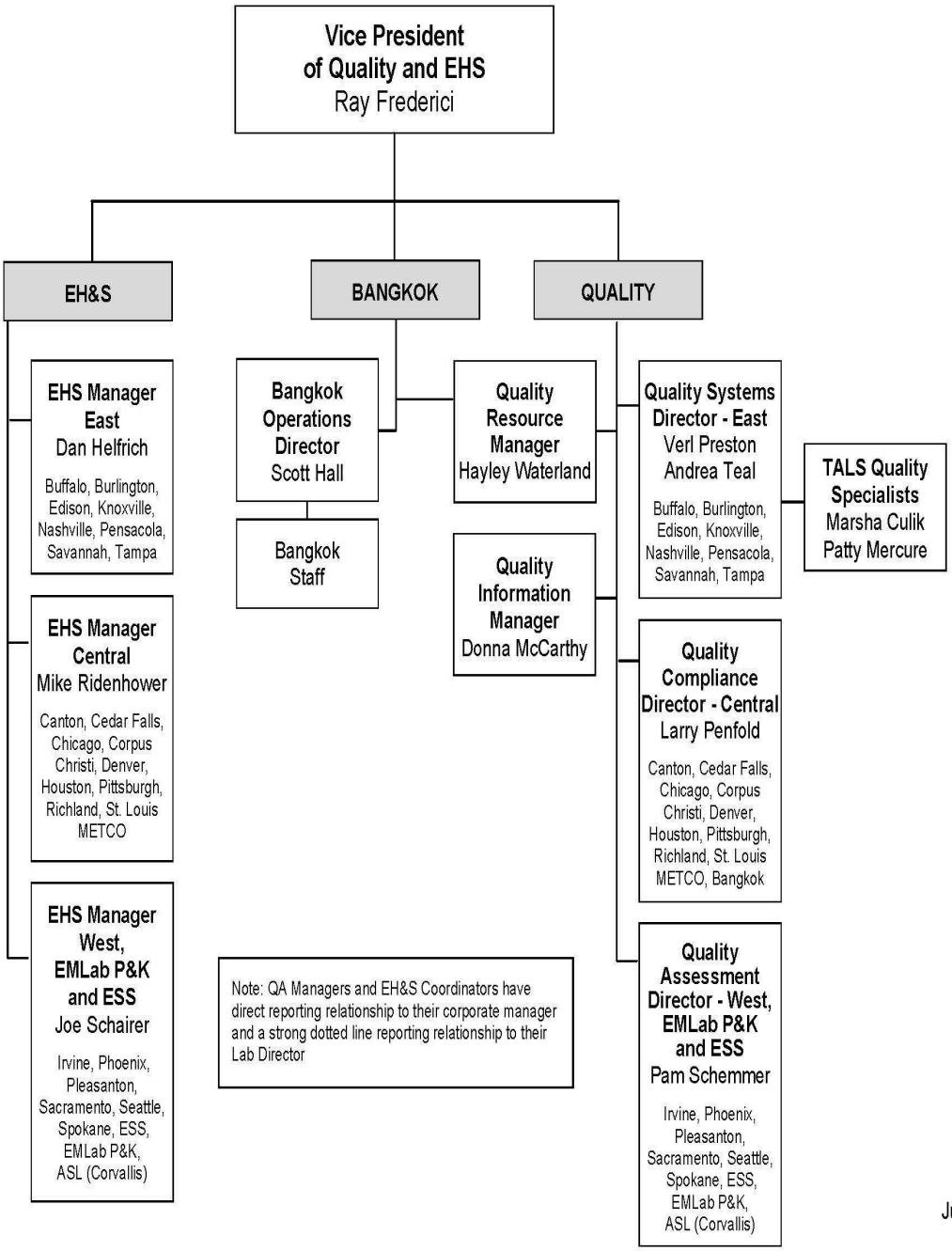
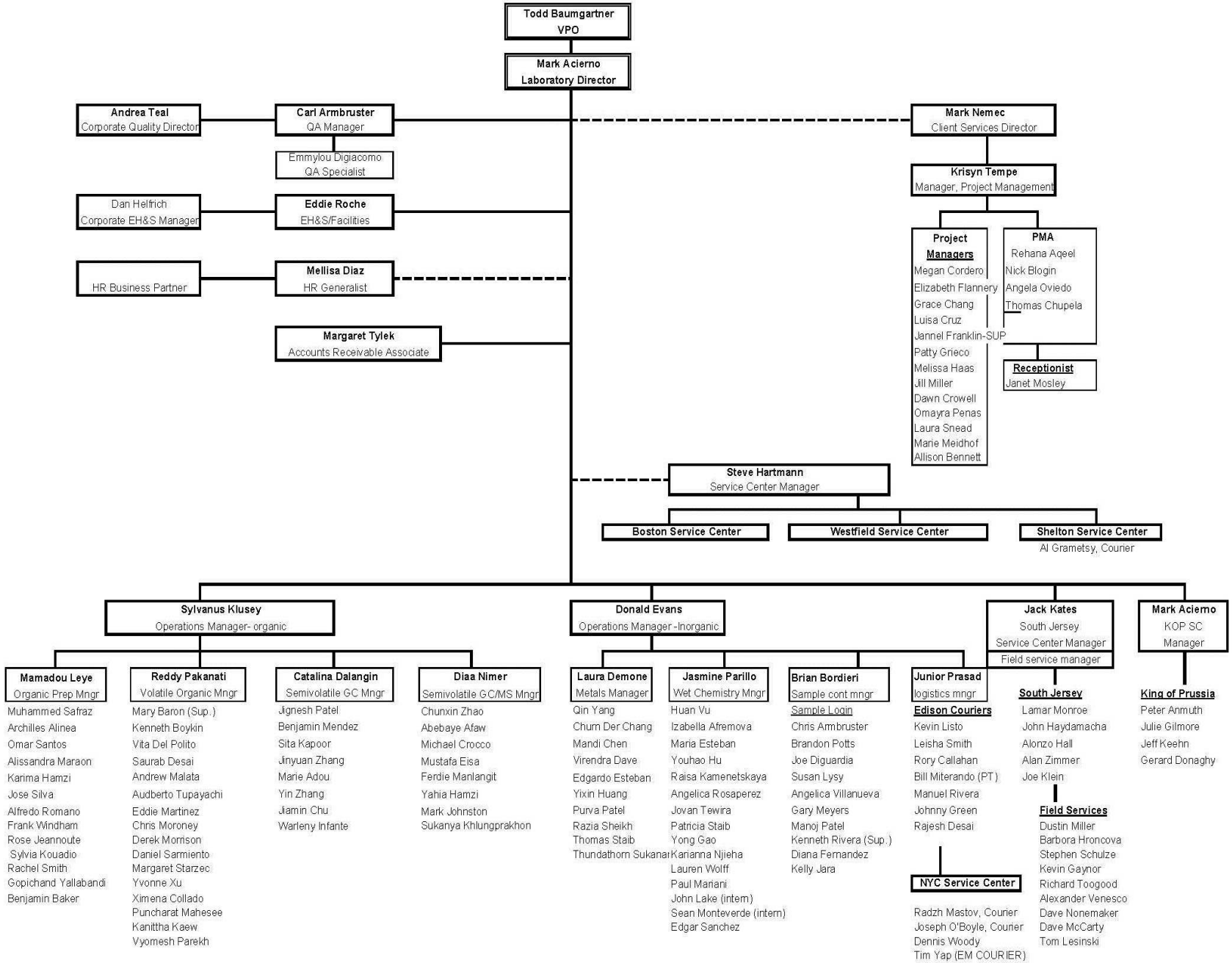
Quality, EHS, Bangkok



June 5, 2017

TestAmerica Edison Organization



SECTION 5. QUALITY SYSTEM

5.1 Quality Policy Statement

It is Eurofins 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. Eurofins 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

Eurofins TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of Eurofins 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. CA-Q-S-005).
- 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 the QAPP. 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 being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

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 is 90% (or as specified by a particular project), 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 (Method Detection Limit) or quantified (Reporting Limit).

5.5 Criteria for Quality Indicators

The laboratory maintains Quality Control Limits within the Method Limit Group tables in TALS (the laboratory's LIMS) that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated and are managed by the laboratory's QA department. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits 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. Criteria for development of control limits is contained in Section 24.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs [such as the Ohio Voluntary Action Plan (VAP)]. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts are instructed to use the current limits in the laboratory (dated and approved by the Technical Manager and QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance Department maintains an archive of all limits used within the Method Limit Group tables in TALS (LIMS). If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. 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 QA Manager generates QC charts using the TALS Control Chart program as detailed in SOP No. ED-GEN-026 (Evaluation of Analytical Accuracy and Precision Through The Use of Control Charts). In addition to their use in generating lab specific spike recovery limits and in the evaluation of MDL studies, these charts are used to determine if adjustments need to be made or for corrective actions to methods. All such findings are documented and kept on file in the QA Department.

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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 No. ED-GEN-002 (Document Control).

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 maintains control of records for raw analytical data and 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 (CARs). Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

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. In order to develop a new document, a Department (Technical) 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 that document as the official document on file. That document is then provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved 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 at a minimum of every two years 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 No. ED-GEN-002 (Document Control) Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA Department. Electronic copies are stored on the Public server in the QA folder for the applicable revision.

For changes to SOPs, refer to SOP No. CW-Q-S-002, Writing a Standard Operating Procedure SOP or list your labs SOP on this topic. The SOP identified above also defines the process of changes to SOPs.

Forms, worksheets, work instructions and information are organized by department in the QA office. There is a table of contents. Electronic versions are kept on a hard drive in the QA Department; hard copies are kept in QA files. The procedure for the care of these documents is in SOP ED-GEN-002 (Document Control).

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 No. ED-GEN-002 (Document Control).

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 Eurofins 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 Eurofins 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

Appropriate personnel will review the work request 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 Client Relations Manager (CRM) or CRM Proposal Team, 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 Eurofins TestAmerica's Corporate SOP No. CA-L-P-002**,** Contract Compliance Policy.
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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 (not necessarily in the order below).

- Contract Administrator
- VP of Operations
- The Laboratory Client Services Manager
- The Laboratory Project Manager
- Laboratory and/or Corporate Technical Managers / Directors
- Laboratory and/or Corporate Information Technology Managers/Directors
- Account Executives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

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 Contracts Administrator maintains copies of all signed contracts**.** The applicable Project Manager maintains local copies of 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. These records are maintained in the project file by the Project Manager and/or Key Account Executive. 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 and the Laboratory Director.

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. The PM keeps a phone log of conversations with the client.

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, a PM is assigned 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. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

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 the laboratory during production meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Department (Technical) Manager. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

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).

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 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. Eurofins 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 Eurofins TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the Eurofins 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 Eurofins TestAmerica's Corporate SOP's on Subcontracting Procedures CW-L-S-004 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 TNI/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-TNI accredited work where required.

Project Managers (PMs), Client Service Managers (CSM) or Account Executives (AE) for the Export Lab (Eurofins TestAmerica laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting any samples. The laboratory will advise the client of a subcontract arrangement in writing and when possible approval from the client shall be retained in the project folder. Standard Eurofins TestAmerica Terms & Conditions include the flexibility to subcontract samples within the Eurofins TestAmerica laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies (e.g., USDA) or contracts require notification prior to placing such work.

8.2 Qualifying and Monitoring Subcontractors

Whenever a PM, Account Executive (AE) or Client Service Manager (CSM) 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:

- Subcontractors specified by the client - In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.
- Subcontractors reviewed by Eurofins TestAmerica – Firms which have been reviewed by the company and are known to meet standards for accreditations (e.g., State, TNI and

DoD/DOE); technical specifications; legal and financial information.

A listing of vendors is available on the Eurofins TestAmerica intranet site.

All Eurofins 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).

8.2.1 When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Client Relations Manager (CRM) or Laboratory Director. The CRM or Laboratory Director requests that the QA Manager or PM begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CW-L-S-004, Subcontracting Procedures.

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to the Corporate Quality Information Manager (QIM) for review. After the Corporate QIM reviews the documents for completeness, the information is forwarded to the Finance Department for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the intranet site and the finance group is concurrently notified for JD Edwards.

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. Eurofins TestAmerica does not certify laboratories. The subcontractors on our approved list can only be recommended to the extent that we would use them.

8.3 Oversight and Reporting

8.3.1 The status and performance of qualified subcontractors will be monitored by the Corporate Quality department. Any problems identified will be brought to the attention of Eurofins TestAmerica's Corporate Finance, Legal and 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. CSO personnel will notify all Eurofins 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 CSO Personnel, Laboratory Directors, QA Managers and

Sales Personnel.

Prior to initially 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 within the project records.

8.3.2 For continued use of a subcontractor, verification of certification is placed upon the subcontractor for the defined project. Samples are subcontracted under Chain of Custody with the program defined as 'Accreditation Required' and the following statement for verification upon sample receipt:

Note: Since laboratory accreditations are subject to change, Eurofins TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under Chain of Custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analytes/tests/matrix being analyzed, the samples must be shipped back to the Eurofins TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to Eurofins TestAmerica Laboratories, Inc.

For Eurofins TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

8.3.3 All subcontracted samples must be accompanied by a Eurofins TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must be available in TALS for all samples workshared within Eurofins 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-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI 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 Eurofins TestAmerica work sharing laboratory may be transferred electronically and the results reported by the Eurofins 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 full qualification of a subcontractor may be waived 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 COC.

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 Eurofins TestAmerica at this time.

The use of any emergency subcontractor will require the PM to complete a JDE New Vendor Add Form in order to process payment to the vendor and add them to TALS. This form requires the user to define the subcontractor's category/s of testing and the reason for testing.

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 Eurofins TestAmerica's Capital Expenditure, Controlled Purchase Requests and Fixed Asset Capitalization, SOP No. CW-F-S-007.

Contracts will be signed in accordance with Eurofins TestAmerica's Company-Wide 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 Eurofins TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow Eurofins TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the Eurofins 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, consumables, 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 Eurofins TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001. Approval information for the solvents and acids tested under SOP CA-Q-S-001 is stored on the Eurofins TestAmerica SharePoint, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location.

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. The analyst may check the item out of the on-site consignment system that contains items approved for laboratory use.

If an item is not available from the on-site consignment, the analyst must provide the master item number (from the master item list that has been approved by the Technical Manager), item description, package size, catalogue page number, and the quantity needed. If an item being ordered is not the exact item requested, approval must be obtained from the Technical Manager prior to placing the order. The Department (Technical) Manager or the Laboratory Operations Manager places the order.

9.3.2 Receiving

It is the responsibility of the purchasing manager to receive the shipment. It is the responsibility of the analyst who ordered the materials to document the date materials were received. Once the ordered reagents or materials are received, the analyst compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. This is documented through the addition of the received date and initials to the information present on the daily order log.

The purchasing manager verifies the lot numbers of received solvents and acids against the pre-approval lists. If a received material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained on the shared "public" folder on the computer network.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented.

Safety Data Sheets (SDSs) 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 the analytical Department.

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. To prevent a tank from going to dryness, or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. 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- µmho/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 files or binders 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 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 Technical Manager and/or the Laboratory Director. If they agree with the request, the procedures outlined in Eurofins 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, a unique identification name is assigned and provided to the QA Department for inclusion on the laboratory master 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 the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. 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. The service providers that perform the services are approved by the Technical Manager and/or the Laboratory Operations Managers.

Analytical balances are serviced and calibrated annually in accordance with Eurofins TestAmerica Edison SOP ED-GEN-010 (Calibration of Analytical Balances). The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. When the calibration certificates are received (usually within two weeks of the service), they are reviewed, and documentation of the review is filed with the certificates. If the calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as thermometers, weight sets, autopipettors, etc, are obtained from vendors with current and valid ISO 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department, and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory

9.6 Suppliers

Eurofins TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the 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 Eurofins 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

Eurofins 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 Eurofins TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Services 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 Eurofins TestAmerica Edison SOP No. ED-GEN-003 (Control of Non-Conformances and Corrective Action).

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to Eurofins TestAmerica Edison SOP No. ED-GEN-003 (Control of Non-Conformances and Corrective Action).

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 Quality 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. When an analyst encounters such a situation, the problem is presented to the Department (Technical) Manager for resolution. The

manager may elect to discuss it with the Lab Director and/or QA Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratories corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative 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. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Laboratory Director and QA Manager, documented and included in the project folder. Deviations **must** also be noted on the final report with a statement that the compound is not reported in compliance with TNI (or the analytical method) requirements and the reason. Data being reported to a non-TNI state would need to note the change made to how the method is normally run.

11.2 Responsibilities and Authorities

Under certain circumstances, 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 well documented using the laboratory's corrective action procedures. This information may also be documented in logbooks and/or data review checklists as appropriate**.** 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 ECO (e.g., the VP-QA/EHS) 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, VP of Operations 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.

Corporate SOP entitled Data Recalls (CW-Q-S-005) is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

Corporate SOP entitled Internal Investigations (CW-L-S-002) is the procedure to be followed for investigation and correction of situations involved alleged incidents of misconduct or violation of the company's ethics policy.

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 Eurofins TestAmerica's Corporate SOP No. CW-Q-S-005.

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. On a monthly basis, 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 VP of Operations 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, Laboratory Operations Managers, QA Manager, Department Technical 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 Eurofins 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 Eurofins TestAmerica's Incident and Corrective Action Tracker (iCAT) (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 Memo (NCM) - 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 NCMs.
- Issues found while reviewing NCMs that warrant further investigation.
- Internal and external audit findings
- 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. A 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 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. Corporate SOP Root Cause Analysis (No. CA-Q-S-009) describes the procedure.

Systematically analyze and document the root causes of the more significant problems that are reported. 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.
- Each CAR is entered into a the iCAT database for tracking purposes and a monthly summary of all corrective actions is printed out for review to aid in ensuring that the corrective actions have taken effect.
- Eurofins TestAmerica laboratories began using the Incident/Corrective Action Tracker (iCAT) database developed by the company in 2015. (Previously, a local Excel database served this purpose.) An incident is an event triggering the need for one or more corrective actions as distinct from a corrective action, a potential deficiency stemming from an incident that requires investigation and possibly fixing. The database is independent of TALS, available to all local and corporate managers, and capable of notifying and tracking multiple corrective actions per event, dates, and personnel. iCAT allows associated document upload, categorization (such as, external/internal audit, client service concerns, data quality issues, proficiency testing, etc.), and trend analysis. Refer to Figure 12-1.
- The QA Manager reviews monthly CARs 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 a CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

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 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

TestAmerica Edison - Quality Assurance

Corrective Action 8698

Incident 3098: WS0717 PT Failures
Incident Status: Closed
Response Due to Client: Sunday, Oct 8, 2017

Created By:	Carl Armbruster	Created On:	Friday, Sep 8, 2017
Laboratory Function:	Other Lab Functions	Date Follow-up Due:	
Corrective Action Type:	PT and/or Double Blind Failures	Date Follow-up Done:	
Department:	Metals	Response Due to QA:	Sunday, Oct 8, 2017
Finding Number:	1	Planned Closure Date:	Sunday, Oct 8, 2017
Is Repeat Finding?:	No	Date Closed:	Monday, Oct 16, 2017
Finding Reference:			
Assigned To/Lead:	Laura Demone		
Priority:	2 (High Importance)		
Follow-up Assigned To:			
C.A. Status:	Closed		

Issue Requiring Corrective Action:

Rec'd evaluation of 'Not Acceptable for Arsenic by EPA 200.8: Assigned value: 8.17 ug/l Reported result: 10.9 ug/l Acceptance limits: 5.72 - 10.6 ug/l. Rec'd evaluation of 'Not Acceptable for Iron by EPA 200.7: Assigned value: 304 ug/l Reported result: 218 ug/l Acceptance limits: 258 - 349 ug/l. Investigate and submit correction action plan along with completed PT corrective action checklist (attached to this iCAT item).

Investigation/Response:

Drinking water PT 460-137368 sample 12 (PT study WS0717) failed low for iron by EPA 200.7 and failed high for arsenic by EPA 200.8.

Root Cause:

PT sample results as well as instrument and batch QC samples were checked for any anomalies or issues that may have contributed to the failures. For EPA 200.7, the calibration curve and blanks look very good for iron, and QC recoveries are within the acceptable range. For EPA 200.8, the same is true, the arsenic curve and all blanks are very good and all QC recoveries are also within the acceptable range for this method. The only issue noticed in the evaluation of the 200.8 data is that the serial dilution result for arsenic went down with higher dilution. For example,. the serial dilution at 5x was 9.62 ug/L (this is high but within the acceptance limits for arsenic) and at 10x the result was 8.12 ug/L, which is essentially the assigned value of arsenic. Perhaps there was an interference (both copper and zinc needed dilution for this sample) that caused high bias for the arsenic that was removed by the dilution of the sample.

Corrective Action Plan:

As per an older corrective action response, when laboratory sample is logged in for both an ICP and an ICP-MS method, the final data is compared before reporting, and this of course is also true for PT samples. The iron result on the ICP-MS for EPA 200.8 was 301 ug/L but since iron was not logged in as a reportable analyte for this method, this data was not compared to the ICP result. The same is true for arsenic, this analyte was not reported via Method 200.7 so the data was not compared either, (the arsenic result via method 200.7 was 9.98 ug/L, which is high but within the acceptable range) Had these results been compared, the discrepancies would certainly have been noticed and investigated further. Going forward, all data will be compared between the two methods, even when only one method is actually needed for reporting purposes, and all QC data will be examined more carefully to check for possible interferences. In addition, part of the issue is simply that the metals PT samples are either started early but then not reviewed/ compared until close to the due date or they are not started until well after they are received. If there were more time to carefully review data and compare results, it is much more likely that any issues would be caught and resolved. With all future PT studies, metals samples will be digested, analyzed and reviewed within two weeks of login to TALS and if all data is acceptable, results will also be submitted in this time frame. Phenova sent a QC sample (Trace Metals QC Lot #9066-04) with the rapid response PT sample for drinking water by EPA 200.7 and 200.8 with a certified value of 933 ug/L for iron and acceptance limits of 790-1070 ug/L, and a certified value of 21.1 ug/L for arsenic and acceptance limits of 14.8-27.4 ug/L. This sample (460-140875-2) was digested and analyzed with the rapid response PT sample and we got an iron result of 1020 ug/L which is within the acceptable recovery range. We also ran this rapid response QC sample on the ICP-MS for method 200.8 arsenic and we got a result of 23.2 ug/L (this is on A468012, not identified since it is not logged in for this method in TALS) which is within the acceptable range. We also carefully checked QC recoveries on the ICP/ ICPMS and ran the samples on the ICPMS and compared the results from the two instruments as usual, so we feel confident with the rapid response results as reported. Going forward for drinking water by method 200.8, analysts have been reminded to matrix match the standards with the samples (eg, rinse water, internal standard, calibration standards all use 2% HNO3 to match non-digested drinking waters). According to the batch notes this was done in the initial run of the PT.

Corrective Action Documents (3)

iCAT3098_PT corrective action narrative checklist_WS0717_Fe_460-137368.pdf	Con4AanA4.LONG_DATE_STRING 6:58 AM
iCAT3098_PT corrective action narrative checklist_WS0717_As_460-137368.pdf	Con58AanA58.LONG_DATE_STRING 7:3 AM
iCAT3098_PT corrective action QC sample Iron_140875-2.pdf	Con29PanP29.LONG_DATE_STRING 12:32 PM

For QA Use Only

QA Comments	Follow Up
Enter a QA Comment	*Enter Follow Up*

Notifications

Location QA (notification required)

Name	Title
Carl Armbruster	Quality Assurance Manager
Emmylou DiGiacomo	Quality Assurance Specialist
Hayley Waterland	

Additional Notifications

Name	Title
Mark Acierno	Laboratory Director
Laura Demone	Department Manager I
Donald Evans	Operations Manager

Table 12-1. Example – General Corrective Action Procedures

(Individual Responsible for Initiation/Assessment)	**Acceptance Criteria**	**Recommended Corrective Action**
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc..
Initial Calibration Standards *(Analyst, Technical Manager(s))*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - 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 control limits.	- 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)*	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in TALS Method Limit Groups.	- 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.

(Individual Responsible for Initiation/Assessment)	**Acceptance Criteria**	**Recommended Corrective Action**
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in TALS Method Limit Groups.	- 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 of method or within three standard deviations of the historical mean.	- 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	- 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.

(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-Q-S-005, Data Recall	- Corrective action is determined by type of error. Follow the procedures in SOP CW-L-S-002 or Eurofins TestAmerica Edison's Corrective Action SOP (ED-GEN-003),
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.

Note:

1. See specific method SOPs for blank acceptance criteria. Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalate.. This allowance presumes that the detection limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur.

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, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- review of the monthly QA Metrics Report,
- trending NCMs,
- review of control charts and QC results,
- trending proficiency testing (PT) results,
- performance of management system reviews,
- trending client complaints,
- review of processing operations, or
- staff observations.

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. The metrics report is reviewed monthly be the laboratory management, Corporate QA and Eurofins TestAmerica's Executive Committee. These metrics are used ~~to~~ in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lesson Learned, Technical Services audit report, Technical Best Practices, or as Corporate or management initiatives.

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 and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action/process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvement.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/process Improvement is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions/Process Improvement 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. Through these various tracking indicators, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of indicators monitored under this collective system include:

- SOP Tracking
  Current Revisions w/ Effective Dates
  Required Biennial Revisions w/ Due Date

- Proficiency Testing (PT) Sample Tracking
  Pass / Fail – most current 2 out of 3 studies.

- Instrument / Equipment List
  Current / Location

- Accreditations
  New / Expiring

- Method Capabilities
  Current Listing by program (e.g., Potable Water, Soils, etc.)

- Key Personnel
  Technical Managers, Department Supervisors, etc..

These items are maintained on Eurofins TestAmerica's Intranet (Proposal Library) or on our internal database (TotalAccess) which uploads to our company internet site

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. Exceptions for programs with longer retention requirements are discussed in Section 14.1.2.

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. More detailed information on retention of specific records is provided in CW-L-P-001, Records Retention Policy and CW-L-WI-001, Eurofins TestAmerica Records Retention/Storage Schedule. Quality records are maintained by the QA department in a database, which is backed up as part of the regular laboratory backup. Records are of two types; either 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 Laboratory Operations under the direction of the Laboratory Operations Managers.

Table 14-1. Record Index[1]

	Record Types [1]:	**Retention Time:**
Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals - Published Methods	Indefinitely
	- Certifications - Method and Software Validation / Verification Data	Indefinitely
	- Internal & External Audits/Responses - Corrective/Preventive Actions - Management Reviews -- 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)

	Record Types [1]:	Retention Time:
Records	- Sample Receipt & COC Documents - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*
Records	Financial and Business Operations	Refer to CW-L-WI-001
	EH&S Manual, Permits	Indefinitely
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	Refer to HR Manual
	Administrative Policies	Indefinitely
	Technical Training Records	7 years
	Legal Records	Indefinitely
	HR Records	Refer to CW-L-WI-001
	IT Records	Refer to CW-L-WI-001
	Corporate Governance Records	Refer to CW-L-WI-001
	Sales & Marketing	5 years
	Real Estate	Indefinitely

[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 which 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. 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	10 years (lab reports and raw data) 10 years - Radiochemistry (project records)
Drinking Water Lead and Copper Rule	12 years (project records)
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement
OSHA	30 years

[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. For additional details please refer to refer to Eurofins TestAmerica Edison SOP No. ED-GEN-024 (Record Storage and Retention).

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. The laboratory's copy of the COC is stored with the invoice and the work order sheet generated by the LIMS.The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.

- 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 purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set. Reference Eurofins TestAmerica Edison SOP No. ED-GEN-024 (Record Storage and Retention).

- Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method; a copy of each day's run log or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. 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. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing results.

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. Operating conditions/parameters are typically recorded in instrument maintenance logs where available.
- analysis type**;**
- all manual calculations and manual integrations**;**
- analyst's or operator's initials/signature**;**
- sample preparation including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents**;**
- 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. These are indicated both in the LIMS and on specific analytical report formats**.**

14.2.4 All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a documented supervisory or peer review on a monthly basis.

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. Laboratory notebooks are issued on a per analysis basis, and are numbered sequentially. All data are recorded sequentially within a series of sequential notebooks. Bench sheets are filed sequentially. Standards are maintained in the LIMS – no logbooks are used to record that data**.** Records are considered archived when noted as such in the records management system (a.k.a., document control.)

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 Eurofins TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CW-Q-S-003. 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 QA Technical Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	QA Technical Audits Frequency: 50% of methods annually

Description	Performed by	Frequency
SOP Method Compliance	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CW-Q-S-003)	SOP Compliance Review Frequency: • Every 2 years
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 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, Eurofins TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, 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 assess data authenticity and analyst integrity. These 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., Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period. All analysts should be reviewed over the course of a two year period through at least one QA Technical Audit

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 Technical Manager or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

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: Drinking Water, Non-potable Water, Soil and Hazardous Waste.

It is Eurofins 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 Eurofins 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 using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Technical Managers 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 VP of Operations. 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, VP of Operations 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 VPs of Operations.

16.2 Annual Management Review

The senior lab management team (Laboratory Director, Technical Managers, 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. Corporate Operations and Corporate

QA personnel is be included in this meeting at the discretion of the Laboratory Director. 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 cannot be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CW-Q-S-004 and Work Instruction No. CW-Q-WI-003) 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 VP of Operation 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. Eurofins TestAmerica's Corporate

Internal Investigations 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.

Eurofins TestAmerica's President and CEO, Executive VP of Operations, VP of Client & Technical Services, VPs of Operations and Quality Directors receive a monthly report from the VP-QA/EHS summarizing any current data integrity or data recall investigations. The VPs of Operations 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 Eurofins 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 Eurofins TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc., are also considered).

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
Department Managers (i.e,Technical Managers) - **General**	Bachelor's Degree in an applied science or engineering with 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
Department Managers (i.e,Technical Managers)– **Wet Chem** only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Technical Manager, 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 violations). This information is maintained in the employee's secured personnel file.

Further details of the laboratory's training program are described in the Laboratory Training SOP (Eurofins TestAmerica Edison SOP No. ED-GEN-022).

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 Eurofins TestAmerica and is provided for each employee at Eurofins 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 Eurofins TestAmerica places on maintaining high ethical standards at all times; Eurofins 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 Eurofins TestAmerica's ability to do work on Government contracts, and for that reason, Eurofins 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 Eurofins TestAmerica and administered by the Corporate Quality Department.

SECTION 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 42,000 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. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory.

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 keys 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.

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 Eurofins 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 (annually for Drinking Water and DoD/DOE SOPs), and where necessary, 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:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; 40CFR Part 136 as amended by Method Update Rule; May 18, 2012.*
- *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.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *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; Final Update V, August 2015.*
- *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)* ***(DW labs only)***
- *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) (reference Eurofins TestAmerica Edison Training SOP No. ED-GEN-022) is performed whenever there is a change in instrument type (e.g., new instrumentation), matrix, method or personnel (e.g., analyst hasn't performed the test within the last 12 months).

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

The initial demonstration of capability must be thoroughly documented and approved by the Department Manager (i.e., 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 must 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.

Methods on line prior to the effective date of this Section shall be updated to the procedures outlined above as new analysts perform their demonstration of capability. A copy of the new record will replace that which was used for documentation in the past. At a minimum, the precision and accuracy of four mid-level laboratory control samples must have been compared to the laboratory's quality control acceptance limits.

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. Detection limit studies are conducted as described in Section 19.7 below. Where other protocols for estimations and/or demonstrations of sensitivity are required by regulation or client agreement, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Limit of Quantitation (LOQ) –An important characteristic of expression of sensitivity is the distinction between the LOD and the LOQ. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The LOQ is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias, equivalent to the laboratory's routine reporting limit (RL). 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 LOQ. 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 LOQ, 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.

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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)

The MDL is the minimum measured quantity of a substance that can be reported with 99% confidence that the concentration is distinguishable from method blank results, consistent with 40CFR Part 136 Appendix B, August, 2017. The MDL is equivalent to the TNI LOD, and is also equivalent to the DoD/DOE Quality Systems Manual (QSM) DL. The working or final MDL is the higher of the MDL value determined from spikes (MDLs) and the MDL value determined from blanks (MDLb). An initial MDL study shall be performed during the method validation process and when the method is altered in a way that can reasonably be expected to change its sensitivity. On-going data are collected during each quarter in which samples are being analyzed. At least once every 13 months the MDLs and MDLb are re-calculated and re-evaluated using data collected during the preceding period. Details of Eurofins TestAmerica's procedure for conducting MDL studies are given in SOP # CA-Q-S-006).

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.

19.9 Limit of Quantitation (LOQ)

The LOQ shall be at a concentration equivalent to the lowest calibration standard concentration, with the exception of methods using a single-point calibration, and shall be greater than the MDL. The LOQ is verified by preparing and analyzing spikes at concentrations two (2) times or less than the selected LOQ, employing the complete analytical process.

19.10 Verification of Detection and Reporting Limits

Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, Atomic Absorption, etc.) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does 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 MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually

When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit and annually thereafter. The annual requirement is waived for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

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19.11 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. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory SOPs.

19.12 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.

19.13 Estimation of Uncertainty of Measurement

19.13.1 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.

19.13.2 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.

19.13.3 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.

19.13.4 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 uncertainties at approximately the 99% confidence level with a coverage factor of k = 3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 +/- 0.5 mg/L.

19.13.5 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.

19.14 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 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 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.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Area Supervisor *or* Laboratory Director if unsure.

19.15 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.

19.15.1 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 the Eurofins TestAmerica Corporate IT SOPs and in Eurofins TestAmerica Edison SOPs No. ED-GEN-001 (Data Management and Handling Procedures) and ED-GEN-002 (Document Control). The laboratory is currently running the TALS LIMS which is a custom in-house developed LIMS system that 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 Microsoft SQL Server which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.15.1.1 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.

19.15.1.2 **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.

19.15.1.3 **Maintain Confidentiality** – Ensure data confidentiality through physical access controls such as password protection or website access approval when electronically transmitting data.

19.15.2 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.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Technical Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the Eurofins TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices*.

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.

19.15.2.1 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.

19.15.2.2 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.

19.15.2.3 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 2 significant figures on the final report.

19.15.2.4 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.

19.15.2.5 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.

19.15.3 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 Department Technical Manager/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.15.4 Review / Verification Procedures

Review procedures are out lined in several SOPs (including but not limited to, Eurofins TestAmerica Edison SOP Nos. ED-GEN-021: Data Review, ED-SPM-001:Login, and ED-RP-001:Reports Production) 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 general review concepts are discussed below, more specific information can be found in the SOPs

19.15.4.1 Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the

project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

19.15.4.2 First Level Data Review - The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's analytical run, evaluation of QC data, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

19.15.4.3 Second Level Data Review – All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

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

19.15.4.4 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Director/Manager, Technical Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.15.4.5 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

19.15.4.6 As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and 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 the COC is

followed, cover letters / narratives are present, flags are appropriate, and project specific requirements are met. The Project Manager may also evaluate the validity of results for different test methods given expected chemical relationships.

19.15.4.7 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.

19.15.5 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 Eurofins TestAmerica's Corporate SOP (CA-Q-S-002).

19.15.5.1 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.

19.15.5.2 Analysts shall not increase or decrease peak areas 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 principles and policy and is grounds for immediate termination.

19.15.5.3 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.

19.15.5.4 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

DEMONSTRATION OF CAPABILITIY (DOC)

Laboratory Name:_____
Laboratory Address:_____
Method:_____ Matrix:_____
Date:_____ Analyst(s):_____
Source of Analyte(s):_____

Analytical Results

Analyst	Conc. (Units)	Rep 1	Rep 2	Rep 3	Rep 4	Avg. % Recovery	% RSD

% RSD = Percent relative standard deviation = standard deviation divided by average % Recovery

Raw data reference: _____

Certification Statement:

We, the undersigned, certify that:
1. The cited test method has met Demonstration of Capability requirements.
2. The test method was performed by the analyst(s) identified on this certification.
3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on site.
4. The data associated with the method 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, and the associated information is well organized and available for review.
6.

_____ _____
Analyst Signature Date

_____ _____
Technical Manager Signature Date

_____ _____
Quality Assurance Coordinator Signature Date

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. The most current list of laboratory instrumentation can be found in Eurofins TestAmerica Edison Work Instruction No. ED-WI-002 (Equipment Inventory).

Equipment is only operated by authorized and trained personnel. Manufacturer's 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 Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

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.

At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) 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 $\pm$ 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 at a specific frequency with a NIST-traceable thermometer. Liquid-in-glass devices are calibrated annually. IR thermometers, digital probes and thermocouples are calibrated quarterly.

- If the temperature measuring device is used over a range of 10℃ or less, then a single point verification within the range of use is acceptable;
- If the temperature measuring device is used over a range of greater than 10℃, then the verification must bracket the range of use.

IR thermometers, digital probes and thermocouples are calibrated quarterly. IR Thermometers should be calibrated over the full range of use, including ambient, iced (4^{o}C) and frozen (0^{o}C to -5^{o}C), per the Drinking Water Manual.

The 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 method-specific logbooks. More information on this subject can be found in the laboratory SOP No. ED-GEN-014 (Thermometer Calibration***).***

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 working day.

Ovens, waterbaths and incubators are monitored on days of use.

Each piece of equipment has a unique identification number, and is assigned a thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and $\leq$ 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 Daily Temperature Logbooks and method-specific logbooks.

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 cannot be used for any quantitative measurements. Refer to Eurofins TestAmerica Edison SOP No. ED-GEN-011 (Calibration and Use of Lab Pipettes).

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.

20.3.6 Field Sampling Devices (Isco Auto Samplers)

Each Auto Sampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is also recorded on the sampling documentation.

The Auto Sampler is calibrated as needed based on manufacturer's recommendations.

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 initially and as needed after that and at least annually *(the annual requirement does not apply to Isotope dilution).*

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 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 (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exceptions to these rules. ICP and ICPMS methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of daily calibration 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 then bracketing standards are not required, only daily verifications are needed (unless otherwise specified in the source method). 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 under the following special conditions:

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).

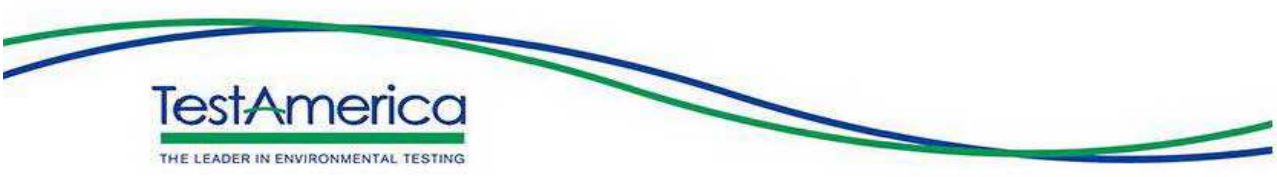
For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

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



TestAmerica Edison Instrument List

Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Metals Department					
ICP (ICP5)	Thermo Jarrell Ash	ICAP 6500 DUO View	IC5D20121709	2012	New
ICP (ICP4)	Thermo Jarrell Ash	ICAP 6500 DUO View	ICP-20073407	2009	New
ICP/MS (ICPMS1)	Agilent Technologies	7500CE	JP51201560	2006	New
Heat Exchanger	Agilent Technologies	3370	G57335		
Autosampler	Cetac	G3286A	US0808108A520		
ICP/MS (ICPMS2)	Agilent Technologies	7500CX	JP82802644	2010	New
Heat Exchanger	Agilent Technologies	3370	1C1160265	2006	Used
Autosampler	Cetac	ASX500	021134A520	2006	New
ICP/MS (ICPMS3)	Agilent Technologies	G8403A	JP16121357	2016	New
Heat Exchanger	PolyScience	G3292-80000	2U1570105	2016	New
Autosampler	Agilent Technologies	G8410A	AU16101128	2016	New
Mercury Analyzer 6	Leeman Labs	Hydra II	2008 112-00064-1	2014	New
Mercury Analyzer 7	Leeman Labs	Hydra II	US17159010	2017	New
Hot Block (Hot Block 2)	Environmental Express Limited	SC-154	2391CE1273	2004	New
Hot Block (Hot Block 3)	Environmental Express Limited	SC-150	4298CEC2048	2004	New
Hot Block (Hot Block 4)	Environmental Express Limited	SC-150	4507CEC2115	2006	New
Hot Block (Hot Block 5)	Environmental Express Limited	SC-150	466CEC2183	2006	New
Hot Block (Hot Block 7)	Environmental Express Limited	SC-150	2772CDC1378	2006	New
Hot Block (Hot Block 8)	Environmental Express Limited	SC154	1423CEC1154		
Hot Block (Hot Block 9)	Environmental Express Limited	SC-150	1917CEC1155		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Hot Block (Hot Block 11) **OUT FOR REPAIR – 11/7/17**	Environmental Express Limited	DigiPrep	4102030316		
Hot Block (Hot Block 12)	Environmental Express Limited	SC-154	3098CEC1508		
Top Loading Balance (Balance #35)	Acculab	VIC-412	18255989	2005	New
Top Loading Balance (Balance #33)	Ohaus	AR5120	F0461200521139	2001	New
Semivolatile GC/MS Department					
GC/MS System (BNAMS2)					
Gas Chromatograph	Agilent Technologies	6890A	CN10447031	TBD	New
MS Detector	Agilent Technologies	5973	US44647039	TBD	New
Autosampler Tower	Agilent Technologies	7683B	US82410944	TBD	New
Autosampler Tray	Agilent Technologies	7683	US85002901	TBD	New
GC/MS System (BNAMS4)					
Gas Chromatograph	Hewlett Packard	5890 Series II	3108A34490	1986	New
MS Detector	Hewlett Packard	5971A	3114A02077	1986	New
Autosampler Tower	Hewlett Packard	7673A	3429A33228	1986	New
Autosampler Tray	Hewlett Packard	7673	3624A42191	1986	New
Controller	Hewlett Packard		2803A11211	1986	New
GC/MS System (BNAMS5)					
Gas Chromatograph	Agilent Technologies	7890A	CN10726100	2005	New
MS Detector	Agilent Technologies	5975C	US35120328	2005	New
Autosampler Tower	Agilent Technologies	7673B	CN72441261	2005	New
Autosampler Tray	Agilent Technologies	7673	CN43830668	2005	New
Controller	Agilent Technologies		CN40427800	2005	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS System (BNAMS9)					
Gas Chromatograph	Agilent Technologies	6890N	CN10349071	2004	New
MS Detector	Agilent Technologies	5973	US35120328	2004	New
Autosampler Tower	Agilent Technologies	7683	CN34433497	2004	New
Autosampler Tray	Agilent Technologies	7683	CN40327770	2004	New
Controller	Agilent Technologies		CN40427800	2004	New
GC/MS System (BNAMS11)					
Gas Chromatograph	Agilent Technologies	7890A	CN10727109	2007	New
MS Detector	Agilent Technologies	5975C	US71236621	2007	New
Autosampler Tower	Agilent Technologies	7683B	CN72441255	2007	New
Autosampler Tray	Agilent Technologies	7683	CN72544441	2007	New
Controller	Agilent Technologies			2007	New
GC/MS System (BNAMS12)					
Gas Chromatograph	Agilent Technologies	6890A	CN10531011	2012	New
MS Detector	Agilent Technologies	5975C	US52420834	2012	New
Autosampler Tower	Agilent Technologies	7683B	CN61732705	2012	New
Autosampler Tray	Agilent Technologies	7683	CN24322270	2012	New
Controller	Agilent Technologies				
GC/MS System (BNAMS13)					
Gas Chromatograph	Agilent Technologies	6890A	CN10529024	2012	New
MS Detector	Agilent Technologies	5975C	US10503712	2012	New
Autosampler Tower	Agilent Technologies	7683B	CN48320808	2012	New
Autosampler Tray	Agilent Technologies	7683	CN40327583	2012	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Controller	Agilent Technologies			2012	New
GC/MS System (BNAMS14)					
Gas Chromatograph	Agilent Technologies	7890B	CN14393167	2012	New
MS Detector	Agilent Technologies	5975C	US83131020	2012	New
Autosampler Tower	Agilent Technologies	7683B	CN759A2046	2012	New
Autosampler Tray	Agilent Technologies	7683	CN72544431	2012	New
Controller	Agilent Technologies			2012	New
GC/MS System (BNAMS15)	Agilent Technologies				
Gas Chromatograph	Agilent Technologies	9000 Intuvo	CN17010006	2015	New
MS Detector	Agilent Technologies	5977A	US1433L427	2015	New
Autosampler Tower	Agilent Technologies	7963A	CN14410091	2015	New
Autosampler Tray	Agilent Technologies	7963	CN14360040	2015	New
GC/MS System (BNAMS16)					
Gas Chromatograph	Agilent Technologies	6890N	CN10402079	TBD	New
MS Detector	Agilent Technologies	5975	US55132182	TBD	New
Autosampler Tower	Agilent Technologies	7683	CN22025342	TBD	New
Autosampler Tray	Agilent Technologies	G2614A	CN404427800	TBD	New
GC/FID System (BNAGC8)					
Gas Chromatograph	Hewlett-Packard	5890	3121A35833	1986	New
Autosampler Tower	Hewlett-Packard	7673A	2704805765	1986	New
Autosampler Tray	Hewlett-Packard		3131A25914	1986	New
Controller	Hewlett-Packard		2921A03449	1986	New
Manifold	Western Enterprise	Innovator HBAC2-5-4	28452	2004	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Volatiles Department (GC and GC/MS)					
GC/MS System (VOAMS1)					
Gas Chromatograph	Agilent Technologies	6890N	CN10606023	2006	New
MS Detector	Agilent Technologies	5975	US60532504	2006	New
Autosampler	OI	4551A	D60745B342	2006	New
Concentrator	OI	Eclipse 4660	D608466853	2006	New
Spiker	OI	SAM	E54175492	2006	New
GC/MS System (VOAMS2)					
Gas Chromatograph	Hewlett-Packard	7890A	CN10813013	2008	New
MS Detector	Hewlett-Packard	5975C	US80838709	2008	New
Autosampler	OI	4552 (Archon 5100)	14608	2008	New
Concentrator	OI	Eclipse 4660	K41746689OP	2008	New
GC/MS System (VOAMS3)					
Gas Chromatograph	Agilent Technologies	6890N	CN10406105	2004	New
MS Detector	Agilent Technologies	5973 Inert	US35120382	2004	New
Autosampler	EST	Centurion	CENT140051304	2004	New
Concentrator	EST	Encon	478021506	2004	New
Concentrator	EST	Encon	478021506	2004	New
GC/MS System (VOAMS4)					
Gas Chromatograph	Hewlett-Packard	7890A	CN10813014	2008	New
MS Detector	Hewlett-Packard	5975C	US80838712	2008	New
Autosampler	OI	4552	15264	2008	New
Concentrator	OI	2008	D809466076	2008	New
GC/MS System (VOAMS5)					
Gas Chromatograph	Agilent	6890	US10518019	TBD	New
MS Detector	Hewlett-Packard	5973	US44621422	TBD	New
Autosampler	OI	4552 (Archon 5100)	12206	1998	New
Concentrator	OI/EST	Encon	425042704	TBD	New
Concentrator	OI/EST	Encon	425042705	TBD	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS System (VOAMS6)					
Gas Chromatograph	Agilent Technologies	6890N	CN10406076	2004	New
MS Detector	Agilent Technologies	5973 Inert	US35120322	2004	New
Autosampler	OI	4551A	D54645B461	2005	New
Concentrator	OI	4660	D548466579	2005	New
Spiker	OI	SAM	C425475656	2004	New
GC/MS System (VOAMS7)					
Gas Chromatograph	Agilent Technologies	6890N	CN10437064	2006	New
MS Detector	Agilent Technologies	5973 Inert	US43110514	2004	New
Autosampler	Teledyne Tekmar	Solatek	US08121007	2008	New
Concentrator	Teledyne Tekmar	Stratum	US08007007	2008	New
GC/MS System (VOAMS8)					
Gas Chromatograph	Hewlett-Packard	6890	US00028879	TBD	New
MS Detector	Hewlett-Packard	5973	US91411758	TBD	New
Autosampler	EST Archon	5100A	13097	TBD	New
Concentrator	EST Encon	4560	389092704E	TBD	New
GC/MS System (VOAMS9)					
Gas Chromatograph	Agilent	6890	CN10517107	TBD	New
MS Detector	Agilent	5973	US44610847	TBD	New
Autosampler	OI	4552	15266	2008	New
Concentrator	OI	4660	D548466579	TBD	New
GC/MS System (VOAMS10)					
Gas Chromatograph	Agilent	6890	CN10419047	TBD	New
MS Detector	Hewlett-Packard	5973	US10461695	TBD	New
Autosampler	OI	4100	D714410066	TBD	New
Concentrator	OI	4760	A714447065	TBD	New
GC/MS System (VOAMS11)					
Gas Chromatograph	Agilent Technologies	6890N	CN10324011	2003	New
MS Detector	Agilent Technologies	5973N	US30965664	2003	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Autosampler	EST Archon	5100A	13970	2003	New
Concentrator	EST	Encon Eclipse	A714447060	2017	New
GC/MS System (VOAMS12)					
Gas Chromatograph	Agilent Technologies	6890N	CN10439051	2005	New
MS Detector	Agilent Technologies	5973 inert	US43110519	2004	New
Autosampler	EST	5100A	14448	2005	New
Concentrator	EST	Encon	430051605	2005	New
Turbo Pump Upgrade	Agilent Technologies	Performance	56115832	2005	New
GC/MS System (VOAMS13)					
Gas Chromatograph	Agilent Technologies	6890N	CN10439052	2005	New
MS Detector	Agilent Technologies	5973 inert	US43110517	2004	New
Autosampler	EST	5100A	14449	2005	New
Concentrator	EST	Encon	431051605	2005	New
Turbo Pump Upgrade	Agilent Technologies	Performance	56069171	2005	New
GC/MS System (VOAMS14)					
Gas Chromatograph	Agilent Technologies	7890B	17293078	2017	New
MS Detector	Agilent Technologies	5977B	US1731M027	2017	New
Autosampler					
Concentrator					
GC/MS System (VOAMS15)					
Gas Chromatograph	Agilent Technologies	7890B	CN17293101	2017	New
MS Detector	Agilent Technologies	5977B	US1731M011	2017	New
Autosampler					
Concentrator					
GC/FID System (VOAGC1)					
Gas Chromatograph	Agilent Technologies	6890N	US10610006	2006	New
Autosampler	OI	4552	14608	2006	New
Concentrator	OI	4660	D607466340	2006	New
Autosampler	OI	4551A	D60745B342	2006	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Concentrator	OI	4660	D607466341	2006	New
Spiker	OI	SAM	E610475713	2006	New
GC/FID System (VOAGC3)					
Gas Chromatograph	Hewlett-Packard	5890 II	3310A49242	1996	New
Autosampler	Dynatech Archon	5100	11780-795	1996	New
Concentrator	OI	4560	J437460274	1996	New
GC/FID System (VOAGC4)					
Gas Chromatograph	Hewlett-Packard	6890	00031073	TBD	New
Headspace Autosampler	Teledyne Tekmar	HT3	US17187006	TBD	New
Headspace Autosampler	Teledyne Tekmar	HT3	US1715201	TBD	New
GC/FID System (VOASCREEN5/6)					
Gas Chromatograph	Hewlett-Packard	5890 II	2921A23492	1993	New
Autosampler	Tekmar	7050	US04156005	2004	New
Headspace Sampler	Tekmar	7000	US04156003	2004	New
Autosampler	Tekmar	7050	US04148014	2004	New
Headspace Sampler	Tekmar	7000	US04163001	2004	New
Top Loading Balance (Balance #22)	Mettler	PB1501	2115517886	1997	New
Precision Balance (Balance #50)	Ohaus	Explorer Pro 413	1125573353	2006	New
Top Loading Balance (Balance #32)	Denver Instruments	P602	126008	2009	New
Drying Oven	Fisher Isotemp Oven	13-246-516G	502N0045	2005	New
Drying Oven	Baxter	DX-1	199012	2000	New
H-Nu PID	H-Nu Systems	PI101	801023	1989	New
Fume Hood	Air Science	PurAir15	P41007	2004	New
GC Semivolatile Department					
Analytical Balance (Balance #30)	A&D	HR200C	12315880		
Ion Chromatograph (IC-B)	Metrohm Peak, Inc.			2005	New
Pump 1	Metrohm Peak, Inc.	818	04187	2005	New
Pump 2	Metrohm Peak, Inc.	818	04197	2005	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Conductivity Detector	Metrohm Peak, Inc.	819	03195	2005	New
Injector and Oven	Metrohm Peak, Inc.	820	04147	2005	New
2-channel interface	Metrohm Peak, Inc.	830	04184	2005	New
Liquid Handling 1	Metrohm Peak, Inc.	833	04154	2005	New
Liquid Handling 12	Metrohm Peak, Inc.	833	04118	2005	New
Autosample	Metrohm Peak, Inc.	838	03198	2005	New
Ion Chromatograph (IC-A)	Metrohm Peak, Inc.			2010	New
Pump 1	Metrohm Peak, Inc.	818	SS4818011006190	2010	New
Pump 2	Metrohm Peak, Inc.	818	SS1818011003192	2010	New
UV-VIS Detector	Metrohm Peak, Inc.	1010 (Bischoff)	SS1153001010101	2010	New
Conductivity Detector	Metrohm Peak, Inc.	819	03181	2005	New
IC Interface	Metrohm Peak, Inc.	830	SS1830002003180	2010	New
Separation Center	Metrohm Peak, Inc.	820	SS1820023003168	2010	New
Sample Processor	Metrohm Peak, Inc.	838	SS1838001009171	2010	New
Filter Pump 1	Emerson		N SA55-NXGTB 4142		New
Filter Pump 2	Emerson	SA55JXgtd-4144	G8ECX	2002	New
Ion Chromatograph (IC-1)	Metrohm USA, Inc.	Compact IC Flex 930.2460		2017	New
Compact Flex Oven/Ses/Deg	Metrohm USA, Inc.	29302460	00103716	2017	New
Conductivity Detector	Metrohm USA, Inc.	28509010			
Dosino	Metrohm USA, Inc.	28000010	00099636		
MSM-A Rotor	Metrohm USA, Inc.	28509010	00102177		
Metrohm Data Management System	Metrohm USA, Inc.	66059321	JB5FKH2		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
ProfIC Sample Processor Pump	Metrohm USA, Inc.	28580020	000091657		
Ion Chromatograph (IC-2)	Metrohm USA, Inc.	Compact IC Flex 930.2460		2017	New
Compact Flex Oven/Ses/Deg	Metrohm USA, Inc.	29302460	00103714	2017	New
Conductivity Detector	Metrohm USA, Inc.	28509010			
Dosino	Metrohm USA, Inc.	28000010	00099712		
Dosino Invial Dilution	Metrohm USA, Inc.	28000010	00099731		
MSM-A Rotor	Metrohm USA, Inc.	28509010	00102177		
Metrohm Data Management System	Metrohm USA, Inc.	66059321	JB5DKH2		
ProfIC Sample Processor Pump	Metrohm USA, Inc.	28580020	000098576		
GC/FID System (BNAGC1)					
Gas Chromatograph	Agilent Technologies	6890N	US10248079		
Autosampler	Agilent Technologies	G2913A	**CHECK**		
Autosampler	Agilent Technologies	G2913A	US95110886 (Compco)		
Autosampler Tray	Agilent Technologies	G2914A	CN82949935		
GC/FID System (BNAGC2)					
Gas Chromatograph	Agilent Technologies	6890N	US00005410		
Autosampler	Agilent Technologies	G2913A	US00210996		
Autosampler	Agilent Technologies	G2914A	**CHECK**		
Autosampler Tray	Agilent Technologies	G2914A	CN21420543		
GC/FID System (BNAGC3)					
Gas Chromatograph	Agilent Technologies	6890N	US10202132		

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Autosampler	Agilent Technologies	G2913A	CN22025340		
Autosampler	Agilent Technologies	G2914A	US00210996		
Autosampler Tray	Agilent Technologies	G2914A	CN43830663		
GC/FID System (BNAGC4)					
Gas Chromatograph	Agilent Technologies	6890N	US10610005	2006	New
Autosampler	Agilent Technologies	G2913A	CN24428046	2006	New
Autosampler	Agilent Technologies	G2913A	CN43820799	2006	New
Autosampler Tray	Agilent Technologies	G2914A	CN43930714	2006	New
GC/ECD System (PESTGC1)					
Gas Chromatograph	Hewlett-Packard	5890A	2612A07669	1992	New
Autosampler	Hewlett-Packard	G1513A	US72202218	1992	New
Autosampler Tray	Hewlett-Packard	18596C	3401A34202	1992	New
Controller	Hewlett-Packard	G1512A	CN00005085	1992	New
GC/ECD System (PESTGC3)					
Gas Chromatograph	Hewlett-Packard	5890A	3223A42873	1992	New
Autosampler	Hewlett-Packard	18593B	3216A38325	1992	New
Autosampler Tray	Hewlett-Packard	18596B	3120A27740	1992	New
Controller	Hewlett-Packard	18594B	3049A23890	1992	New
GC/ECD System (PESTGC4)					
Gas Chromatograph	Hewlett-Packard	5890A Series II	US00024529	1997	New
Autosampler	Hewlett-Packard	18593B	**Check?**	1997	New
Autosampler Tray	Hewlett-Packard	7673	US13807350	1997	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Controller	Hewlett-Packard	18594B	3227A29129	1997	New
GC/ECD System (PESTGC5)					
Gas Chromatograph	Agilent Technologies	6890N	US10226033	2002	New
Autosampler	Agilent Technologies	G2613A	US83301937	2002	New
Autosampler Tray	Agilent Technologies	G2614A	CN61739524	2002	New
GC/ECD System (PESTGC6)					
Gas Chromatograph	Hewlett-Packard	5890A	2950A26642	1998	New
Autosampler	Hewlett-Packard	18593B	US83301937	1998	New
Autosampler Tray	Hewlett-Packard	18596B	2942A20025	1998	New
Controller	Hewlett-Packard	G1512A	CN00004777	1998	New
GC/ECD System (PESTGC7)					
Gas Chromatograph	Hewlett-Packard	5890A	3029A29927	1998	New
Autosampler	Hewlett-Packard	18593A	3120A28315	1998	New
Autosampler Tray	Hewlett-Packard	18596B	3346A33861	1998	New
Controller	Hewlett-Packard	18594A	626059	1998	New
GC/ECD System (PESTGC8)					
Gas Chromatograph	Agilent Technologies	6890	US00004463	2000	New
Autosampler	Agilent Technologies	G1513A	**Check**	2000	New
Autosampler Tray	Agilent Technologies	18596M	3334A32973	2000	New
Controller	Agilent Technologies	G1512A	3631A05939	2000	New
GC/ECD System (PESTGC9)					
Gas Chromatograph	Agilent Technologies	6890	US00043694	2001	New
Autosampler	Agilent Technologies	G1513A	**Check**	2001	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Autosampler Tray	Agilent Technologies	18596B	3228A29094	2001	New
Controller	Agilent Technologies	G1512A	CN00004150	2001	New
GC/ECD System (PESTGC11)					
Gas Chromatograph	Agilent Technologies	6890	US00008746	2003	New
Autosampler	Agilent Technologies	18593B	3120A28308	2003	New
Autosampler Tray	Agilent Technologies	18596C	3249A30680	2003	New
Controller	Agilent Technologies	G2512A	US72202100	2003	New
Wet Chemistry Department					
UV/VIS Spectrophotometer	HACH	DR2800	1205122	2007	New
UV/VIS Spectrophotometer	HACH	DR2800	1204684	2007	New
UV/VIS Spectrophotometer	HACH	DR2800	1120442	2007	New
Turbidimeter	HACH	HACH 2100N	12050C028810	2006	New
Ion Selective Meter	Orion	720A	006825	1994	New
Ion Selective Meter	Orion	720A+	092904	2007	New
pH Meter	Orion	A211	X16125	2017	New
pH Meter	Orion	A211	X39284	2017	New
pH Meter	Orion	A211	X37844	2017	New
pH Meter	Orion	A211	26256	2017	New
pH Meter	Orion	A211	Y28592	2016	New
Oven	VWR	1320	0402001	2001	New
Oven	VWR	1300U	VWR	2001	New
Oven	VWR	1305U	VWR	2001	New
Oven	Fisher	230G	Fisher	1997	New
Muffle Furnace	Fisher	550-14	901N002	2002	New
Drying Oven	VWR	1320	VWR	2001	New
Analytical Balance (Balance #27)	A&D	HR-200C	12315883	2005	New
Analytical Balance (Balance #29)	A&D	HR-200C	12315872	2005	New
Micro Balance (Balance #100)	Mettler	MX-5	122423439	2006	New
Top Loading Balance (Balance #13)	Sartorius	LC-421	50709085		
Top Loading Balance (Balance #200)	Denver Instruments	P-602	095010		
Analytical Balance (Balance #900)	Ohaus	GA-110	2220		
Top Loading Balance (Balance #25)	Sartorius		3403003		

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THE LEADER IN ENVIRONMENTAL TESTING

Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Water Bath	Precision	50	9302-112	1995	New
Water Bath	Precision	50	9305-024	1995	New
COD Reactor	Hach	DRB 200	960800014651		
COD Reactor	Hach	DRB 200	13060C0213	2007	New
COD Reactor	Hach	DRB 200	1202323	2007	New
COD Reactor	Hach	DRB 200	1209887	2015	New
Flow Injection Autoanalyzer	Lachat	Quickem 8000	A83000	1997	New
Flow Injection Autoanalyzer	Lachat	8000 Series	8300-1658	2000	New
Total Organic Carbon (TOC) Analyzer	Shimadzu	TOC 5000	31242909	1997	New
Autosampler	Shimadzu	ASI 5000	31816800	1997	New
Solid Sample Module	Shimadzu	SSM-5000A	31303115	1997	New
Total Organic Carbon (TOC) Soil Analyzer #2	Thermo Electron Corp.	Flash EA 1112 Series	20034945	2004	New
Printer	Epson	LQ570	41NE28676	1997	New
Total Organic Carbon (TOC) Analyzer	Shimadzu	TOC_VCSH	H51104335164	2006	New
Autosampler	Shimadzu	ASI-V	H52104301656SA	2006	New
Solid Sample Module	Shimadzu	SSM-500A	H52504300040NK	2006	New
BOD Meter	YSI	5000	97S0534AE	1998	New
BOD Meter1 Rinse Pump Interface Control Box Automax 390 autosampler Software Seed pump Dilution pump Computer Monitor		PBM-BOD/AM39010 PC-1000-475 PC-1085-00 PB-10030 PC-1000-1074 PB-10600 PC-1000-408 PC-1000-443	 MT-1F7-414 MT-1G7-249 MT-1H7-200 MT-1H7-100 MT-1K6-559 MT-1G7-230 MXL7112917 CNK72411GS	2017	New
Incubator	GCA Precision Scientific			1998	New
Hot Plate	Corning		103N0071	2001	New
Hot Plate	Fischer Scientific	PC-400	370301092774	2007	New
Hot Plate	Corning	PC-420	390502148495	2007	New
Hot Plate	Fischer Scientific	PC-620	220897070707	2007	New
Conductivity Meter	Fischer Scientific	Accumetab 30	81209007	2002	New
Vortex Mixer	Thermolyne	M63215	632000855604	2002	New
Dishwasher	Miele Professional	G7783CD	208479	2003	New
Easy-Dist Distillation	Westco		1095	2003	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Easy	Westco		J097	2003	New
Easy	Westco		1063	2007	New
Easy	Westco		1110	2007	New
Automated Discrete Analyzer #1	Konelab	20	S2019177	2003	New
Automated Discrete Analyzer #2	Konelab	20	2519236	2003	New
Computer	Dell		246175	2003	New
PC-Titration Plus Autotitrator	Mantech Assoc., Inc			2004	New
Interface		PC-1000-102/4	MS-0H4-373		
Titra-Rinse 1		PC-1000-408	MS-0G4-198		
Titra-Rinse 2		PC-1000-408	MS-0G4-200		
Buret Module 1		PC-1104-00	MS-0H4-627		
Buret Module 2		PC-1104-00	MS-0H4-625		
Titration Module		PC-1300-475	MS-0B5-657		
Redox Meter	VWR	8005	001149	1997	New
TCLP Extraction Laboratory					
Peristaltic Pump	PC-Titrate	PC-1000-40	MS-OF3-568	2004	New
TCLP Extraction Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-4 BRE	1320	2006	New
TCLP Extraction1 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BRE	1352	1997	New
TCLP Extraction2 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BRE	1053	1997	New
TCLP Extraction3 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BRE	1249	1997	New
TCLP Extraction4 Apparatus/Timer included	Environmental Express Ltd	LE 1002	3384-12-473	2005	New
TCLP Extraction5 Apparatus/Timer included	Environmental Express Ltd	LE 1002	3384-12-472	2005	New
TCLP Extraction6 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BREII	2125	2006	New
TCLP Extraction7 Apparatus/Timer included	Assoc. Design and Mfg. Co.	3740-12 BREII	2126	2006	New
Sample Control Department					
Top Loading Balance (Balance #104)	Denver Instruments	P602	126006		
Oven #1	Fisher	Isotemp 637G	410B01117	2005	New
Oven #2	Fisher	Isotemp 637G	505N0063	2005	New
Oven #3	Fisher	6921			
DI Water System (LOGIN)	Millipore		07348-C	1990	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Organic Prep Department					
Analytical Balance (Balance #28)	A&D	HR200C	12315879		
Analytical Balance (Balance #A1)	Denver Instruments	P214	1050008		
Top Loading Balance (Balance #60)	Denver Instruments	P602	115003		
DI Water System	Barnstead	D11911	1191020210415	1995	New
Microwave Extraction System	MARS Xpress 230/60	907501	MD5095	2012	Inter-company transfer
Microwave Extraction System	MARS Xpress 230/60	907501	MD1952	2009	
Microwave Extraction System	MARS Xpress 230/60	907501	MD4965	2014	
Sonicator (Controller)	Sonic & Material, Inc.	VC750	58783	2012	Inter - company transfer
Sonicator Horn	Sonic & Material, Inc.	CV335	33107206	2012	Inter-company transfer
N-Evap #1	Organomation	112	52792	2004	New
N-Evap #2	Organomation	112	1694	1990	New
N-Evap #3	Organomation	112	59284	2014	New
N-Evap #4	Organomation	112	10203	2014	New
Water Bath #1	Fischer	15-491	605021280	2005	New
Water Bath #2	Fischer	15-491	204272	2007	New
Large Muffle Furnace	Wilt Industries	210	041213	2001	New
Dishwasher #1	Miele Professional	G7783CD	53081646	2003	New
Dishwasher #2	LabConco	4540031	130576299 E	2003	New
Vacuum Pump #1	Emerson Electric MLD	5KH36KN90HX	UNL231171	1990	New
Vortex Mixer	Scientific Industries	6560	2-318564	1995	New
Electric Mixer	Barnstead/Thermlyne		125404091646	1995	New
Mini Stirring Hotplate	VWR	220	33918-604	1995	New
Separatory Funnel Rotator 1	AP & R Machine & Tool		222307	2003	New
Separatory Funnel Rotator 2	AP & R Machine & Tool		222306	2003	New
Separatory Funnel Rotator 3	AP & R Machine & Tool		222305	2003	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Separatory Funnel Rotator 4	AP & R Machine & Tool		222304	2003	New
Separatory Funnel Rotator 5	AP & R Machine & Tool		222303	2003	New
Separatory Funnel Rotator 6	AP & R Machine & Tool		222302	2003	New
Centriguge #1	Sigma	2-5	78646	2001	New
Field Services Department					
pH meter E-036	HACH	Sension1-5170060	10120C210304		New
pH meter E-019	HACH	Sension1-5170060	412000029333	2006	New
pH meter E-035	HACH	Sension1-5170060	08040C310395		
pH meter M-016	Hach	Sension1	050400022762	2005	New
pH meter M-039	Hach	Sension1	08040C410063	2006	New
pH meter M-031	Hach	HQ40D			
pH meter	Hach	Sension1	050600C10445	2005	New
pH meter E-036	HACH	5170060	0C260049		New
pH meter M-042	HACH	5170060	08110C111808		New
pH meter M-010	HACH	5170060	40300004162		New
pH meter E-021	ThermoOrion	230A	017900		New
pH meter E-033	ThermoOrion	230A	017788		New
pH/COND M-059	HACH	HQ40Dmulti	130800092563		New
pH+EC Sensor EP-091	HACH	5059	230		New
pH+ORP+EC Sensor MP-162	HACH	5048	151		New
DO meter M-056	HACH	Sension+DO6	401123		New
DO meter M-058	HACH	Sension+DO6	326101		New
DO meter M-032	HACH	Sension6-5185060	05070C360249	2006	New
DO meter E-037	HACH	Sension6-5185060	10120C260049		
DO meter M-027	Hach	Sension6	050500C60066	2005	New
DO meter M-007	Hach	Sension6	020900001321		New
DO meter	Hach	Sension6			New
DO meter M-015	Hach	Sension6	001200002352	2000	New
DO Meter E-037	HACH	5185000	0C260049		New
DO Meter	Hach	Sension +DO6	348155		New
DO Meter	Hach	Sension +DO6	403037		New
Conductivity Meter E-038	HACH	Sension5-5180060	10120C250073		New
Conductivity Meter M-028	HACH	Sension5-5180060	050500C50288	2005	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Conductivity Meter E-006	HACH	Sension5-5180060	501000002708		New
Conductivity Meter M-018	HACH	Sension5	050300013668		New
Conductivity Meter M-0055	HACH	HQ40D	12080078247		New
Conductivity Meter	HACH	Sension5			New
Conductivity Meter M-014	HACH	Sension5	030500006215		New
Conductivity Meter E-038	HACH	5180000	0C250073		New
Conductivity Meter E-027	HACH	5180060	050500C50193		New
ORP Meter E-039	HACH	Sension1-5170060	10120C210070		New
ORP Meter M-060	HACH	HQ40Dmulti	130100083125		New
ORP Meter E-028	HACH	Sension1-5170060	40800010007		New
ORP Meter E-009	HACH	Sension1-5170060	402000003831		New
ORP Meter M-017	HACH	Sension1	05040002039		New
ORP Meter M-041	HACH	Sension1	08040C410042		New
ORP Meter	HACH	Sension1			New
ORP Meter M-006	HACH	Sension1	04030004238		New
ORP Meter E-039	HACH	5170000	0C210070		New
ORP Meter M-069	HACH	HQ40D	140300101090		New
Turbidity Meter E-056	Lamotte	2020we	584-0311		New
Turbidity Meter M-056	Lamotte	2020we	3458-2313		New
Turbidity Meter M-053	Lamotte	2020we	2404-3012		New
Turbidity Meter E-058	Lamotte	2020we	371-4610		New
Turbidity Meter M-047	Lamotte	2020we	567-0111		New
Turbidity Meter M-048	Lamotte	2020we	639-0411		New
Turbidity Meter	Lamotte	2020we			New
Turbidity Meter M-049	Lamotte	2020we	546-0111		New
Turbidity Meter M-066	Lamotte	2020we	4225-1014		New
Turbidity Meter M-054	Lamotte	2020we	2385-0312		New
Turbidity Meter E-059	Lamotte	2020we	3462-2313		New
Turbidity Meter E-055	Lamotte	2020we	180-3710		New
Turbidity Meter M-050	Lamotte	2020we	640-0411		New
Turbidity Meter EP-057	Lamotte	2020we	369-4610		New
Multi Meter (pH/Cond/ORP) M-064	Hach	HQ40D	131200097322		New
Multi Meter (pH/Cond/ORP) M-062	Hach	HQ40D	131100096885		New
Multi Meter (pH/Cond/ORP) M-068	Hach	HQ40D	140300101093		New
Chlorine Meter CL-007	HACH	Pocket Colorimeter II	040200011290	2006	New
Chlorine Meter CL-002	HACH	Pocket Colorimeter	020100174404	2006	New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Chlorine Meter CL-003	HACH	Pocket Colorimeter II	040200011345	2006	New
Chlorine Meter CL-004	HACH	Pocket Colorimeter	961200102549	2006	New
Chlorine Meter CL-006	HACH	Pocket Colorimeter	030400034505		New
Chlorine Meter CL-005	HACH	Pocket Colorimeter	020100174252		New
Chlorine Meter CL-008	HACH	Colorimeter 1200	4796-4900		New
PID	RAE	Min:RAE2000	110-010940		New
PID	RAE	Min:RAE2000	110-010984		New
Peristaltic Pump	Solonist	410	003270		New
Peristaltic Pump	Solonist	410	002642		
Peristaltic Pump	Solonist	410	002634		New
Peristaltic Pump	ISCO	ISCO 150	202F01835		New
Peristaltic Pump	ISCO	ISCO 150	195K01032		New
Peristaltic Pump	ISCO	ISCO 150	N/A		New
Peristaltic Pump	Sigma	N/A	22151		New
Peristaltic Pump	GeoPump	9001280	603003533		New
Composite sampler	ISCO	3700	204G00978		New
Composite sampler	ISCO	3700	210S00481		New
Composite sampler	ISCO	3700	211D00260		New
Composite sampler	ISCO	3700	212L00333		New
Grundfos	Grundfos	MP1/1A106003 P1	10460002		New
Grundfos	Grundfos	MP1/1A106003 P1	11030045		New
Grundfos	Grundfos	MP1/1A106003 P1	7460012		New
Grundfos	Grundfos	MP1/1A106003	98040466		New
Grundfos	Grundfos	MP1/1A106003	51418349		New
Sub Pump	Proactive	N/A	1371		New
Monsoon Control	Proactive	N/A	NA		New
Compressor	QED	3020	18323		New
Compressor	Coleman	CT5090412	D02812339		New
Compressor	Honda/Cambell	N/A	091593L689231VT69 7203AJ		New
Control Pack	QED	MP15	1278		New
Control Pack	QED	MP15	1299		New
Control Pack	QED	MP15	1079		New
Control Pack	QED	MP15	1528		New
Control Pack	QED	MP15	1280		New
Control Box	Grundfos	96765947	H100520040		New
Control Box	Grundfos	81128527	H0303130012		New
Control Box	Grundfos	91126028	H0412210115		New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Control Box	Grundfos	91126028	H0412210120		New
Control Box	Grundfos	SI-MP1115	151131		New
Control Box	Grundfos	SI-MP1115	203718		New
Bladder Pump	QED	MP-SPK-4P	12219		New
Bladder Pump	QED	MP-SPK-4P	10218		New
Bladder Pump	QED	MP-SPK-4P	12794		New
Bladder Pump	QED	MP-SPK-4P	12523		New
Bladder Pump	QED	MP-SPK-4P	11191		New
Bladder Pump	QED	MP-SPK-4P	11192		New
Bladder Pump	QED	MP-SPK-4P	11991		New
Bladder Pump	QED	MP-SPK-4P	11697		New
Bladder Pump	QED	MP-SPK-4P	11714		New
Bladder Pump	QED	MP-SPK-4P	12751		New
Bladder Pump	QED	MP-SPK-4P	11512		New
Bladder Pump	GeoTech	Model D 0.675	18		New
Bladder Pump	GeoTech	Model D 0.675	93		New
Generator	Honda	EU Inverter 2000	EAAS-2126666		New
Generator	Honda	EM 1800	E2CK-1011585		New
Generator	Honda	EM 3000	E2GL-1002925		New
Metal Detector	Fisher	FX-3	10123978		New
Marshaulk	N/A	N/A	N/A		New
Water Level Meter	Solonist	101	236477		New
Water Level Meter	Solonist	101	236505		New
Water Level Meter	Solonist	101	200769		New
Water Level Meter	Solonist	101	58356		New
Water Level Meter	Solonist	N/A	N/A		New
Interphase	Solonist	122	58167		New
Interphase	N/A	N/A	N/A		New
PID	RAE	MiniRae 2000	110-010953		New
PID	RAE	PGM-7615	103958		New
PID	RAE	MiniRae 3000	592-906947		New
YSI Meter	YSI Inc.	556MPS	06F1362 AC		New
Bladder Pump	QED	MP-SPK-4P	12870		New
Bladder Pump	QED	MP-SPK-4P	12175		New
Bladder Pump	QED	MP-SPK-4P	10996		New
Bladder Pump	QED	MP-SPK-4P	12023		New
Bladder Pump	QED	MP-SPK-4P	12752		New
Bladder Pump	QED	MP-SPK-4P	10997		New
Bladder Pump	QED	MP-SPK-4P	10200		New
Bladder Pump	QED	MP-SPK-4P	12087		New
Bladder Pump	QED	MP-SPK-4P	10649		New
Bladder Pump	QED	MP-SPK-4P	12568		New
Bladder Pump	QED	MP-SPK-4P	12654		New
Bladder Pump	Solinst	NA	NA		New
Bladder Pump	Solinst	NA	NA		New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Submersible Pump	Proactive	Monsoon XL	24730		New
Monsoon Control Box	Proactive	LCD Controller	H10867		New
Grundfos Pump	Grundfos	MP1/1A106003	044917629		New
Grundfos Pump	Grundfos	MP1/1A106003	06029591		New
Grundfos Pump	Grundfos	MP1/1A106003	051418361		New
Grundfos Pump	Grundfos	A 1A106003PI	10030064		New
Grundfos Pump	Grundfos	A 1A106003PI	07460012		New
Grundfos Pump	Grundfos	A 1A106003PI	11150009		New
Control Box	Grundfos	BMI/MP1-115V	9517		New
Control Box	Grundfos	SI/MP1-115/230V	203831		New
Control Box	Grundfos	IN2039B11	H1006080040		New
Control Box	Grundfos	IN0853A43	H0303130012		New
Control Box	Grundfos	IN0903A44	H0412210120		New
Control Pack	QED	MP-15	1181		New
Control Pack	QED	MP-15	1537		New
Control Pack	QED	MP-15	1615		New
Control Pack	QED	MP-15	1297		New
Control Pack	QED	MP-15	1060		New
Control Pack	QED	MP-15	1538		New
Control Pack	QED	MP-15	1180		New
Control Pack	QED	MP-15	1300		New
Peristaltic Pump	Solinst	410	002562		New
Peristaltic Pump	Solinst	410	002071		New
Peristaltic Pump	Solinst	410	001979		New
Peristaltic Pump	Solinst				New
Peristaltic Pump	GeoTech	900-1280	J02003143		New
Interface Meter	Solinst	122	59307		New
Interface Meter	Solinst	122	122 008699-1		New
Water Level Meter	Solinst	101	50333		New
Water Level Meter	Solinst	101	200766		New
Water Level Meter	Solinst	101	50331		New
Water Level Meter	Solinst	101	236317		New
Water Level Meter	Solinst	101	35312		New
Water Level Meter	Solinst	101	222854		New
Composite sampler	ISCO	3700 Sampler	212L00327		New
Composite sampler	ISCO	3700 Sampler	205C01380		New
Composite sampler	ISCO	3700 Sampler	205C01376		New
Composite sampler	ISCO	2700 Sampler	04939-054		New
Composite sampler	ISCO	2910 Sampler	197J00505		New
Composite sampler	ISCO	2700 Sampler	06522-094		New
Metal Detector	Chicago Steel Tape	Magna-Trak 102	102066024		New
Metal Detector	Chicago Steel Tape	Magna-Trak 102			New
Fresh Water Pump	NorthStar	10633	2252957		New

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Instrument Type (Name)	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
Generator	Honda	EB 3000C	EZGP-1145763		New
Generator	Honda	EB 3000C	EZGP-1151238		New
Generator	Honda	EM 3000C	EZGL-1002930		New
Compressor	Industrial Air	CTA5090412.GNE	K13110207A		New
Power Inverter	N Power	NA	120270929		New
PID	PE Photovac	2020	DQ-GD-302		New
Control Box	Grundfos	SI/MP1-115/230V	9909		New
Generator	Troy Bilt	01924	1010594921		New
Composite sampler	ISCO	2710 Sampler	05248-001		New
Mini Interface Meter	Water Mark	H01L/SM01L	01-1096		New
Interface Meter	Testwell Inc.	NA	NA		New
Water Level Meter	Fisher	M-Scope	NA		New
Water Level Meter	Fisher	M-Scope	NA		New
Varistaltic Pump	Manostat	72-310-000	M97005467		New
Utility Pump	TEEL	2P110A	1962		New
Utility Pump	TEEL	2P110B	3021		New
Utility Pump	TEEL	2P110B	0034		New
Utility Pump	TEEL	2P110B	0036		New

Table 20-2. Example: Schedule of Routine Maintenance

Table 20-2. Example: Schedule of Routine Maintenance		
Instrument	**Procedure**	**Frequency**
Leeman Mercury Analyzer	Check tubing for wear Fill rinse tank with 10% HCl Change dryer tube Fill reductant bottle with 10% Stannous Chloride	Daily Daily As needed Daily
ICP	Check pump tubing Check liquid argon supply Check fluid level in waste container Check filters Clean or replace filters Check torch Check sample spray chamber for debris Clean and align nebulizer Check entrance slit for debris Change printer ribbon Replace pump tubing	Daily Daily Daily Weekly As required Daily Monthly Monthly Monthly As required As required
ICP MS	Change pump tubing Clean torch Check / clean nebulizer Clean cones Check air filters Check multiplier voltages & do cross calibration Replace sample uptake tubing Check rotary pump oil Check oil mist filters Check chiller water level	Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Weekly or As required Monthly Monthly
UV-Vis Spectrophotometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check	As required As required Semi-annually
Auto Analyzers	Clean sampler Check all tubing Clean inside of colorimeter Clean pump well and pump rollers Clean wash fluid receptacle Oil rollers/chains/side rails Clean optics and cells	Daily Daily Daily Quarterly Weekly Weekly Quarterly

Table 20-2. Example: Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Gas Chromatograph/Mass Spectrometer (GC/MS)	Ion gauge tube degassing Pump oil-level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment COMPUTER SYSTEM AND PRINTER: Air filter cleaning Change data system air filter Printer head carriage lubrication Paper sprocket cleaning Drive belt lubrication	As required Monthly Annually As required As required As required As required As required As required As required As required
Gas Chromatograph	Compare standard response to previous day or since last initial calibration Check carrier gas flow rate in column Check temp. of detector, inlet, column oven Septum replacement Glass wool replacement Check system for gas leaks with SNOOP Check for loose/frayed wires and insulation Bake injector/column Change/remove sections of guard column Replace connectors/liners Change/replace column(s)	Daily Daily via use of known compound retention Daily As required As required W/cylinder change as required Monthly As Required As Required As Required As Required
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Photoionization Detector (PID)	Change O-rings Clean lamp window	As required As required
HPLC	Change guard columns Change lamps Change pump seals Replace tubing Change fuses in power supply Filter all samples Change autosampler rotor/stator	As required As required Semi-annually or as required As required As required Daily As required
Balances	Class “S” traceable weight check Clean pan and check if level Field service	Daily, when used Daily At least Annually
Conductivity Meter	0.01M KCl calibration Conductivity cell cleaning	Daily As required
Turbidimeter	Check light bulb	Daily, when used
Deionized/Distilled Water	Daily conductivity check Check deionizer light Monitor for VOA’s System cleaning Replace cartridge & large mixed bed resins	Daily Daily Daily As required As required

Table 20-2. Example: Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
Vacuum Pumps/ Air Compressor	Drained Belts checked Lubricated	Weekly Monthly Semi-annually
pH/Specific Ion Meter	Calibration/check slope Clean electrode	Daily As required
BOD Incubator	Temperature monitoring Coil and incubator cleaning	Daily Monthly
Centrifuge	Check brushes and bearings	Every 6 months or as needed
Water baths	Temperature monitoring Water replaced	Daily 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), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory Accreditation Cooperation) or APLAC (Asia–Pacific Laboratory Accreditation Cooperation). A calibration certificate and scope of accreditation is kept on file at the laboratory.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors that are accredited to ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a certificate that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number
- Calibration method
- Concentration with associated uncertainties
- 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 Eurofins 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 applicable analytical Departments. 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. Blended gas standard cylinders use a nominal concentration if the certified value is within +/-15%, otherwise the certified values is used for the canister concentration.

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
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- 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 (***from LIMS***)
- 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 by the facility Environmental Health and Safety Coordinator.

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)

- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an 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 preparation/analytical batch records.

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 provides sampling services. Sampling procedures are described in the following SOPs as applicable::

- Groundwater Sampling (Eurofins TestAmerica Edison SOP #s ED-FLD-008 and ED-FLD-009)
- Wastewater Sampling (Eurofins TestAmerica Edison SOP # ED-FLD-014)
- Potable Sampling
- Waste Sampling
- Soil and Sediment Sampling
- Flow Monitoring (Eurofins TestAmerica Edison SOP #s ED-FLD-008 and ED-FLD-009)
- Field Parameter Analysis (Eurofins TestAmerica Edison SOPs ED-FLD-001 thru ED-FLD-007, ED-FLD-010)
- Cleaning and Decontamination of Field Equipment (see individual SOPs listed above and Eurofins TestAmerica Edison SOP# ED-GEN-013)

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. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.

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. 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 SOP No. ED-GEN-007 (Subsampling).

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 includes 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 Eurofins 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 Eurofins 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

The laboratory may, upon special request, adhere to legal/evidentiary chain of custody requirements. If Eurofins TestAmerica agrees to such procedures the samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and 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.

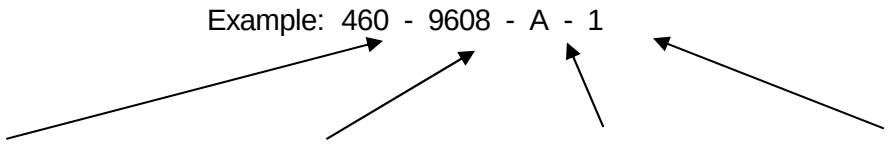
23.2.1 Laboratory Receipt

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 on a via the Sample Receipt application within TALS (the laboratory LIMS) 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):



Location ID Login ID Container Occurrence Sample Number
(3-digit # for Eurofins TestAmerica Edison)

The above example states that Eurofins TestAmerica Edison Laboratory (Location 460). 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: 460 - 9608 - A - 1 - **A** ←——**Secondary Container Occurrence**

Example: 460-9608-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 COC filled out completely;
- 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);

- all samples submitted for water/solid Volatile Organic analyses must have a Trip Blank submitted at the same time;
- 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.

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 SOP No. ED-SPM-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. Sample containers designated for metals only analysis are stored un-refrigerated. 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 every two weeks.

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. All samples are kept in the refrigerators for 30 days after delivery of the final report to the client, which meets or exceeds most sample holding times. After 30 days the samples are disposed of or, upon client request moved to a sample archive area where they are stored for an additional time period agreed upon with the client or dictated by the applicable analytical program (ex. USEPA CLP).

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 Eurofins 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.

Procedures for the handling and storage of hazardous samples are addressed in the Eurofins TestAmerica Corporate Safety Manual (TestAmercia Document No. CW-E-M-001) and in Eurofins TestAmerica Edison SOP No. ED-SPM-001 (Sample Receipt, Login, Identification, and Storage).

Procedures for the acceptance and handling of USDA regulated domestic and foreign soils are detailed in Eurofins TestAmerica SOP No. ED-SPM-006 (Procedure for Acceptance and Handling of Regulated Domestic and Foreign Soils).

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 Eurofins 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, Eurofins TestAmerica Edison SOP No. ED-SPM-007 (Disposal of Samples and Associated Laboratory Waste). 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).

Figure 23-1. Example: Chain of Custody (COC)

CHAIN OF CUSTODY / ANALYSIS REQUEST

TestAmerica Edison
777 New Durham Road
Edison, New Jersey 08817
Phone: (732) 549-3900 Fax: (732) 549-3679

Page ___ of ___

Name (for report and invoice)	Samplers Name (Printed)	Site/Project Identification
Company	P.O. #	State (Location of site): NJ: ☐ NY: ☐ Other:
		Regulatory Program:
Address	Analysis Turnaround Time	ANALYSIS REQUESTED (ENTER "X" BELOW TO INDICATE REQUEST)
City State	Standard ☐	LAB USE ONLY Project No:
Phone Fax	Rush Charges Authorized For: 2 Week ☐ 1 Week ☐ Other ☐ _____	Job No:

Sample Identification	Date	Time	Matrix	No. of. Cont.									Sample Numbers
Preservation Used: 1 = ICE, 2 = HCl, 3 = H_2SO_4, 4 = HNO_3, 5 = NaOH					Soil:								
6 = Other _____, 7 = Other _____					Water:								

Special Instructions_____ Water Metals Filtered (Yes/No)?_____

Relinquished by	Company	Date / Time	Received by	Company
1)		|	1)	
Relinquished by	Company	Date / Time	Received by	Company
2)		|	2)	
Relinquished by	Company	Date / Time	Received by	Company
3)		|	3)	
Relinquished by	Company	Date / Time	Received by	Company
4)		|	4)	

Laboratory Certifications: New Jersey (12028), New York (11452), Pennsylvania (68-522), Connecticut (PH-0200), Rhode Island (132).

Figure 23-2. Example: Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

Per State and/or Federal Regulation, the client is responsible to ensure that samples are shipped in accordance with DOT/IATA requirements, and that radioactive materials may only be delivered to licensed facilities. Any samples containing (or suspected to contain) Source, Byproduct, or Special Nuclear Material as defined by 10 CFR should be delivered directly to facilities licensed to handle such radioactive material. Natural material or ores containing naturally occurring radionuclides may be delivered to any Eurofins TestAmerica facility or courier as long as the activity concentration of the material does not exceed 270 pCi/g alpha or 2700 pCi/g beta (49 CFR Part 173).

1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
   - Client name, address, phone number and fax number (if available)
   - Project name and/or number
   - The sample identification
   - Date, time and location of sampling
   - The 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.
   - The date and time of receipt must be recorded between the last person to relinquish the samples and the person who receives the samples in the lab, and they must be exactly the same.
   - Information must be legible

2) Samples must be properly labeled.
   - Use durable labels (labels provided by Eurofins TestAmerica are preferred)
   - Include a unique identification number
   - Include sampling date and time & sampler ID
   - Include preservative used.
   - Use indelible ink
   - Information must be legible

3) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested.

4) Samples must be preserved according to the requirements of the requested analytical method.

5) Most analytical methods require chilling samples to 4^{o} C (other than water samples for metals analysis). For these methods, the criteria are met if the samples are chilled to below 6^{o} C and above freezing (0^{o}C). For methods with other temperature criteria (e.g. some bacteriological methods require $\leq$ 10 ^{o}C), the samples must arrive within $\pm$ 2^{o} C of the required temperature or within the method specified range. **Note:** Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

5i.) Samples that are delivered to the laboratory on the same day they are collected may not meet the requirements of Section 5. In these cases, the samples shall be considered acceptable if the samples were received on ice.

5ii.) If sample analysis is begun within fifteen (15) minutes of collection, thermal preservation is not required.

5iii.) Thermal preservation is not required in the field if the laboratory receives and refrigerates the sample within fifteen (15) minutes of collection.

- Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.

- **For Volatile Organic analyses in drinking water (Methods 502.2 or 524.2**). Residual chlorine must be neutralized prior to preservation. If there is prior knowledge that the samples are not chlorinated, state it on the COC and use the VOA vials pre-preserved with HCl. The following are other options for a sampler and laboratory where the presence of chlorine is not known:

  - 1. Test for residual chlorine in the field prior to sampling.
    - If no chlorine is present, the samples are to be preserved using HCl as usual.
    - If chlorine is present, add either ascorbic acid or sodium thiosulfate prior to adding HCl.

  - 2. Use VOA vials pre-preserved with sodium thiosulfate or ascorbic acid and add HCl after filling the VOA vial with the sample.

- **FOR WATER SAMPLES TESTED FOR CYANIDE (by Standard Methods or EPA 335)**
  - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample must be treated with Cadmium Chloride and filtered prior to the addition of NaOH.

    - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements or the laboratory can analyze the samples as delivered and qualify the results in the final report.

  - It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.

- The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

6) Sample Holding Times
   - Eurofins TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (2 working days) remaining on the holding time for us to ensure analysis.

   - Analyses that are designated as "field" analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, Eurofins TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for "field" analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day after receipt (i.e., Monday, unless Monday is a holiday). Samples will remain refrigerated and sealed until the time of analysis. The actual times of all "field" sample analyses are noted in the final report. Samples analyzed in the laboratory will be qualified on the final report with an 'H' to indicate holding time exceedance.

7) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. Eurofins TestAmerica will supply a blank with the bottle order.

8) The project manager will be notified if any sample is received in damaged condition. Eurofins TestAmerica will request that a sample be resubmitted for analysis.

9) Recommendations for packing samples for shipment.

   - Pack samples in Ice rather than "Blue" ice packs.

   - Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top, do not seal very well and are prone to intrusion from the water which results from melted ice.

   - Water samples are best package when wrapped with bubble-wrap or paper (newspaper, or paper towels) and then placed in plastic zip-lock bags.

   - Fill cooler void spaces with bubble wrap.

Figure 23-3. Example: Cooler Receipt Form

TestAmerica Edison
Receipt Temperature and pH Log

Page ___ of ____

Job Number: _____

Number of Coolers: _____ IR Gun # _____

Cooler Temperatures

	RAW	CORRECTED		RAW	CORRECTED		RAW	CORRECTED
Cooler #1:	°C	°C	Cooler #4:	°C	°C	Cooler #7:	°C	°C
Cooler #2:	°C	°C	Cooler #5:	°C	°C	Cooler #8:	°C	°C
Cooler #3:	°C	°C	Cooler #6:	°C	°C	Cooler #9:	°C	°C

TALS Sample Number	Ammonia (pH<2)	COD (pH<2)	Nitrate Nitrite (pH<2)	Metals* (pH<2)	Hardness (pH<2)	Pest (pH 5-9)	EPH or QAM (pH<2)	Phenols (pH<2)	Sulfide (pH>9)	TKN (pH<2)	TOC (pH<2)	Total Cyanide (pH>12)	Total Phos (pH<2)	Other	Other

If pH adjustments are required record the information below:

Sample No(s). adjusted: _____

Preservative Name/Conc.: _____ Volume of Preservative used (ml): _____

Lot # of Preservative(s): _____ Expiration Date: _____

The appropriate Project Manager and Department Manager should be notified about the samples which were pH adjusted.

** Samples for Metal analysis which are out of compliance must be acidified at least 24 hours prior to analysis.*

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Initials: _____ Date: _____

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. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. 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

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 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 differentiate between contamination caused by the analytical system and that caused by the analytical sequence to minimize the effect of carryover from samples with high analyte content.

Trip Blank	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	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	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) 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

Type	Details	
(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;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. 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 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	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 if necessary on an annual basis 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 $\pm$ 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.

- The maximum acceptable recovery limit will be 150%.

- The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

- If either the high or low end of the control limit changes by $\leq$ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

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.

24.6.1.1 The QA Department generates and reviews Quality Control Limit Summaries using the TALS Control Chart module. These tables summarize the updated, proposed precision and accuracy acceptability limits for each applicable analysis performed at Eurofins TestAmerica Edison. Once the QA Department is satisfied that the proposed limits are satisfactory the tables are forwarded to the applicable Department (Technical) Manager for final review. Once the proposed limits have been reviewed they entered into the appropriate TALS Method Limit Group database and approved for use (effectively replacing the existing limits in the database). The Quality Assurance Department maintains an archive of all limits used within the laboratory. Reference

Eurofins TestAmerica Edison SOP No. ED-GEN-026 (Evaluation of Analytical Accuracy and Precision Through The Use of Control Charts).

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). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 Additional 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.

A variety of report formats are available to meet specific needs.

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 (e.g. work order number) 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.

Note: Page numbers of report are represented as page # of ##. Where the first number is the page number and the second is the total number of pages.

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 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 expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Authorized signatories are qualified Project Managers appointed by the Manager of Project Managers.

25.2.21 When TNI accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.

25.2.22 The laboratory includes a cover letter.

25.2.23 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.

25.2.24 When soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

25.2.25 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.26 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). A complete report must be sent once all of the work has been completed.

25.2.27 Any non-Eurofins TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All Eurofins TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.28 A Certification Summary Report, where required, will document that, unless otherwise noted, all analytes tested and reported by the laboratory were covered by the noted certifications.

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 offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II (also called 'Results/QA) is a Level I report plus summary information, including results for the method blank reported to the laboratory MDL, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- NJDEP Reduced Deliverables Format which contains, at minimum, the elements listed in the current NJDEP Technical Requirements for Site Remediation, N.J.A.C. 7:26E.
- NJDEP Full Deliverables Format (Non-USEPA CLP Methods) which contains, at minimum, the elements listed in the current NJDEP Technical Requirements for Site Remediation, N.J.A.C. 7:26E.
- NJDEP Full Deliverables Format (USEPA CLP Methods) which contains, at minimum, the elements listed in the current NJDEP Technical Requirements for Site Remediation, N.J.A.C. 7:26E.
- NYSDEC ASP 'A' and 'B' Deliverables Format which contain, at minimum, the elements listed in the current *New York State Department of Environmental Conservation Analytical Services Protocol*.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. Procedures used to ensure client confidentiality are outlined in Section 25.6.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of Eurofins TestAmerica's services in addition to the test report as described in Section 25.2. When NELAP accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD. Eurofins TestAmerica Edison offers a variety of EDD formats including NJ Hazsite Deliverables, 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 TNI 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.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by 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 Eurofins 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.

Eurofins 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 Eurofins TestAmerica or any information disclosed to Eurofins 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 Eurofins TestAmerica under the compulsion of legal process. Eurofins 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.

Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are to meet all requirements of this document, include cover letter.

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 "Rev (n)" where 'n' is the revision number. The revised report will have the words "Revision (n)" on the report cover page beneath the report date. Additionally, a section entitled"Revised Report" will appear on the Case Narrative page. A brief explanation of the reasons for the re-issue will be included in this section.

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

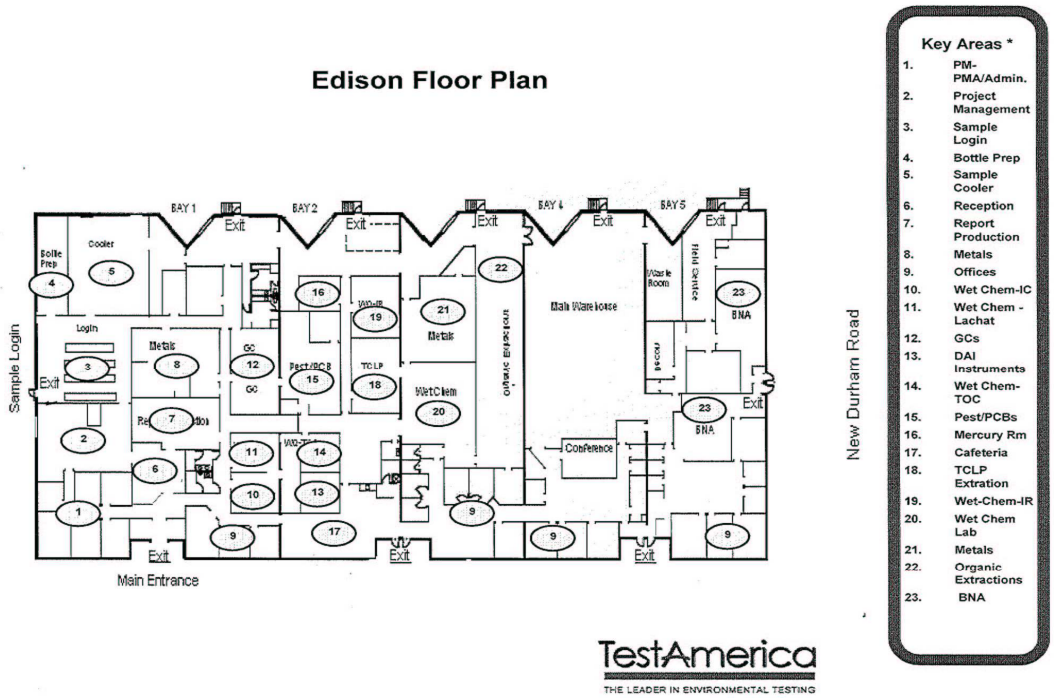
Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

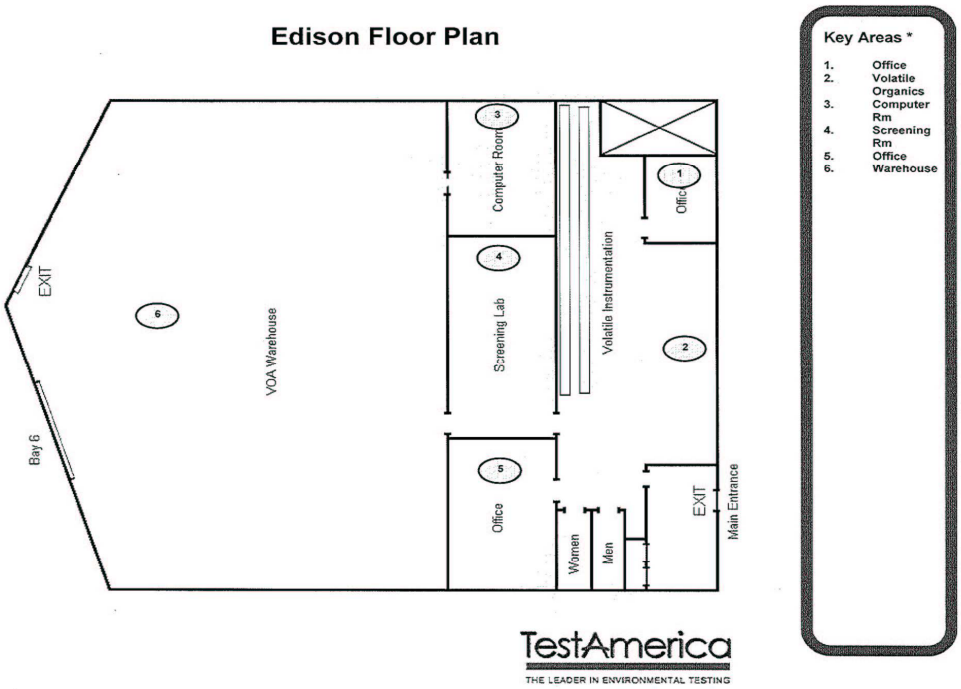
- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- 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

Eurofins 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)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

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 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. TNI and its representatives agree to safeguard 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), whether in the laboratory's control or not.

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: Those matrix, technology/method, and analyte combinations for which the 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)]: The MDL is the minimum measured quantity of a substance that can be reported with 99% confidence that the concentration is distinguishable from method blank results, consistent with 40CFR Part 136 Appendix B, August, 2017

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.

(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 sorbent 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: See Limit of Detection (LOD).

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.

Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

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 laboratory 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 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 2^{nd} 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 2^{nd} 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)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

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
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate

SDS - Safety Data Sheet
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

Eurofins TestAmerica Edison maintains accreditations, certifications, and approvals with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc.

. At the time of this QA Manual revision, the Eurofins TestAmerica Edison laboratory has accreditation/certification/licensing with the following organizations:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Certifications

Laboratory	Program	Authority	Identification	Expiration Date
TestAmerica Edison	Federal	USDA	NJCA-003-08	06/13/2020
TestAmerica Edison	NELAP	New Jersey	12028	06/30/2018
TestAmerica Edison	NELAP	New York	11452	04/01/2018
TestAmerica Edison	NELAP	Pennsylvania	68-00522	02/28/2018
TestAmerica Edison	State Program	Connecticut	PH-0200	09/30/2018
TestAmerica Edison	State Program	DE Haz. Subst. Cleanup Act (HSCA)	N/A	12/31/2017
TestAmerica Edison	State Program	Rhode Island	LAO00132	12/30/2017

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* Certification Valid - Laboratory is Pending Renewal with the Program Authority

For more information, or to contact a local TestAmerica representative nearest you, please visit our website at www.testamericainc.com

The certificates and accredited parameter lists are available for each State/Program at www.Eurofins TestAmericainc.com under Analytical Services Search – Certifications.

Title: Chlorinated Herbicides [Method 8151A]

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):

7/1/19
Gary Rudz Date
Organic Operations Manager

7/1/19
Kenneth Kasperek Date
Laboratory Director

7/1/19
Michael Mosscrop Date
Quality Assurance Manager

Facility Distribution No. _____ **Distributed To:_____**

1.0 Scope and Application

This method is used to qualify and quantify chlorinated acid herbicides by direct injection 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. Table 1 lists the compounds that may be analyzed using this method.

1.1 Analytes, Matrix(s), and Reporting Limits

This method is used to determine chlorinated acid herbicides in soil and waters. See Table 1 for a listing of laboratory quantitation limits. These values are lab generated and reviewed annually.

Table 1

Analyte	CAS No.	Aqueous Laboratory RL (ug/L)	Solid Laboratory RL (ug/kg)
2,4-D 2,4-Dichlorophenoxy Acetic Acid	94-75-7	0.50	17
2,4,5-TP (Silvex) 2,4,5-Trichlorophenoxy Proprionic Acid	93-72-1	0.50	17
2,4,5-T 2,4,5-Trichlorophenoxy Acetic Acid	93-76-5	0.50	17
Dalapon	75-99-0	0.50	17
Dichloroprop	120-36-5	0.50	17
Dinoseb	88-85-7	0.50	17
Pentachlorophenol	87-86-5	0.50	17
Picloram	1918-02-1	0.50	17

On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in Section 7.0 in the Quality Assurance Manual.

Additional analytes are being developed via a corporate initiative to standardize reporting lists in each lab; Dicamba, 2,4-DB, MCPA, & MCPP.

2.0 Summary of Method

Chlorinated Acid Herbicides are derivatized to form corresponding methyl esters with diazomethane.

These methylated compounds are then analyzed by Gas Chromatography on a HP5890-GC with an Electron Capture Detector using Helium as a carrier gas.

3.0 Definitions

3.1 8151A MOD: The reference to a specific modified version of the general 8151A guidance method.
3.2 LCS: Synonym for laboratory quality control samples.
3.3 MS/MSD/SD: Synonyms for client sample spikes
3.4 DU/MD: Refer to duplicate samples
3.5 MB: refer to method blank
3.6 IBLK/HEXANE: Refers to instrument or solvent blanks used to identify contamination or minimize carryover problems
3.7 TEST RUNS: Used to evaluate instrument operational functionality
3.8 ICV: Initial 2nd source check for Calibration in TALS (Alt Source)
3.9 CCV: Continuing Calibration Verification
3.10 PRIMER: Old standard, QC, or blank analyzed after instrument has been idle
3.11 Derivitize: To convert a compound into another compound or structure that is chemically related to the original structure.
3.12 Methylation: To introduce a "methyl" group into a chemical or structure. The alkyl group: CH3 is derived from Methane by the removal of a single Hydrogen atom.

4.0 Interference

4.1 Method interference can be minimized by proper glassware cleaning methods, as well as the use of high purity reagents and solvents.

4.2 Organic acids and phenols may cause interference in this method.

4.3 If heavily concentrated samples are encountered, contamination by carryover can occur. To avoid cross-contamination of subsequent samples, analysis of highly concentrated samples may be followed by the analysis of one or more blanks to verify instrument cleanliness.

4.4 If visual inspection of samples yields atypical appearance, filtration, dilution, or other procedure may be employed.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Safety Manual (CW – E-M-001) the facility addendum to the CSM, and this document. It is the responsibility of the analyst performing this 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

5.11 Nitrile, latex, and vinyl gloves all provide adequate protection against materials used in this method.

5.1.2 The gas chromatograph contains zones that have elevated temperatures. The analyst need to be aware of the locations of these zones, and must cool them to room temperature prior to direct contact with them.

5.1.3 There are areas of high voltage in the gas chromatograph. Depending on the type of work involved, the power of the instrument may be turned off or may be disconnected from its power source.

5.2 Primary Materials Used

Table 2 contains a list of materials used in this method, which have serious or significant hazard rating. A complete list of the materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it and for the first time or when there are major changes to the SDS.

Table 2

Material (1)	Hazards	Exposure Limit (2)	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.
Sulfuric Acid	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.
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.			

6.0 Equipment and Supplies

6.1 Instrumentation

- 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 (or equivalent)
- Hewlett Packard 7673 Auto Sampler
- Hewlett-Packard 3396A Integrator
- Capillary columns as described in Section 6.2

- Electron Capture Detectors
- PE Nelson Totalchrom data system
- Carrier Gas – Helium
- Make-up Gas – Argon/Methane
- Syringes – various

6.1.1 Instrument Maintenance

- Upon Verification of established operating conditions the following may be performed either after failed QC or as preventative maintenance. All maintenance should be noted in the specific maintenance logbook.
    - Change Septum
    - Check flow and column conditions
    - Analyze solvent blank to check for contamination
    - If degradation or any interference is present, the analyst may replace the injection port liner, bake the column at 300°C or cut a section of the column end (i.e. 6-12 inches)

6.2 Supplies

Herbicides Dual Column Analytical Systems. A two-column system is required to provide confirmation of identification of the herbicides. The following supplies are recommended:

- Column Pair
- 30m x 0.32m x 0.5um RTXCLPI (or equivalent)
- 30m x 0.32m x 0.5um RTXCLPII (or equivalent)
- Restek Press-Tight “Y” Connector (Cat. #20404)
- Guard Column
- Column Configuration. The guard column is connected to the injection port. A “Y” connector is then placed at the end of the guard column to split the flow to the two analytical columns. These columns are then connected to two separate Electron Capture Detectors.

7.0 Recommended Reagents and Standards

- Certified Herbicide Mix (Ultra Scientific HBM-8151 A-1) or Supelco (46861-U)
- Herbicides Methyl Derivatives (EM Science EPM80138-1), (Ultra Scientific HBM-8151M) Alternate Source
- DCAA (surrogate) (2.4 Dichlorophenyl-acetic acid) (Restek 32049)
- DCAA Methyl ester solution (Ultra Scientific PPS-166-1)
- Additional vendor supplied standards as needed
- Hexane (reagent grade)
- Isooctane (reagent grade)
- Methanol (pesticide grade)
- (Trimethylsilyl) diazomethane solution
- Silicic Acid

8.0 Sample Collection, Preservation, Shipment and Storage

Both aqueous and soil samples must be stored and maintained at the lab at 4°C, ±2, in Teflon sealed amber containers until the analyst is prepared for the analytical process, which must take place no longer than 40 days after extraction. Table 3 details acceptable containers, preservation and holding times.

Table 3

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time [1]	Reference
Waters	Glass	1 L amber container	Cool 4 ± 2°C	7 days	N/A
Soils	Glass	4oz wide mouth	Cool 4 ± 2°C	14 days	N/A

9.0 Quality Control

9.1 Sample QC

Surrogates

All samples, method blanks, blank spikes, and matrix spikes are fortified with the surrogate DCAA (2,4 Dichlorophenyl acetic acid) to monitor the performance of the extraction, methylation and, analytical analysis. Control limits are developed using procedures described in Standard Operating Procedure BF-QA-002; Quality Control Limits. If the values obtained are out of this range, re-extraction and re-analysis must be performed. If upon re-analysis the values are still outside the control limits, comments must be made describing the reason, i.e., matrix interference or chromatographic interference.

(Re-extraction for surrogate failure is not routinely performed for Leachate samples or TCLP samples due to the known sample pH effects on recoveries)

Method Blanks

A method blank is a volume of a clean reference matrix (reagent water for water samples) that is carried through the entire analytical procedure. The volume of the reference matrix must be approximately equal to the volume or weight of samples associated with the blank. The purpose of a method blank is to determine the levels of contamination associated with the processing and analysis of samples. A method blank must be prepared and analyzed with each batch (maximum 20 samples). This method blank must contain a concentration less than the reporting limit for all target analytes to be acceptable.

(For AFCEE and other DoD projects, the concentration in the method blank must be <1/2 the reporting limit.)

Lab Control Sample

A Lab Control Sample is a volume of a clean reference matrix spiked with a known quantity of target analytes and is carried through the entire analytical procedure. The volume of the reference matrix must be approximately equal to the volume or weight

of samples associated with the LCS. The LCS is analyzed in order to ensure that the analytical system is in control and to ensure that the laboratory is capable of making accurate and precise measurements. A Lab Control Sample Duplicate may be analyzed if there is insufficient volume for the analysis of a Matrix Spike and Matrix Spike Duplicate. Lab Control Sample and Lab Control Sample Duplicate recoveries should fall within the laboratory Quality Control limits that are determined using procedures described in Standard Operating Procedure BF-QA-002; Quality Control Limits. If the recoveries are not achieved, re-extraction and reanalysis must be performed.

If the recovery in the LCS is elevated and the associated samples are ND for the respective compound, the data are considered acceptable for reporting.

Matrix Spike/Matrix Spike Duplicate

A Matrix Spike and Matrix Spike Duplicate are an aliquot of an environmental sample spiked with known quantities of target analytes. The MS/MSD is carried through the entire analytical procedure and is evaluated to determine sample matrix bias on the analytical system or method. A MS/MSD shall be prepared once per each analytical batch or 1 per 20 environmental samples. If insufficient volume has been received for the analysis of a MS/MSD, a LCS/LCSD must be analyzed.

Table 4 summarizes the frequency and control limits of individual QC.

Table 4

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 (LCSD) is performed only when insufficient sample is available for the MS/MSD or when requested by the client/project/contract.
[2] The sample selected for MS/MSD are randomly chosen, unless specifically requested by a client.
[3] Analytical and QC samples (MB, LCS, MS/MSD)
[4] Statistical control limits are updated annually and are updated into LIMS.

9.2 ACCEPTANCE CRITERIA FOR QUALITY CONTROL MEASURES

9.2.1 ICAL: %RSD < 20% or calibration factor >0.995

9.2.2 ICV (second source): Within +/-15% of true value

9.2.3 CCV: %D < 15%
If the CCV is out high and there are no positives in the samples the results may be reported. It must, however, be noted in the logbook and on the Job Summary.

9.2.4 Method Blank:
Detected concentrations < PQL

AFCEE or DoD requires conc.<1/2 RL.
Detected concentrations < 10X amount in associated samples

9.2.5 LCS:
Recovery within lab derived historical limits.
*DEP RPC limits must be within 30-150%

9.2.6 MS/MSD:
Recovery within lab derived historical limits.

9.2.7 Surrogate:
Recovery within lab historical limits.
*DEP RPC limits must be within 30-150%

9.3 Contingencies for Handling 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-extraction
- Re-extraction 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.

For CCV's, a comment must be added to the report non-conformance summary stating which analytes exceeded the individual 15% D criteria.

10.0 Procedure

10.1 Standard Preparation

Preparation of Primary Herbicide/ Surrogate Intermediate Solution
Add 1ml isooctane, 0.5ml methanol and 1ml of hexane to a 10ml volumetric flask. Accurately add 1.0ml of the certified herbicide mixture (from Ultra HBM-8151A) and 0.5ml of the DCAA solution (from Restek 32049) to the volumetric with a syringe. Add 100ul (Trimethylsilyl) diazomethane solution and let it react for 1 hour. Make sure the yellow color persists. Quench the reaction with 0.1-0.2g silicic acid. Dilute to the 10mL mark with Hexane. Transfer the standard to a sealed amber vial, label and refrigerate until needed. (All components in this resulting solution are present at a concentration of 10μg/ml. This is the Herbicide/Surrogate Intermediate solution.

Additional sample preparation information can be located in the following:

- SOP #BP-OP-011
- SOP #BP-OP-012

10.1.1 GC Conditions

The following are recommended GC Conditions for model HP5890:

- Initial Temperature: 70ºC hold for 0.5 min
- Rate1: 12º/minute to 210ºC, hold 6 min

- Rate2: 20º/minute to 270ºC, hold 4 min
- Inj A/B Temperature: 220ºC
- Detector A/B Temperature: 330ºC
- Epp B Pressure: 4.0psi @ 70ºC – Const Flow Mode
- Injection volume: 1ul

Column			
RTX-CLPI		RTX-CLPII	
rt	compound	rt	compound
6.11	Dalapon	6.81	Dalapon
12.37	2,4-Dichlorophenylacetic acid	14.13	2,4-Dichlorophenylacetic acid
13.55	Dichloroprop	15.73	Dichloroprop
13.89	2,4-D	16.42	2,4-D
14.37	Pentachlorophenol	17.74	Pentachlorophenol
15.25	Silvex (2,4,5-TP)	18.55	Silvex (2,4,5-TP)
15.77	2,4,5-T	19.40	2,4,5-T
19.21	Picloram	20.78	Dinoseb
19.50	Dinoseb	22.13	Picloram

(Yellow highlighted components switch elution order on columns)

10.2 Calibration

A five-point calibration curve is recommended for each compound of interest. The following is a summary of the calibration concentration and the corresponding final concentration in sample extracts for each compound of interest.

10.2.1 Curve Preparation

The following describes the preparation of the Initial Calibration curve standards. (State specific requirements may require each calibration level to be derivitized separately) See section 11.2 for calibration curve calculations.

- 0.05 ng/µl Multicomponent Herbicide Mixed Solution and surrogate. This is prepared by adding 50µl of the Herbicide/surrogate intermediate solution to a 10ml volumetric flask and diluting to the mark with hexane.

- 0.10ng/µl Multicomponent Herbicide Mixed Solution and surrogate. This is prepared by adding 100µl of the Herbicide/surrogate intermediate solution to a 10ml volumetric flask and diluting to the mark with hexane.

- 0.25ng/µl Multicomponent Herbicide Mixed Solution and surrogate. This prepared by adding 250µl of the Herbicide/surrogate intermediate solution to a 10ml volumetric flask and diluting to the mark with hexane.

- 0.50ng/µl Multicomponent Herbicide Mixed Solution and surrogate. This is prepared by adding 500µl of the Herbicide/surrogate intermediate solution to a 10ml volumetric flask and diluting to the mark with hexane.

- 1.00ng/µl Multicomponent Herbicide Mixed Solution and surrogate. This is prepared by adding 1ml of the Herbicide/surrogate intermediate solution to a 10ml volumetric flask and diluting to the mark with hexane.

- 0.02ng/µl Multicomponent Herbicide mixed Solution is required for Pentachlorophenol calibration only. This is prepared by adding 20ul of the Herbicide/Surrogate intermediate solution to a 10ml volumetric flask and diluting to the mark with hexane.

- 0.01ng/µl Multicomponent Herbicide mixed Solution is required for Pentachlorophenol calibration only. This is prepared by adding 100µl of the 0.1ng/ul multicomponent herbicide mix (13.2.3) to a vial and adding 900ml of hexane.

The preparation of the 0.25ng/µl Alternate Source Multicomponent Herbicide Mixed solutions is detailed below.

0.25ng/µl Alternate Source Multicomponent Herbicide mix. This solution is prepared by adding 25µl of EM Science's Chlorinated Herbicides Methyl Derivatives (EPM 80138-1) and 25µl DCAA methyl ester solution (from Ultra Scientific) to a 10ml volumetric flask and diluting to the mark with hexane.

A purchased methyl ester standard may be employed also as a second source and as a reference to the laboratories derivatization process to verify responses.

Other mixes may be incorporated in order to provide additional information on compounds to be added to the routine list stated in this SOP, and to handle any variability in the second source provided by various vendors.

10.2.2 Curve Calibration

The %RSD can be calculated using equation 2 in section 11.2

- If the % RSD for all analytes is <20%, the curve can be assumed to be linear and the average Calibration Factor can be used to calculate the concentration of any compound detected during sample analysis.

- If the %RSD exceeds 20% for any compound the calibration can be verified using either linear regression.

- Linear regression may be used to calculate the concentrations of any compounds found in a sample, as long as that compound's correlation coefficient is >0.995.

- The alternative source described in section 10.2.1 may be used to verify the initial calibration.

10.2.3 Continuing Calibration

- The concentration of the standard used for calibration verification is prepared at the midpoint of the five-point initial curve.

- Analysis is performed after every 10 samples and at the end of a particular sequence of samples. (*Secondary CCV level required if utilizing a Quadratic Curve Model)

- The calibration factor of the calibrator verification standard must be ±15% Difference (D) of the average calibration factor of the initial calibration curve. Failure to meet the 15% D criteria for calibration verification requires maintenance. If the maintenance performed is insufficient, an analyst may recalibrate the instrument (new initial curve).

Alternate source – A midpoint standard must also be prepared using a solution of the herbicide mixture of interest from a second source. This provides a check of our calibration curve and methylation procedure. This alternate source must be run after a new calibration curve and must have a %D of ±20% of the average response factor of the curve.

Table five summarizes the parameters for Calibration.

Table 5

Calibration Controls	Sequence	Control Limit
Calibration Standards	5-point (minimum) linearity	≤20% RSD or R2 >0.990
Continuing Calibration Verification (CCV)	Prior to / after every 10 injections (*Secondary CCV level required if utilizing a Quadratic Curve Model)	<15% D
RT Windows (RTW)	Init. CCV determines mid pt. of RTW	±3X SD

10.3 Sample Analysis

Samples are run on an HP5890 gas chromatograph using Hexane as a solvent and Helium as a carrier gas. Table 6 shows an example analysis queue / sequence for method 8151.

Table 6

Step	*Standards*	*Type*	*Control Limit*	*Frequency*
Method # 8151				
Initial Cal	*5 to 7pt*	*Linear or Ave Cal Factor*	*0.990 r^2 or 20%RSD*	*As Needed*
ICV	*2nd Source*	*Lot or Vender*	*< 15% D*	*After Every ICAL*
CCV	*ICAL Std*	*Midpoint (Secondary concentration CCV also required if utilizing Quadratic Curve Model)*	*< 15% D*	*Prior to analysis*
10 Runs	*MBLK*	*Blank*	*< Rpt Limit*	*Every 20 Samples*
	LCS	*Spike*	*In-House Limits*	*Every 20 Samples*

	LCSD	*Spike*	*In-House Limits*	*Every 20 Samples if no MS/MSD*
	MSMSD	*Sample Spike*		*As required by clients*
	Samples & Inst Blanks			
CCV	*ICAL Std*	*Midpoint (Secondary concentration CCV also required if utilizing Quadratic Curve Model)*	*< 15% D*	*Every 10 Runs*
10 Runs	*Samples & Inst Blanks*			
CCV	*ICAL Std*	*Midpoint (Secondary concentration CCV also required if utilizing Quadratic Curve Model)*	*< 15% D*	*Every 10 Runs*

10.4 Retention Time Windows

The width of the retention time window for each compound is determined using the standard deviation of three retention time measurements of individual standards measured over the course of a 72-hour period.

- Make three injections of a mid-level standard mixture throughout a 72-hour period. Retention time windows are defined as plus or minus three times the standard deviation of the absolute retention time for each component. The experience of the analyst should weigh heavily in the interpretation of the chromatogram.

Retention time windows are to be calculated for each standard on each GC column on an annual basis or whenever the chromatographic conditions change, (i.e., a new GC column is installed or the instrument is subjected to major maintenance.) If the calculated windows encompass a variable range of 0.0 min to 0.10 minutes, a default of 0.03 minutes can be applied to all for consistency. Chromatography conditions may vary the window size that best suits the data set, so It is important to utilize the smallest RT window that can be practically applied to minimize the potential for false positives..

When relative retention time windows are updated, the new calibration method will be printed out for review of proper elution order for the particular column, and then dated and initialed upon completion of review. This will be filed with the initial curve for comparison.

11.0 Calculations / Data Reduction

11.1 CF Calculation Details

The concentration of specific analyses in samples is determined using the Average Calibration Factor (CF) calculated from the initial curve.

Equation 1: CF = Peak Area/Standard Concentration (ng/µl).

Aqueous Calculation

Determine the calibration factor for each compound in the initial curve using equation 1 above, and calculate the ACF.

NG of Compound in Sample = Peak Area of Compound/ACF
µg/l of Compound = [{NG x DF x FV}/{I,V x ExV}]

DF = Dilution Factor
FV = Final Volume of Concentrated Extract (mls)
I,V = Injection Volume (µls)
ExV = Extraction Volume (L)

Soil/Solid Calculation
Determine the calibration factor for each compound in the initial curve using equation 1 above, and then calculate the ACF.

NG of compound in Sample = Peak Area of Compound/ACF.
µg/KG of Compound = [{NG x DF x FV}/{I,V x ExW x DW}] X 1000

DF = Dilution Factor
FV = Final Volume of Concentrated Extract (mls)
I,V = Injection Volume (µls)
ExW = Extraction Weight (grams)
DW = Decimal Dry Weight

11.2 Calibration Calculations

Equation 2: %RSD= [CF Standard Deviation/CF Mean] X 100
Equation 3: % D = [Avg.CF (Initial) – CF (Cal. Verif.)/Avg. CF (Initial)] X 10

11.3 Through the use of a Totalchrom data link, the nanogram amounts from the quantitation system are downloaded into the TALS system, where the final calculation is performed electronically. A second analyst reviews this data.

12.0 METHOD PERFORMANCE

12.1 Method Detection Limit

A valid method detection limit for each analyte of interest must be generated. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B. See SOP AQA-BF-QA-001, “The Determination of Method Detection Limits,” current revision, for further guidance. Current Test America MDLs are maintained by the QA department and are easily viewed in the TALS.

12.2 Demonstration of Capabilities

A one–time initial demonstration of performance for each individual method for both soils and water matrices must be generated.

This requires quadruplicate analysis of a mid–level check standard containing all of the standard analytes for the method using the same procedures used to analyze samples, including sample preparation.

Calculate the average recovery and standard deviation of the recovery for each analyte of interest.

Compare these results with the acceptance criteria given in the Method or to laboratory historical limits (if available).

Repeat the test for any analyte that does not meet the acceptance criteria. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

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 acceptable manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

The following waste types are generated for this procedure and where they are to be disposed of:

- C-Waste: all solvent waste gets dumped into appropriately marked metal cans. These cans need to be grounded whenever they are emptied to reduce explosion hazards. Discarded standards (except PCB's) will also be dumped into C-Waste.

- Solid Waste: all contaminated paper, solid sample waste, sodium sulfate and all other non-glass material that has been contaminated is to be wrapped in foil and gathered to be dumped into 55 gallon drums.

- Glass: contaminated glass needs to be rinsed with methylene chloride and disposed of with all other glass in glass specific containers with special extra thick polypropylene liners. These containers are for glass only.

- Extract Vials: extract vials are to be archived after they have been shot. After one year of archival vials are to be crushed into a 55-gallon drum.

- All acidified aqueous waste is to be disposed into a labeled "A" waste container.

15.0 References / Cross-References

Method 8151A U.S. Environmental Protection Agency, Office of Solid Waste and Energy Response, “Test Methods for Evaluating Solid Waste Physical/Chemical Methods” 3rd Ed., SW-846; update III, Dec. 96.

16.0 Method Modifications: N/A

17.0 Dual Column Procedure

17.1 Dual Column Procedure (Policy No. CA-Y-P-003)

17.1.1 The laboratory may designate a primary column for each analyte (in which case the 2nd column is the confirmation column for each analyte), or may the lower result from the two columns. The same column does not have to be primary for every analyte. Both columns are intended to be calibrated and meet verification requirements.

17.1.2 Whichever approach is used QC must be assessed and reported in the same manner as the samples (i.e. report from a primary column or the lower number)

17.1.3 40% RPD Criterion

17.1.3.1 When using the primary column option, if the RPD for the dual column results is </= 40%, then the result from the primary column is normally reported. The exception is situations where a chromatographic interferent is evident in the primary column chromatogram that is not present in the confirmatory column chromatogram.

17.1.3.2 If using the primary column option and the RPD for the dual column results is >40%, then the lower value is reported. (An RPD od >40% is clear evidence of chromatographic interference/co-elution on the higher value) A case narrative comment, flag, or footnote citing this failure must be included in the final report.

17.1.4 Calibration Verification Criterion – Primary Column Option

17.1.4.1 If the CCV recovery for the primary column is within acceptance limits and the analyte is confirmed on the secondary column, but the second column is outside of acceptance limits, then the primary column may be reported with a case narrative comment or footnote.

17.1.4.2 It the CCV recovery confirmation column is within acceptance limits, and the recovery for the primary column is in the range of +15 to +40%, then the results may be reported from the confirmation column with a case narrative comment or footnote.

17.1.4.3 If the CCV recovery is below acceptance limits for the primary column, or the secondary column is below acceptance limits and the analyte is not confirmed, then the problem should be investigated and fixed. The associates samples will need to be reanalyzed with acceptable CCVs.

17.1.4.4 If the CCV recovery on either column is >40% above acceptance limits, any associated sample positives will need to be reanalyzed with acceptable CCVs.

17.1.5 Calibration Verification Criterion – Lower Result Option

17.1.5.1 If the CCV recovery for the column with the lower result is within acceptance limits and the analyte is confirmed on the secondary column, but the secondary column is outside acceptance limits, then results from the lower column may be reported with a case narrative comment or footnote.

17.1.5.2 If the CCV recovery for the higher result is within acceptance limits, but the lower results column fails acceptance criteria and the RPD is <15%, then the higher result may be reported with a case narrative comment or footnote.

17.1.5.3 If the CCV recovery on either column is >40% above acceptance limits, any associated sample positives will need to be reanalyzed with acceptable CCVs.

18.0 Revision History

Revision 0, dated 27 October 2006
- Deleted Calcium Carbonate Powder from section 10.1
- Deleted reference to Calcium Carbonate and sample prep section 14.1 and renumbered section.
- Removed Dicamba from ICAL summary table under section 14.2.1

Revision 1, dated 01 August 2009
- Revised into new format and revision, removed all Grand Mean references.

Revision 2, dated 07, September 2011
- Revised to reference TALS nomenclature, removed ELEMENT references in many sections.
- Section 3.0, Corrected 8151A reference
- Section 1.0, reformatted Table 1.
- Changed Quality Manager, signature added.

Revision 3, dated 13, July 2012
- Section 9.2, Added DEP RCP requirements.

Revision 4, dated 1, April 2014
- Section 1.1, added additional compounds targeted via the standard:standard corporate directive.
- Section 7.0, expanded reagent list as per above.
- Section 10.2.1, expanded options for curve preparation to encompass additional compound development.
- Update Quality Manager

Revision 5, dated 29, September 2014
- Section 17 Inserted Dual Column procedure cited from Policy No. CA-Y-P-003
- Section 10.1 Updated instrument conditions
- Section 10.1 Inserted elution order and relative RT time table
- Section 9.2.8 removed old dual column approach

Revision 6, dated 6, September 2016
- Section 10.3.2 – added quadratic additional CCV requirements
- Section 10- Tables 3 & 4 – added quadratic additional CCV requirements
- Update Manager references, signatures added

Revision 7, dated 15, September 2019
- Changed Quality Manager, signature added

Revision 8, dated 1, July 2019
- Sect. 2 - edited spacing to correct formulas – '=O' were positioned improperly
- Sect. 8 - Corrected soil prep HT to 14d
- Sect. 9 – changed Method Blank to 'detection limit' to 'reporting limit' for consistency with other sections.
- Rev 7 had two 'Table 3' and two 'Table 4'. Re-designated the ones in sections 10.2.3 and 10.3 as 'Table 5' and 'Table 6'
- Updated CCV criteria from <20%D to <15%D in Section 10.2, Table 4 (now table 6); in order to match with sections 9.2 and 10.2.3 and for consistency with TALS ICAL limit group and within the SOP (some spots had <20%D)

Title:Organochloride Pesticides [Methods 608, 608.3, 8081A, & 8081B]

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):

1/22/19	1/21/19
Gary S. Rudz Department Manager	Date	Kenneth Kasperek Laboratory Director	Date

1/22/19

Michael Mosscrop
Quality Assurance Manager

Date

1.0 Scope and Application

1.1 This method is used to qualify and quantify organochlorine Pesticides in extracts from solid and liquid matrices by direct injection techniques onto a capillary column. An electron capture detector (ECD) is employed for identification and quantification.

1.2 Pesticides are analyzed in an analytical run to allow separation of all single component pesticides.

1.3 The presence of single component pesticides is confirmed with a second dissimilar column and is based on retention time, peak shape, and response.

1.4 Pesticides analyses are performed in a single injection with a "Y" split into two analytical column systems.

1.5 This method is restricted to use by or under the supervision of analysts experienced in the use of a gas chromatograph and the interpretation of gas chromatograms. Table 4 indicates compounds that may be determined by this method.

1.6 Analytes, Matrix(s), and Reporting Limits

1.6.1 Applicable matrices are soil or aqueous samples

1.6.2 Reporting limits are defined on an analyte specific basis by the low point in the calibration curve and are supported by the performance of annual method detection limit studies

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 Soil or solid samples are extracted with an appropriate solvent using ultrasonic extraction (SOP BF-OP-005). For aqueous samples, approximately 1 liter of sample is extracted with methylene chloride using a separatory funnel (SOP BF-OP-003). The extract is then exchanged to hexane and concentrated to 10 ml or less. The final extract is then separated by gas chromatography and detected by an electron capture detector. Florisil column cleanup procedures and sulfur removal procedures may be utilized to mitigate any interferences that may be encountered during analysis. Although these procedures may eliminate several interferences, contamination of the sample may come from a variety of sources, including solvents, reagents, glassware and any of the hardware used in sample processing. For this reason, reagent and solvent blanks shall be analyzed to insure their purity.

3.0 Definitions

3.1 MDL

The theoretical calculated method detection limit using statistical means.

3.2 PQL

The practical quantification limit based on the lowest level of the calibration curve.

3.3 CRQL /CDL

The client required quantification limit or the client detection limit based on specific client or site regulations

3.4 Multi-component
The target compounds that exhibit many peaks as individual parts of the reported component. e.g. Toxaphene & Chlordane (also called technical chlordane)

3.5 LCS
Laboratory Quality Control samples.

3.6 MS/MSD/SD
Synonyms for client spikes

3.7 DU/MD
refers to duplicate samples

3.8 VBLK/MBLK/BLK
refer to Method Blanks

3.9 IBLK/HEXANE
refer to instrument or solvents used to identify contamination or minimize carry over problems

3.10 EBLK/BLK2
refers to the extractor blank performed with TCLP tumbling in TALs.

3.11 TEST RUNS
used to evaluate instrument operational functionally

3.12 ICV
Initial Calibration Verification-2nd source check for calibration in TALs (Alt Source)

3.13 IS
Internal Standard: 1-bromo-2-nitrobenzene

3.13 CCV
Continuing Calibration Verification

3.14 Primer
Old standard, QC, or blank analyzed if instrument has been idle

4.0 Interferences

4.1 Sources of interference in this method can be grouped into three broad categories: contaminated solvents, reagents or sample processing hardware; contaminated GC carrier gas, parts, column surfaces or detector surfaces; and the presence of co-eluting compounds in the sample matrix to which ECD will respond. Interferences co-extracted from the samples will vary considerably. As part of this method, unique samples may require additional cleanup approaches to achieve desired degrees of discrimination.

4.2 Florisil Cartridge Cleanup (SOP BF-OP-007 3610A) for Pesticides is routinely performed if extracts are highly colored.

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

5.1.1 The gas chromatograph contains 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.

5.1.2 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

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 Safety Data Sheets (SDS) 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 SDS for each material before using it for the first time or when there are major changes to the SDS.

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.
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.
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.			

6.0 Equipment and Supplies

6.1 Instrumentation

6.1.1 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.

- **6.1.1** Hewlett Packard 5890 gas chromatograph/Agilent 6890 gas chromatograph
- **6.1.2** Hewlett Packard 7673 Auto Sampler/Agilent 7683 Auto Sampler
- **6.1.3** Hewlett Packard 3392 and 3396A Integrators for HP5890 GC only
- **6.1.4** Capillary columns as described in sections 6.2
- **6.1.5** Electron Capture Detector
- **6.1.6** PE Nelson Turbochrom data system
- **6.1.7** Carrier Gas – Helium / Hydrogen
- **6.1.8** Make Up Gas - Argon/Methane / Nitrogen
- **6.1.9** Syringes – various
- **6.1.10** CHROM – TALs chromatography system

6.2 Pesticides dual column analytical system

6.2.1 Column pair or equivalents

- **6.2.1.1** Dual column injection Tee (Restek Corporation) 1\4 inch glass injection tee, deactivated.
- **6.2.1.2** 30 m x 0.53 mm ID RTX-CLPI (Restek).
- **6.2.1.3** 30 m x 0.53 mm ID RTX-CLPII (Restek)
- **6.2.1.4** 30 m x 0.32 mm ID RTX-CLPI (Restek)
- **6.2.1.5** 30 m x 0.32 mm ID RTX-CLPI (Restek)

6.3 Instrument Maintenance

6.3.1 Upon verification of established operating conditions, the following is performed on a sequence basis, or sooner if deemed necessary. All maintenance shall be noted in the specific maintenance logbook.

- **6.3.1.1** Change septum
- **6.3.1.2** Check flows and column condition (i.e., degradation)
- **6.3.1.3** Analyze solvent blank to insure system is free of contamination
- **6.3.1.4** If degradation or any interferences are present, the analyst may replace the injection port liner, bake the column at 300°C or cut a section of the column end (i.e., 6-12 inches).
- **6.3.1.5** Cut guard and/ or column

6.4 Supplies

- Volumetric Flasks (Class A): 100 mLs; 200 mLs; 500 mLs; 1000 mLs
- Syringes Various sizes

7.0 Reagents and Standards

7.1 Pesticide grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of determination.

7.1.1 Standards are stored in the GC Standard Incubator at 4±2°C in teflon-sealed amber containers.

7.1.2 All stock standard solutions are replaced before the expiration date. All other standard dilutions or working standards are discarded after six month (or at the stock standard expiration date, whichever comes first) or sooner if routine QC indicates a problem.

7.1.3 All standards (Primary and Alternate Source) shall be acquired from a certified vendor. For standard traceability and preparation, refer to SOP BF-GP-019.

7.1.4 Calibration Standards for Pesticides

7.1.4.1 1-Bromo-2-Nitrobenzene: Stock 100 ng/ul, to be added ultimately to each extract and standard at a final concentration of 0.5ng/ul (ug/ml)

7.1.4.2 The intermediate solution made from a stock containing both pesticides and surrogates diluted in Hexane to make the 10.0 ng\ul intermediate standard. The intermediate standard and the intermediate surrogate solution are respectively and subsequently diluted to prepare five concentrations (0.005 ng\µl, 0.010 ng\µl, 0.05 ng\µl, 0.10 ng\µl and 0.15 ng\µl).

7.1.4.3 Intermediate multi-component Pesticides Mix Solution: Dilute stock standard solution to prepare five concentrations (0.050 ng\µl, 0.10 ng\µl, 0.500 ng\µl, 1.000 ng\µl and 1.500 ng\µl).

7.1.4.4 Performance Evaluation Mix (PEM): The PEM stock solution is made of alpha-BHC, beta-BHC and gamma-BHC at 1.0 ng\µl of each pesticide, Endrin at 5.0 ng\µl, DDT at 10.0 ng\µl and Methoxychlor at 25 ng\µl. The intermediate PEM solution is prepared by adding 100 µl of the stock PEM solution to a 10.0 ml volumetric flask and bringing to volume with Hexane.

7.1.5 Spike Solution

7.1.5.1 The spike mixture contains each single-component parameter of interest at 1.0 ng/µl in acetone or methanol. For all routine analysis, 500ul of the spiking solution will be added to each water/soil spike (extract final volume = 10.0ml). The applicable expected

concentration in the extract for all single component pesticides is then 0.050ng/ul. This concentration is equal to the midpoint of the calibration curve, and below the midrange of the calibration curve range. Additional information on the spike mixture can be found in the sample preparation SOPs BF-OP-005, and BF-OP-003.

7.1.5.2 For 3510C_LVI, the final volume of 2ml will be applied to utilize a 250ml extraction volume, and maintain the same reporting limits as a 1 Liter extraction.

7.2 See Table 1 for Summary Concentrations

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 Aqueous samples are to be collected in a 1-liter amber glass jar and stored at 4±2°C. Organic preparation is to be performed within 7 days of collection. Analysis of the extracts is to be performed within 40 days of preparation.

8.2 Soil samples are collected in a 2 or 4 oz wide mouth glass jar and stored at 4±2°C. Organic preparation is to be performed within 14 days of collection. Analysis of the extracts is to be performed within 40 days of preparation.

8.3 Holding times specified in project specific quality assurance plans may supercede the above listed method criteria.

8.4 Extracts are stored under refrigeration at 4±2°C.

8.5 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	1-Liter Amber glass	1000 mLs	Cool 4 ± 2°C	7 Days to extraction; 40 days to analysis	40 CFR Part 136.3
Soils	2 or 4oz wide mouth glass jar	30 grams	Cool 4 ± 2°C	14 Days to extraction; 40 days to analysis	N/A

9.0 Quality Control

9.1 The reader is referred to TestAmerica Laboratories' Corporate Quality Management Plan (QMP) and 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 Laboratories' QMP, LQM or the following criteria. The following criteria are subsequently presented as minimum criteria or those criteria deemed applicable in the absence of project-specific DQOs.

9.2 Sample QC -The following quality control samples are prepared with each batch of samples.

9.2.1 Surrogates:

9.2.1.1 Lab QC and sample surrogate recoveries shall fall within method, lab calculated, or client specific limits. Samples outside these ranges are to be reanalyzed. Blank recoveries outside this range may lead to: Re-extraction if within holding time and volume available, noting recoveries in case narrative or flagging values as estimated. The spike results, sample matrix and reported positives in the prep batch are also to be considered. Acceptability may be determined by citing historical sample and method results on a case by case basis.

9.2.2 Matrix Spike/Matrix Spike Duplicates (MS/MSD)/Method Blank (LCS):

9.2.2.1 MS/MSD samples are to be prepared at a frequency of at least 5% (1 MS/20 samples and 1 MSD/20 samples) or with each analytical batch when sample volume permits it. A LCS is also to be prepared at a frequency of at least 5% (1 LCS /20 samples) or with each analytical batch. If insufficient field sample volume is available for MS/MSD in a batch of 20 samples, a LCS/LCSD shall be prepared. (For method 608, the spike frequency is 1 MS/10 Samples)

9.2.2.2 The percent recovery of the MS/MSD/LCS is calculated to determine the accuracy (%R) and precision (RPD) acceptability of the extraction batch. The laboratory's internal QA/QC limits are calculated annually and are used to monitor the laboratory quality performance and/or to identify trends in analysis. Laboratory limits are reviewed to determine compliance with the method acceptance criteria.

$$\%R = \{ [Conc._{spiked\ sample} - Conc._{base\ sample}] / Spike\ added \} X\ 100$$

$$RPD = [MS - MSD] / \{[MS + MSD] / 2\} X\ 100$$

9.2.2.3 If both the MS and MSD recovery fall outside the established control limits, matrix interference is assumed and LCS recovery acceptable, no corrective action is performed.

9.2.2.4 If only the MS or MSD falls outside the established control limits, the system shall be investigated to determine a possible cause of error.

9.2.2.5 If the recovery of the LCS falls outside control limits, the system shall be investigated to determine a possible cause of error. Re-extraction/re-analysis of the entire extraction batch may be performed. Lab QC recoveries shall fall within method, lab calculated, or client specific limits. QC outside these ranges are to be reanalyzed. Recoveries outside this range may lead to: Re-extraction if within holding time and volume available, noting recoveries in case narrative or flagging values as estimated. The spike results, sample matrix and reported positives in the prep batch are also to be considered. Acceptability may be determined by citing historical sample and method results on a case by case basis.

9.2.3 QC acceptance criteria for MS samples and LCS

9.2.3.1 Where in-house limits have been developed for matrix spike recoveries, the LCS results shall fall within those limits, as the LCS is prepared in a clean matrix. The laboratory shall use 70 - 130% as interim acceptance criteria for recoveries of spiked analytes, until in-house LCS limits are developed. It is necessary for laboratories to develop in-house performance criteria and compare them to those in the methods. In-house limits are developed with a minimum of 15-20 spike results set by the formula. For Method 608.3, the LCS limits are based off of Table 4 acceptance criteria found in method 608.3 December 2016.

9.2.3.2 For each matrix spike blank sample analyzed, calculate the percent recovery of each spike compound added to the blank. For each field sample, calculate the percent recovery of each surrogate.

9.2.3.3 Calculate the average percent recovery (p) and the standard deviation (s) for each of the spike compounds after analysis of 15-20 matrix spike blanks of the same matrix, using the equations below, as guidance. Calculate the average percent recovery (p) and the standard deviation (s) for each of the surrogates after analysis of 15-20 field samples of the same matrix, in a similar fashion.

9.2.3.4 After the analysis of 15-20 matrix spike blanks of a particular matrix (for matrix spike limits) or 15-20 field samples (for surrogate limits), calculate upper and lower control limits for each spike or surrogate compound:
Upper control limit = p + 3s
Lower control limit = p - 3s

9.2.3.5 The laboratory will develop and retain in-house limits to be evaluated annually based on historical results.

9.3 Method Blank

9.3.1 At a minimum, one method blank per extraction batch must be extracted and analyzed. (Minimum one/20 Samples). The concentration of any target compound in the method blank must be less than the reporting limit.

9.3.2 If the concentration of any compound exceeds the reporting limit, the system shall be investigated to determine a possible cause of error. If there are no positives in the associated samples, the data may be used noting the exceptions in the case narrative. The method blank and all related field and QC samples shall be re-extracted/re-analyzed. Acceptability may be determined by citing historical sample and method results on a case by case basis.

9.4 Summary of QC

9.4.1 Method Blank (Mblk)
9.4.1.1 Detected concentrations < PQL or <CDL
9.4.1.2 Detected concentrations < 10X amount in associated samples
9.4.2 LCS: (Minimum) Every 20 Samples
9.4.2.1 Recovery within lab historical limits
9.4.2.2 Recovery within lab historical limits
9.4.3 LCSD if insufficient sample volume for MS/MSD
9.4.3.1 Recovery within lab historical limits, %RSD <30%

9.4.4 MS/MSD:
9.4.4.1 Recovery within lab historical limits %RSD <30%, failures noted in job comments, no action required

9.4.5 Surrogates TCX & DCBP:
9.4.5.1 All Samples and Quality Control - One surrogate recovery within lab historical limits, none below 10%.

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 (LCSD) 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.

9.5 Instrument QC

9.5.1 ICAL:
9.5.1.1 608 - %RSD < 10% or linear R factor >0.995, (R^2 >0.990)
9.5.1.2 8081 - %RSD < 20% or linear R factor >0.995, (R^2 >0.990)
9.5.2 CCV: ICV (second source): Within +/-20% of true value

9.6 Corrective actions for Out-of Control Data
9.6.1 Indicate routine corrective actions if control limits not met for each of the following
9.6.1.1 ICAL Analysis can not begin without an acceptable calibration curve. Instrument maintenance may be required
9.6.2 ICV: Reanalyze calibration curve if unacceptable ICV is obtained
9.6.3 CCV: Reanalyze the CCV for external standard method.
9.6.3.1 If 2nd analysis is acceptable, analytical sequence can continue, however the previous 10 samples must be reanalyzed.
9.6.3.2 If 2nd analysis is unacceptable, analyze a new ICAL or instrument

maintenance may be needed.

9.6.3.3 If internal standard method is used, all results prior to the failing CCV are acceptable. (up to 20 injections)

9.6.3.4 For 608.3, CCV needs to be 2nd source/lot# then ICAL, and analyzed at the end of the analytical batch.

9.6.4 Method Blank: Re-extract all samples associated with an unacceptable method blank.

9.6.5 LCS

9.6.5.1 If below limits: Re-extract all samples associated with an unacceptable LCS

9.6.5.2 If above limits: Re-extract all samples with detections of Pesticides. Re-extraction not required if samples are ND.

9.6.6 MS/MSD:

9.6.6.1 Matrix interference can be assumed and corrective action is not required if both of the following conditions are met:

Recoveries in both MS and MSD are consistent (%RSD<30) and the LCS recovery is acceptable

If recoveries in MS/MSD are different (e.g.: one high, one low) further evaluation shall be made. Matrix interference can not be assumed in this case. Discussion with the department supervisor, operations manager or QA manager shall be included in the final decision process prior to releasing data.

9.6.7 Surrogate:

9.6.7.1 All Samples and Quality Control - One surrogate recovery within lab historical limits, none below 10%, comment only.

9.6.7.2 Lab Quality control - Both surrogates out, rerun, still out, batch re-extraction

9.6.7.3 Samples – Both surrogates out without matrix effects or historical support, re-extraction required.

9.6.7.4 Samples – Leachate, Waste or Historically supported matrix effects, report and add job comment

ICAL: %RSD < 20% or calibration factor >0.995

ICV (second source): Within +/-20% of true value

CCV: %D < 20%

If the CCV is out high and there are no positives in the samples the results may be reported. It must, however, be noted in the logbook and on the Job Summary.

Method Blank:

Detected concentrations < PQL

Detected concentrations < 10X amount in associated samples

LCS:

Recovery within lab derived historical limits.

*DEP RPC limits must be within 40-140%

MS/MSD:
Recovery within lab derived historical limits.

Surrogate:
Recovery within lab historical limits.

*DEP RPC limits must be within 30-150%

9.7 CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

9.7.1 Acceptability may be determined by citing historical, sample, and method results on a case by case basis.

9.7.2 In the event acceptable data can not be obtained, a Non-Conformance Memo (NCM) must be filed with the Project Manager for notification of the client.

10 Procedure

10.1 Sample Preparation

10.1.1 Extraction Refer to SOPs BF-OP-004 (Continuous Liquid-Liquid Extraction), BF-OP_005 (Aqueous Separatory Funnel Extraction Procedure), BF-OP-003 (Method 3550-Ultrasonic Extraction Procedure), and Project-specific extraction procedure for guidance in choosing the appropriate extraction procedure.

10.1.2 Spiked samples and Matrix Spike Blank(s) are used to verify the applicability of the chosen extraction technique to each extraction batch and to determine the accuracy of the procedure. For Pesticide analysis, the spike solution consists of all single component pesticides listed in Table 2 with the exception ADDS.

10.1.3 Florisil Catridge Cleanup (SOP BFOP007 3610A) for pesticides is routinely performed if extracts are highly colored.

Step	Standards	Type	Control Limit	Frequency
Method # 608				
Initial Cal	*3 Point Ical Minimum*	*Calibration Curve*	*%RSD ,<10% or Linear >0.990*	*When ICV criteria cannot be reached with routine maintenance*
Second Source (ICV)	*Single Point*	*Alternate Lot# or Vender*	*<15% D*	*After each calibration*
Degradation Check	*Single Point*	*Performanc e Evaluation Mix*	*<20%degradation of Endrin and <20% degradation 4,4'-DDT*	*Daily*
CCV	*Single Point*	*Midrange Standard*	*<15% D*	*Prior to analysis of samples*
CCV	*Single Point*	*Midrange Standard*	*<15% D*	*Every 10 injection for external standard. Prior to every 20 injections for Internal Standard.*
Method # 8081A/B				
Initial Cal	*5 Point Ical Minimum*	*Calibration Curve*	*%RSD <20% or Linear >0.990*	*When ICV criteria cannot be reached with routine maintenance*
Second Source (ICV)	*Single Point*	*Alternate Lot# or Vender*	*<20% D (8081B) <15% D (8081A)*	*After each calibration*
Degradation Check	*Single Point*	*Performanc e Evaluation Mix*	*<20% degradation of Endrin and <20% degradation 4,4'-DDT*	*Daily*
CCV	*Single Point*	*Midrange Standard*	*<20% D (8081B) <15% D (8081A)*	*Prior to analysis of samples*
CCV	*Single Point*	*Midrange Standard*	*<20% D (8081B) <15% D (8081A)*	*Every 10 injection for external standard. Prior to every 20 injections for Internal Standard.*

10.2 Calibration

10.2.1 A five-point calibration curve is established for each compound of interest and must be reanalyzed whenever calibration verification cannot be achieved. The 5 levels for all single component pesticides are 0.005/0.010/0.050/0.100/0.15 ng/µl. These values are generated by using the Method Detection Limit (MDL) Study for the instrument, the working range of the detector, and the concentration required to meet routine detection limits based on the low standard in the calibration curve. This gives an expected low final concentration of 0.05ug/L for all water analysis given a sample volume of 1 Liter, and 1.667 ug/Kg for all soil analysis given a sample weight of 30.0g and 100% dry.

10.2.1.2 Calculate the calibration factor (CF) for each compound at each concentration level.
CF = Peak Area / Standard Concentration (ng)

10.2.1.3 Calculate the percent Relative Standard Deviation (%RSD) between the calibration factors of each compound at all concentration levels.
%RSD = [CF Standard Deviation / CF Mean] X 100

10.2.1.4 If the %RSD for each analyte is <20% the curve (608 <10%)can be assumed to be linear and the average Calibration Factor can be used to calculate the concentration of any compounds detected during sample analysis

10.2.1.5 If the %RSD exceeds 20% for any compound, concentrations of that compound found in samples must be calculated using linear regression. The correlation coefficient of this linear fit must be greater than 0.995.

10.2.1.6 The ICIS will be designated to the midpoint of the calibration (using the IS recovery for this run to link to all other CCVIS standards for reference)

10.2.2 The concentration of the standard used for calibration verification is prepared at the midpoint of the five point initial curve. (Below the midrange)

10.2.2.1 Single Component Analysis is performed after every 10 samples (20 injections if internal standard is added) and at the end of a particular sequence of samples. Multi-component analytes will be run weekly when they are target analytes to insure pattern recognition. When identified, they will be verified either before or after the sample containing the positive in as timely a manner as possible.

10.2.2.2 The calibration factors of the components in the standard hall all be less than or equal to $\pm$ 20% Difference (D) of the average response factor osf the initial calibration curve.
$\%D = [Avg.CF_{(Initial)} - CF_{(Cal.Verif.)} / Avg.CF_{(Initial)}] \times 100$

10.2.2.3 When using linear regression rather than %RSD, the %Difference values are calculated based upon nanogram values rather than calibration factors.

10.2.2.4 Failure to meet the average 20% D criteria for calibration verification may require recalibration of the instrument (new initial curve) and re-analysis of all samples analyzed since the last compliant calibration verification. If the CCV exhibits an elevated response, and the samples show no positives, the data may be used to show non-detects in the samples affected.

10.2.2.5 Cases where the CCV exhibits a %D > 20% but < 30%, can be utilized when known matrix affects consistently produces these results, either presently or historically. The exceptions will be noted in reference to the specific compounds and samples that are affected.

10.3 Retention Time Windows

10.3.1 Initial width of the retention time window for each compound can be determined based upon the standard deviation of three retention time measurements of the individual standards measured over the course of a 72-hour period.

10.3.1.1 Make three injections of all single component standards mixtures and multi-component products throughout a 72-hour period.

10.3.1.2 Calculate the standard deviation of the three absolute retention times of each single component compound. For multi-component compounds, choose 3 major peaks and calculate the maximum deviation of the three absolute retention times for that peak. Multiply this by 1.5.

If the standard deviation calculates to be negligible, a default retention time of +/-0.01 minutes is to be used for all single component pesticides, +/-0.03 minutes for all multi-components, and +/- 0.015 minutes for the later eluting DCBP surrogate.

10.3.1.3 The windows need to be assessed and applied per instrument.

10.3.2 Ongoing Retention time window assessments are critical to operation functionality. The RT window applied to the first CCV of the day should be functional to the batch processing in Chrom. Upon batch analysis, the LCS and CCV identification should work correctly. If any of these analytes fall outside the daily windows, the windows should be widened to encompass these variances. The entire batch will need to be reprocessed with the updated windows.

10.3.3 The widened Retention time windows shall remain in subsequent batches, though these should not exceed +/- 0.03 min. If so, the system should be carefully evaluated to insure maintenance is not required, or performance parameters need to be adjusted.

10.3.4 Subsequent to maintenance and/or calibration, the existing RT windows need to be carefully re-assessed to insure the tightest conditions possible applied to samples to minimize the potential for identification anomalies.

Calibration Controls	Sequence	Control Limit
Calibration Standards	5-point (minimum) linearity	≤20% RSD
Cont. Cal. Verif. (CCV)	Prior to / after every 20 Injections ISTD (10 injections ESTD)	≤20% RSD 8081B ≤15% RSD 608/8081A
RT Windows (RTW)	Init. CCV determines midpt. of RTW	±3X SD

10.4 Sample/ Gas Chromatographic Analysis

10.4.1 Prime the instrument, if needed, with two injections of 0.15 ng\µl pesticides mix standard, or hexane blank.

10.4.2 DDT and Endrin are easily degraded in the injection port. Breakdown occurs when the injection port liner is contaminated with high boiling residue from sample injection or when the injector contains metal fittings. The breakdown of DDT and Endrin is measured before a pesticide curve or samples are analyzed for pesticides, and then every 12-hours or twice daily while running, Injector maintenance and\or recalibration is performed if the breakdown is greater than 20% for either compound.

10.4.2.4 Calculate percent breakdown as follows:

$$\%\ \text{breakdown for DDT} = \frac{\text{Total DDT degradation peak area (DDE + DDD)}}{\text{peak areas (DDT + DDE + DDD)}} \times 100$$

$$\%\ \text{breakdown for Endrin} = \frac{\text{Total Endrin degradation peak area (Endrin Aldehyde + Endrin Ketone)}}{\text{peak areas (Endrin + Aldehyde + Ketone)}} \times 100$$

10.4.3 A 0.05 ng\µl standard of single component pesticide mix standard solution is analyzed every 10 samples (20 injections ISTD). The response of the standard shall be within 15 % of the initial calibration.

10.4.4 The routine daily sequence shall consist of (at minimum):

PEM (Degradation Check)
8081 std (Midpoint Calibration Verification)
10 Samples (including QC)/ 20 samples ISTD
8081 std (Midpoint Calibration Verification)
10 Samples (including QC)/ 20 samples ISTD
8081 std (Midpoint Calibration Verification)

The multicomponent Toxaphene and Chlordane are run weekly at 0.50ng/ul (MidPoint) to verify the patterns. Adds (Table 4) compounds are injected as needed for quantitation.

10.4.5 Depending on the nature of the sample extracts and the target compounds required by the client, standards can be run more often to confirm any suspected response changes, and to verify potential positives. By using prescreening techniques, the sample extracts can be run diluted and/or interspersed with hexane blanks to allow continuous operation.

10.5 TestAmerica Buffalo Dual Column Approach

10.5.1 Buffalo adheres to the requirements stated in TestAmerica Corporate Policy CA-T-P-003: 'Reporting Results for Methods That Require Second Column Confirmation'. Since there are several options presented in this policy, the option and specific details used by Buffalo are presented here.

10.5.2 The laboratory routinely designates a primary column based on optimal separation of compounds of interest and other desirable characteristics (in which case the 2nd column is the confirmation column for each analyte). Both columns are intended to be calibrated and meet verification requirements.

10.5.3 If the difference between the dual column results is </- 40% RPD, report results from the primary column.

10.5.4 If there is a surrogate recovery or CCV problem for one of the two samples and not for the other report all results for that sample from the column with the acceptable QC.

10.5.4.4 If the CCV recovery for the primary column is within acceptance limits and the analyte is confirmed on the secondary column, but the second column is outside of acceptance limits, then the primary column may be reported with a case narrative comment or footnote.

10.5.4.5 If the CCV recovery for the confirmation column is within acceptance limits, and the recovery for the primary column is in the range of +15 to +40%, then the results may be reported from the confirmation column with a case narrative comment or footnote.

10.5.4.6 If the CCV recovery is below acceptance limits for the primary column, or the secondary column is below acceptance limits and the analyte is not confirmed, then the problem should be investigated and fixed. The associated samples will need to be reanalyzed with acceptable CCVs.

10.5.4.7 If the CCV recovery on either column is >40% above acceptance limits, any associated sample positives will need to be reanalyzed with acceptable CCVs.

10.5.5 The sample and QC values are calculated from the chromatographic peaks that fall within the daily retention time windows established from the most recent preceding calibration verification.

10.5.6 If the calculated values are >40% RPD from each other, the data must be evaluated more closely to determine which value should be reported and an appropriate comment must be noted in the job summary and report case narrative.

10.5.6.4 Where surrogates are similar on both columns but there is a large difference (>40%) between the sample values, the difference may be due to a positive interference on the column with the higher result. In this case the lower of the two numbers should be reported.

10.5.7 If the surrogates are very different between columns (>40% RPD), this may be indicative of a bad injection or columnar blockage. The sample should be

reanalyzed. If similar results are obtained following reanalysis, report the lower of the two numbers and describe the circumstance in the job summary and report case narrative.

10.5.8 If the CCV on one of the columns is more than 40% different from the correct value, it can be assumed that there has been significant drift on that column. The sample shall be reanalyzed against an acceptable calibration.

10.5.8.4 An exception to this requirement would be if the CCV recovery on one column were elevated and >40% RPD but the associated samples were non-detect for all target analytes on both columns. In this case the non-detect results may be reported from the compliant column.

10.5.9 For method 608.3, the %D from the two column results is assessed at 50% for all determinations.

11.0 Calculations / Data Reduction

The concentration of specific analytes in samples is determined using the Average Calibration Factor (ACF) calculated from the initial curve.

AQUEOUS CALCULATION

CF = Peak Area of Standard / Standard Concentration (ng)
(Determine the calibration factor for each compound in the initial curve and then calculate the ACF)

NG of Compound in Sample = Peak Area of Compound / ACF

SOIL/SOLID CALCULATION

CF = Peak Area of Standard / Standard Concentration (ng)
(Determine the calibration factor for each compound in the initial curve and then calculate the ACF)
NG of Compound in Sample = Peak Area of Compound / ACF

UG/KG of Comp. = [{NG X DF X FV X GPC} / {ExW X DW} X 1000

UG/L of Compound = [{NG X DF X FV} / {ExV}] X 1000

DF = Dilution Factor
FV = Final Volume of Concentrated Extract (mls)
ExV = Extraction Volume (mls)

DF = Dilution Factor
FV = Final Volume of Concentrated Extract (mls)
GPC= A factor of 2 is incorporated if GPC is used
ExW= Extraction Weight (grams)
DW = Decimal Dry Weight

Nanograms values may also be determined based upon the linear regression of the initial curve.

Calibrations, surrogates, spikes, method blanks, and chromatograms are reviewed by the

analyst on a 100% basis to determine acceptability of the data. Through Turbochrom, the signals are downloaded into the TALs system, where the final calculation is performed electronically.

11.1 Accuracy

11.1.1 ICV / CCV, LCS % Recovery = observed concentration / known concentration x 100

11.1.2 MS % Recovery = (spiked sample) - (unspiked sample) / spiked concentration x 100

11.1.3 Precision (RPD)

Matrix Duplicate (MD) = |orig. sample value - dup. sample value| / [(orig. sample value + dup. sample value)/2] x 100

11.1.4 Concentration = mg/kg or L = C x V x D / W

Where:
C = sample concentration in extract (ppm)
V = Volume of extract (mL)
D = Dilution Factor
W = Weight/Volume of sample aliquot extracted (grams or mLs)

NOTE: All dry weight corrections are made in LIMS at the time the final report is prepared.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

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 19.7 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.

12.2 Demonstration of Capabilities

A one time Demonstration of Capability is executed to document the ability to perform the method. The accuracy and precision obtainable with this method depend on the sample matrix, sample preparation technique, optional cleanup techniques, and calibration procedures used.

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. The following waste streams are produced when this method is carried out.
The following waste streams are produced when this method is carried out.

- Aqueous waste generated in the lab.
- Solvent waste generated by the extraction
- Vials containing sample extracts.

All solvent waste generated by the extraction is to be disposed of in a labeled "C" waste container.

All acidified aqueous waste is to be disposed of into a labeled "A" waste container.

15.0 References / Cross-References

15.1 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"; SW846, Third Edition, Final Update III; Method 8081A; December 1996.

16.0 Method Modifications: NA

17.0 Attachments

17.1 Table 1: Standard Concentrations – Single Component
17.2 Table 2: Standard Concentrations – Multi-Component
17.3 Table 3: Standard Concentrations - Surrogates
17.4 Table 4: Target Compound List
17.5 Table 5: Column Elution & Relative RT Order
17.6 Table 6: 608.3 CCV & LCS acceptance Criteria

18.0 Revision History

Revision 6, January 22, 2019

- Section 7.1.4 removed sections referring to separate surrogate and single component pesticide intermediates. Now only refers to intermediate containing both surrogate and pesticides.

- Section 10.1.3 removed reference to Gel Permeation Cleanup, changed florisil use frequency.

- Throughout added that if ISTD is added to samples, 20 samples are allowed between CCVs.

Revision 5, July 12, 2018
- Changed Title to add 608.3
- Revised section 4.2, removed GPC references
- Added 608.3 LCS limits reference to section 9.2.3.1
- Added 608.3 Calibration CCV limits reference to section 10.2
- Section 10.5.9 %D of 50% added for dual column reference
- Section 9.6.3.4 added 2nd source and closing requirement for CCV for 608.3
- Section 17.6 added Table for 608.3 CCV & LCS acceptance criteria

Revision 4, August 17, 2016
- Revised section 10.3 to incorporate newly formed policy on Retention Time window determination and assessment.
- Quality Manager Change, signature added.

Revision 3, August 31, 2015
- Added IS references for reagents and standards
- Added ISTD options and requirements to CCV sections
- Combined 8081A CCV criteria into appropriate sections
- In Section 9.3.1 removed reference to USACE.
- Laboratory Director Change, signature added

Revision 2, September 29, 2014
- Section 10.5 - Updated dual column reporting policy
- Added Table for Elution order and relative RTs
- Section 9.2.2.1 - added 608 MS frequency requirement

Revision 1, February 11, 2013
- Quality Manager Change, signature updated.
- Section 7.1.5.2 Added LVI-250ml extraction reference
- Section 16.0 – Cited above in method modifications.

TABLE 1

STANDARD CONCENTRATIONS – SINGLE COMPONENT

Standard Level	*Concentration (ng/ul)*	*Conc. in sample - Water (1L)*	*Conc. in sample - Soils (30g/100% dry)*
A	*0.005*	*0.05 ug/L*	*1.667 ug/kg*
B	*0.01*	*0.10 ug/L*	*3.334 ug/kg*
*C**	*0.05**	*0.50 ug/L*	*16.67 ug/kg*
D	*0.10*	*1.0 ug/L*	*33.34 ug/kg*
E	*0.15*	*1.5 ug/L*	*50.01 ug/kg*

*** Mid Point Concentration is used for CCVs and Spikes -0.05ng/ul** (Mid range of Calibration curve is 0.075ng/ul)

TABLE 2

STANDARD CONCENTRATIONS – MULTI-COMPONENT

Standard Level	*Concentration (ng/ul)*	*Conc. in sample - Water (1L)*	*Conc. in sample - Soils (30g/100% dry)*
A	*0.05*	*0.50 ug/L*	*16.67 ug/kg*
B	*0.10*	*1.0 ug/L*	*33.34 ug/kg*
*C**	*0.50**	*5.0 ug/L*	*166.7 ug/kg*
D	*1.0*	*10.0 ug/L*	*333.4 ug/kg*
E	*1.5*	*15.0 ug/L*	*500.1 ug/kg*

*** Mid Point Concentration is used for CCVs and Spikes -0.50ng/ul** (Mid range of Calibration curve is 0.75ng/ul)

TABLE 3

STANDARD CONCENTRATIONS - SURROGATES

Standard Level	*Concentration (ng/ul)*	*Conc. in sample - Water (1L)*	*Conc. in sample - Soils (30g/100% dry)*
A	*0.005*	*0.05 ug/L*	*1.667 ug/kg*
B	*0.01*	*0.10 ug/L*	*3.334 ug/kg*
C	*0.05*	*0.50 ug/L*	*16.67 ug/kg*
D	*0.10*	*1.0 ug/L*	*33.34 ug/kg*
E	*0.15*	*15 ug/L*	*50.00 ug/kg*

TABLE 4

Target Compound List

Single Component Pesticides

Aldrin
α-BHC
ß-BHC
δ-BHC
γ-BHC
γ-Chlordane
α-Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Heptachlor
Heptachlor epoxide
Endrin Ketone
Methoxychlor

ADD Compounds
Hexachlorobenzene
Alachlor
Chlorobenzilate
Mirex
2,4'-DDD
2,4'-DDE
2,4'-DDT

Multi Component Pesticides

Chlordane (Tech Chlordane)
Toxaphene

Table 5

Column Elution & Relative RT Order

Column			
RTX-CLPI		RTX-CLPII	
rt	**compound**	**rt**	**compound**
2.25	Tetrachloro-m-xylene	2.47	Tetrachloro-m-xylene
2.64	alpha-BHC	2.96	alpha-BHC
2.87	gamma-BHC (Lindane)	3.26	gamma-BHC (Lindane)
2.94	beta-BHC	3.33	beta-BHC
3.08	delta-BHC	3.67	delta-BHC
3.26	Heptachlor	3.69	Heptachlor
3.52	Aldrin	4.01	Aldrin
4.09	Heptachlor epoxide	4.59	Heptachlor epoxide
4.21	gamma-Chlordane	4.79	gamma-Chlordane
4.34	alpha-Chlordane	4.94	alpha-Chlordane
4.44	4,4'-DDE	4.99	Endosulfan I
4.45	Endosulfan I	5.12	4,4'-DDE
4.72	Dieldrin	5.28	Dieldrin
4.96	Endrin	5.58	Endrin
5.05	4,4'-DDD	5.71	4,4'-DDD
5.18	Endosulfan II	5.80	Endosulfan II
5.33	4,4'-DDT	6.03	4,4'-DDT
5.62	Endrin aldehyde	6.14	Endrin aldehyde

5.85	Methoxychlor	6.42	Endosulfan sulfate
6.06	Endosulfan sulfate	6.72	Methoxychlor
6.34	Endrin ketone	6.95	Endrin ketone
7.37	DCB Decachlorobiphenyl	8.20	DCB Decachlorobiphenyl
2.50	Hexachlorobenzene	2.81	Hexachlorobenzene
3.64	Alachlor	3.84	Alachlor
4.08	2,4'-DDE	4.73	2,4'-DDE
4.60	2,4'-DDD	5.26	2,4'-DDD
4.86	2,4'-DDT	5.53	Chlorobenzilate
5.06	Chlorobenzilate	5.58	2,4'-DDT
5.94	Mirex	6.87	Mirex

Table 6: 608.3 CCV & LCS acceptance Criteria

TABLE 4 – QC ACCEPTANCE CRITERIA

Analyte	Calibration verification (%)	Test concentration (µg/L)	Limit for s (% SD)	Range for $\bar{X}$ (%)	Range for P (%)	Maximum MS/MSD RPD (%)
Aldrin	75 - 125	2.0	25	54 - 130	42 - 140	35
alpha-BHC	69 - 125	2.0	28	49 - 130	37 - 140	36
beta-BHC	75 - 125	2.0	38	39 - 130	17 - 147	44
delta-BHC	75 - 125	2.0	43	51 - 130	19 - 140	52
gamma-BHC	75 - 125	2.0	29	43 - 130	32 - 140	39
alpha-Chlordane	73 - 125	50.0	24	55 - 130	45 - 140	35
gamma-Chlordane	75 - 125	50.0	24	55 - 130	45 - 140	35
4,4'-DDD	75 - 125	10.0	32	48 - 130	31 - 141	39
4,4'-DDE	75 - 125	2.0	30	54 - 130	30 - 145	35
4,4'-DDT	75 - 125	10.0	39	46 - 137	25 - 160	42
Dieldrin	48 - 125	2.0	42	58 - 130	36 - 146	49
Endosulfan I	75 - 125	2.0	25	57 - 141	45 - 153	28
Endosulfan II	75 - 125	10.0	63	22 - 171	D - 202	53
Endosulfan sulfate	70 - 125	10.0	32	38 - 132	26 - 144	38
Endrin	5 - 125	10.0	42	51 - 130	30 - 147	48
Heptachlor	75 - 125	2.0	28	43 - 130	34 - 140	43
Heptachlor epoxide	75 - 125	2.0	22	57 - 132	37 - 142	26
Toxaphene	68 - 134	50.0	30	56 - 130	41 - 140	41
PCB-1016	75 - 125	50.0	24	61 - 103	50 - 140	36
PCB-1221	75 - 125	50.0	50	44 - 150	15 - 178	48
PCB-1232	75 - 125	50.0	32	28 - 197	10 - 215	25
PCB-1242	75 - 125	50.0	26	50 - 139	39 - 150	29
PCB-1248	75 - 125	50.0	32	58 - 140	38 - 158	35
PCB-1254	75 - 125	50.0	34	44 - 130	29 - 140	45
PCB-1260	75 - 125	50.0	28	37 - 130	8 - 140	38

S = Standard deviation of four recovery measurements for the DOC (Section 8.2.4).
$\bar{X}$ = Average of four recovery measurements for the DOC (Section 8.2.4)
P = Recovery for the LCS (Section 8.4.3)

Note: *These criteria were developed from data in Table 5 (Reference 2). Where necessary, limits for recovery have been broadened to assure applicability to concentrations below those in Table 5.*

Title: Analysis of PCBs
SW846 8082A/ 8082 / 40CFR 608 / 608.3

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):

7/19/18	7/19/18
Gary Rudz Date	Kenneth E. Kasperek Date
Department Manager	Laboratory Director
7/19/18	
Michael Mosscrop Date	
Quality Assurance Manager	

Facility Distribution No. _____ **Distributed To:_____**

1.0 Scope and Application

This method is used to quantify polychlorinated biphenyls (PCBs) in extracts from aqueous, soil, sludge or oil matrices by direct injection techniques into a capillary column equipped gas chromatograph. An electron capture detector (ECD) is employed for identification and quantification. 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.

1.1 Analytes, Matrix(s), and Reporting Limits

This method is used to determine volatile organic compounds in a variety of matrices: water, soil, sediment, sludge and waste drum samples.

Compound	CAS No.
Aroclor 1016	12674-11-2
Aroclor 1221	11104-28-2
Aroclor 1232	11141-16-5
Aroclor 1242	53469-21-9
Aroclor 1248	12672-29-6
Aroclor 1254	11097-69-1
Aroclor 1260	11096-82-5
Aroclor 1262	37324-23-5
Aroclor 1268	11100-14-4

The routine reporting limits are:	Sample	FV	Method
0.5 ug/L for water samples	1 Liter	10 ml	8082
	250ml (LVI)	2ml	8082
0.06 ug/L for low level water samples	1 Liter	2 ml	608/8082LL
1ppM for routine soil samples	2.0 grams	ml	8082
2.5 mg/Kg for routine oil/waste samples	0.2 grams	ml	8082
1 ug/wipe for wipe sample	1 Wipe	ml	8082

2.0 Summary of Method

2.1 Water & Wastewater samples: approximately 1 liter of sample is extracted with Methylene chloride using a separatory funnel (SOP BF-OP-003 3510) or a continuous liquid-liquid extractor (SOP BF-OP-004 3520). Another option is to utilize a 250ml initial volume and reduce to a final volume of 2ml to attain the same RL as a routine 1 Liter extraction

2.1.1 Soil samples are extracted using approximately 2.0g of soil/solid sample using 3550 sonication (SOP BF-OP-016) or 3546 Microwave (SOP # BF-OP-018)The extract is then exchanged to hexane and concentrated to 10 ml or less. The final extract is then separated by gas chromatography and detected by an electron capture detector. (specific low level requested RLs can utilize 30g of soil)

2.2 Florisil & Silica Gel column cleanup procedures and sulfur removal procedures may be utilized to mitigate any interferences that may be encountered during analysis. Although these procedures may eliminate several interferences, contamination of the sample may come from a variety of sources, including solvents, reagents, glassware and any of the hardware used in sample processing. For this reason, reagent and solvent blanks should be analyzed to ensure their purity.

3.0 Definitions

3.1 Definitions of terms used in this SOP may be found in Appendix 2 of the glossary/acronym section of the Laboratory Quality Manual.

3.1.1 PCB (Polychlorinated Biphenyl)

The general term used to describe a mixture of congeners, generated via the manufacturing process.

3.1.2 Aroclor

Another reference to the PCB type, given as a known mixture rather than group of congeners.

3.1.3 Ar-

An abbreviated version of Aroclor, used as Ar1242 (Aroclor 1242).

3.1.4 Congener

Any of the specific individual “Parts” of a PCB, designated by the number of chorines and the various isomers of each.

4.0 Interferences

4.1 Method interferences can be minimized by proper glassware cleaning methods, instrument maintenance, and the use of high purity reagents and solvents.

4.2 Sulfuric acid (SOP BF-OP-010 3665) is part of the extraction procedure for all PCB samples.

4.3 Copper cleanup Method 3660 (AGE-BF-GE-005), Silica Gel Cleanup (SOP BF-OP-008 3630), and Florisil Cartridge Cleanup (SOP BF-OP-007 3620) may be also used on samples when specified by project or historical results warrant further cleanup.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Corporate Safety Manual and this document.

5.2 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.

5.3 Specific Safety Concerns or Requirements

5.4.1 The gas chromatograph contains zones that have elevated temperatures. The analyst needs to be aware of the locations of those zones, and must cool them to near room temperature prior to working on them.

5.4.2 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.

5.5 Primary Materials Used

5.5.1 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 safety Data Sheets (SDS) 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 SDS for each material before using it for the first time or when there are major changes to the SDS.

Material	Hazards	Exposure Limit (1)	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	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.
Sulfuric Acid	Carcinogen Irritant Dehydrator Poison Oxidizer	1 Mg/M3-TWA	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

The health and safety hazards of many of the chemicals used in this procedure have not been fully defined. Additional health and safety information can be obtained from the Safety Data Sheets (SDS) maintained in the laboratory.

Aroclors have been classified as a potential carcinogen. Concentrated solutions of Aroclors must be handled with extreme care to avoid excess exposure.

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.

Capillary columns
ZB-35 30m 0.53mm w/0.5um film or Equivalent (if separation criteria is met)
ZB-5 30m 0.53mm w/1.0um film or Equivalent (if separation criteria is met)
ZB-35 30m 0.32mm w/0.5um film or Equivalent
ZB-5 30m 0.32mm w/1.0um film or Equivalent
Electron Capture Detector
PE Nelson Totalchrom data system (Version 6.2.1 or Later)
Carrier Gas Hydrogen
Make Up Gas - Argon/Methane or Nitrogen
Syringes – 10ul Teflon tipped for Injection
Chrom chromatography analysis system

6.1 Instrumentation *

Hewlett Packard 5890 gas chromatograph w/dual ECD detectors
Hewlett Packard 6890 gas chromatograph w/dual uECD detectors
Hewlett Packard 7673 Auto Samplers
Hewlett Packard 7683B Auto Samplers
Hewlett Packard 3396A Integrators
PE Nelson Totalchrom 6.2.1 data system
PE Nelson 900 Series A/D Boxes
PE Nelson 600 Series Link Controller Boxes
(or Equivalent)*

6.2 Supplies

Carrier Gas Hydrogen
Make Up Gas - Argon/Methane or Nitrogen
Syringes – various
1.8 Crimp-top Vials, Amber & Clear
5 ¾" Disposable Pipettes& Bulbs
Vila Inserts - 250ul Spring
Inlet Liners - Packed Purge w/Pesticide Grade Glass Wool
Inlet Liners – Capillary Drilled Uniler
2-4 um Extract Filters

7.0 Reagents and Standards

7.1 Reagents or pesticide grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of determination.

7.2 Standards are stored in the GC Standard Incubator at 4±2°C in Teflon-sealed amber containers in the dark.

7.3 All stock standard solutions are replaced before the expiration date. All other standard dilutions or working standards are discarded after six month (or at the stock standard expiration date, whichever comes first) or sooner if routine QC indicates a problem. Certified PCB Mixes (Aroclors 1016/1260, 1221, 1232, 1242, 1248, 1254, 1262 & 1268)

7.4 Second Source PCB Mixes for all Aroclors (Different Manu. or Lot #) to verify constant response of newly prepared calibration curve or single point standards.

7.5 ISTD 1-bromo-2-nitrobenzene

7.6 Acetone (pesticide grade)

7.7 Hexane (pesticide grade)

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 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.

8.2 Aqueous Samples (608 & 8082) are to be collected in a 1-liter amber glass jar and stored at 4±2°C. Organic preparation is to be performed within 1 year of collection.

8.3 Soil (solid) samples are to be collected in a 4 oz jar and stored at 4±2°C. Organic preparation is to be performed within 1 year of collection.

8.4 Wipe and Oil samples are to be collected in a 4 oz jar and stored at 4±2°C. Organic preparation is to be performed within 1 year of collection.

8.5 Analysis of all extracts is to be performed within 40 days of preparation.

8.6 Holding times specified in project specific quality assurance plans may supersede the above listed method criteria.

8.7 Extracts are stored in an Incubator under refrigeration at 4±2°C.

9.0 Quality Control

9.1 Sample QC - The following quality control samples are prepared with each batch of samples.

9.1.1 A method blank must be prepared and analyzed with each batch (maximum 20 samples). The acceptance criterion is that the method blank must contain a concentration less than the reporting limit for all target analytes. If the blank fails this criterion, the entire prep batch must be re-extracted and analyzed.

9.1.2 Analysis of at least one matrix spike and one matrix spike duplicate per batch. Sample spike and duplicate recoveries should fall within the laboratory Quality Control limits that are updated annually based upon historical data. If the recoveries are not achieved, the data is still valid as long as the matrix spike blank is acceptable. The routine matrix spiking solution is an Aroclor 1016/1260 mixture prepared at 5.0ng/ul. During preparation, 1000ul of this solution is added to all quality control samples (LCS/MS/MSD).

9.1.3 Limited sample volume can allow for the analysis of a matrix spike blank duplicate instead of a MS and MSD pair.

9.1.4 A matrix spike blank must be prepared and analyzed with each batch. Spike recoveries should fall within the laboratory Quality Control limits that are updated annually based upon historical data.

9.1.5 If Internal Standard ISTD is utilized, the ISTD of 1-bromo-2-nitrobenzene is added to all standards, quality control, and samples prior to analysis at a concentration of 0.5ng/ul.

9.2 Instrument QC

9.2.1 Initial Calibration Curve and Verification (ICC & ICV)

9.2.1.1 An Initial Calibration Curve (ICC) must be run for the Aroclor mix 1016/1260. Other Aroclors specified by project may be required if utilizing non-linear calibration models.

9.2.2 The curve will consist of a minimum of five concentration points ranging from 0.025ng/uL–2.0ng/uL. The concentration points will be prepared by diluting a certified Aroclor standard. Lower Levels may be prepared at the time of calibration by diluting existing higher levels. The following table summarizes the concentration levels used and the associated reporting levels for water, soil, wipe, & oil samples. If Internal Standard is utilized, 0.5ng/ul of 1-bromo-2-nitrobenzene is added to all standards.

9.2.2.1 An Initial Calibration Curve must be run for the surrogate compounds Decachlorobiphenyl and Tetrachloro-meta-xylene, which is to be contained in the Ar1016/1260 calibration standards, or can be analyzed separately, but must be contained in all Ar1660 calibration standards.

9.2.2.2 The ICC for the surrogates will require a minimum of five (5) concentration points. The concentrations will be made by serial dilutions of a certified

standard. These levels are included within the Ar1660 calibration standards, recommended levels are: 0.00125ng, 0.0025ng, 0.005ng, 0.0125ng, 0.025ng, and 0.05ng.

9.2.2.3 A single point calibration must be run for all other Aroclors. The Aroclor concentration should be near the midrange concentration of the 1016/1260 curve (~0.5ng/ul on column).

9.2.2.4 If utilizing a non-linear calibration for Ar1660, multiple point calibrations for all quantified Aroclors must also be utilized.

9.2.3 Continuing Calibration Verification (CCV)

9.2.3.1 If Internal Standard methodology is employed, the initial CCV can be followed by up to 20 Environmental Samples or 12 hours, whichever comes first, and does not require a closing CCV for compliance. A Continuing Calibration Verifications (CCV) must bracket every 10 samples for ESDT methodology.Aroclor1660 is used to represent all Aroclors for this purpose.

9.2.3.2 A CCV for each identified Aroclor should be analyzed daily or within 12 hours of the sample. If criteria is met, no reanalysis is necessary for any positives.

9.2.4 Instrument Blank (IBLK)

9.2.4.1 An Instrument Blank (IBLK) is analyzed immediately after the Continuing Calibration Verification (CCV) to verify the absence of any potential carry-over or contamination.

9.2.5 Calibration Acceptance Summary

9.2.5.1 Retention Time Windows

9.2.5.2 Initial width of the retention time window for each compound can be determined based upon the standard deviation of three retention time measurements of the individual standards measured over the course of a 72-hour period.

9.2.5.3 Make three injections of all single component standards mixtures and multi-component products throughout a 72-hour period.

9.2.5.4 Calculate the standard deviation of the three absolute retention times of each single component compound. For multi-component compounds, choose 3 major peaks and calculate the maximum deviation of the three absolute retention times for that peak. Multiply this by 1.5.

9.2.5.5 If the standard deviation calculates to be negligible, a default retention time of +/-0.01 minutes is to be used for all surrogates, +/-0.03

minutes for all multi-components, and +/- 0.015 minutes for the later eluting DCBP surrogate.

9.2.5.6 The windows need to be assessed and applied per instrument.

9.2.5.7 Ongoing Retention time window assessments are critical to operation functionality. The RT window applied to the first CCV of the day should be functional to the batch processing in Chrom. Upon batch analysis, the LCS and CCV identification should work correctly. If any of these analytes fall outside the daily windows, the windows should be widened to encompass these variances. The entire batch will need to be reprocessed with the updated windows.

9.2.5.8 The widened Retention time windows shall remain in subsequent batches, though these should not exceed +/- 0.03 min. If so, the system should be carefully evaluated to insure maintenance is not required, or performance parameters need to be adjusted.

9.2.5.9 Subsequent to maintenance and/or calibration, the existing RT windows need to be carefully re-assessed to insure the tightest conditions possible applied to samples to minimize the potential for identification anomalies.

9.2.5.10 It is CRITICAL for Aroclor identification that PATTERN Match is the primary means utilized. For samples, varying matrices, degradation, dechlorinating, & non target interferences can cause shifting in the Biphenyl pattern. It is the conservative approach to identify these as potential positives rather than to exclude them due to these shifts. Sample comments (NCMs) should be applied in these cases to document these decisions.

9.2.5.11 Calibration Model

9.2.5.11.1 For 8082A/8082, the Percent Relative Standard Deviation for Aroclor1016 and Aroclor1260 must be $\leq$20% for the ICC to be acceptable, and to use single point standards for the remaining Aroclors. ($\leq$10% for 608, $\leq$15% for 608.3).

For 608, a calibration of 3 points is required, for 8082A/8082, 5 points, and if a quadratic regression fit is required to obtain acceptable data, 6 or more calibration points must be employed. If a 2nd Order Curve Calibration for Ar1660 is used, single points for the remaining Aroclors cannot be used to calculate sample positives. If Aroclor positives are found, then the calibration requirements for full curves are then applied to any such Aroclor.

9.2.5.11.2 If RSD $\leq$20% ($\leq$10% for 608, $\leq$15% for 608.3).for each Aroclor (1016 & 1260), then linearity of the detector can be assumed for all other Aroclors over the same analytical range. The congener range for Aroclor 1016 reflects the ranges for

Aroclors 1221, 1232, 1242, & 1248. The congener range for Aroclor 1260 reflects the ranges for Aroclors 1254, 1262, & 1268.

9.2.5.11.3 The RSD for some of the individual peaks of each Aroclor 1016 & 1260 can be >20% and <30%, as long as the Total Aroclor RSD for each is <20%. (≤20% total ≤10%.for 608).

9.2.5.11.4 For each Aroclor, five major chromatographic peaks are chosen (except Ar1221 which requires three peaks) that represent the key to the patterns present in each particular Aroclor for quantification. Five peaks will be used in calibration to allow for the potential loss of peaks due to interferences. This is important due to the assessment of degraded patterns when determining identification and quantification needs in difficult matrices.

9.2.5.11.5 *Is has been found that "Unique" Peaks for each Aroclor do not exist, due to the fact that many mixes contain all the congeners for another Aroclor.*

9.2.5.11.6 **Due to these facts, the following combinations of Aroclors cannot be identified simultaneously in a given sample**:

9.2.5.11.7 Aroclors: 1016, 1232, & 1242 will not have unique peaks that meet all criteria when compared to one another.

9.2.5.11.8 Aroclors: 1221 & 1232 will not have unique peaks that meet all criteria when compared to one another.

9.2.5.11.9 Aroclors: 1260 & 1262 will not have unique peaks that meet all criteria when compared to one another.

9.2.5.11.10 The remaining Aroclors; 1248, 1254, & 1268 can be identified in combination, and along with any one of the other of the single Aroclors listed above.

9.2.5.11.11 It is important to note that the identification of multiple Aroclors in any given sample can be difficult and requires a vast working knowledge of the distinct parts of each pattern. It is paramount that the majority of the biphenyls present are to be explained using the most representative pattern match, along with the best quantitation of peaks present. The outside factors such as weathering, dechlorination, matrix, and overlap must also be considered when identifying potential Aroclors in complex sample patterns. It may be prudent to chose the single most prominent Aroclor – Pattern and Amount in cases where identification shoe multiple patterns present.

9.2.5.11.12 The Percent Relative Standard Deviation for each surrogate must be ≤20% (≤10% for 608, ≤15% for 608.3), or have a Correlation Coefficient "R" ≥0.995 (R squared ≥0.990) for the ICC to be acceptable. The curve may be determined linear if a minimum of 5 points are used, and quadratic if a minimum of 6 points are used.

9.2.5.11.13 The resolution of the triplet in the latter pattern of Aroclor 1260 is to be ≤75% on one of the two columns used.

10.0 Procedure

10.1 Set up the Hewlett Packard Gas Chromatograph as a single injection split into dual column/detector analysis for each instrument.

10.1.1 Split injection instruments shall have different columns as to maximize the ability to confirm Aroclors present in the extracts in the most efficient manner.

10.1.2 Acceptable ICC's and single point calibrations are run for all Aroclors and surrogates. Both sides of a split injection instrument must be calibrated with the identical injections.

10.1.3 The Packard Gas Chromatograph will require priming prior to use if allowed to sit idle for more than 24 hours.

10.1.3.1 Priming consists of analyzing several recently injected standards and/or hexane blanks to allow the oven and other high temperature zones to equilibrate.

10.1.4 An ICV will consist of a concentration point at or near the midrange of the curve, (generally 0.5ng on column). The concentration point will be prepared through serial dilutions of a certified second source Aroclor standard.

10.1.4.1 The response factor of the ICV must be ±20% D for Aroclors 1016 & 1260.for method 8082A (±15% for 8082/608)
10.1.4.2 The CCVs may be biased high to confirm non-detects. ICVs and CCVs that are biased low will require a sample and system evaluation to determine if the effects are temporary or lasting.
10.1.4.3 In the temporary case, the instrument should be baked out and allowed to come to equilibrium to check compliance.
10.1.4.4 If the symptoms still persist, routine maintenance of liner, septa, syringe, rinse vial, guard column or other replacement may be required prior to checking compliance.
10.1.4.5 If the system still in non-compliant, check the instrument for stability by analyzing several test runs, prior to analyzing a new calibration curve. Detector Maintenance, changing the Column, or changing the detector settings will require recalibration of the system.
10.1.4.6 Sample analysis which continually produces reduced response upon re-analysis can be dealt with in several ways
10.1.4.6.1 The extracts should be check for possible further cleanup and/or dilution to minimize these effects.

10.1.4.6.2 The samples may be diluted for color, due to the presence of metallic or non-carbon compounds which do not respond to electron capture detector, and have severely adverse effects upon the equipment.

10.1.4.6.3 The insertion of hexane blanks after some samples may allow the instrument to recover. This step should not be done as routine without historical or screening data to support it, otherwise all analysis within bracketing CCVs need to be analyzed in a similar manner. Where Internal Standard methodology is employed, blanks may be interspersed at the analyst's discretion.

10.1.4.7 Sample analysis which continually produces reduced response, historically/site based, or have known matrix effects which are unaffected by any cleanup methodology may lead to:

10.1.4.7.1 Dilutions due to these facts, not based upon matrix, positives, color, or any other visual data.

10.1.4.7.2 Review of Report Level requirements and submittal of data as analyzed, with comment that the data is to be considered bias low

10.1.4.7.3 Client notification, if unaware of these potential effects upon the data from this project or site. Decisions then going forward should always consider client feedback for future analysis and actions.

10.1.5 The retention time window determined for each peak must be adjusted using the CCV on a daily basis to account for any shifts in the instrument's operating conditions.

10.1.5.1 The 1016/1260 mix contains all of the unique components (or congeners) of each individual Aroclor and if the CCV is acceptable for this, it can be understood that the CCV is acceptable for all Aroclors.

10.1.6 Continuing Calibration Verifications (CCVs) for Ar1016/1260 must bracket every 10 samples. Other Aroclors may be analyzed along with this ICV/CCV midpoint standard to confirm full pattern recognition. These additional standards are not subject to quantifiable verification. Where Internal Standard methodology is employed, only a CCV prior to every 20 Environmental Samples or 12 hours is required.

10.1.6.1 For 8082A, the response factor for each Aroclor in the CCV must be ±20% D. (±15%D for 608/8082, ±25%D for 608.3) All data is acceptable as long as it is bracketed by an acceptable ICV and CCV, or CCV and CCV. Where Internal Standard methodology is employed, only a CCV prior to every 20 Environmental Samples or 12 hours is required, except for method 608.3, where a closing cccv is assessed at ±25%D.

10.1.7 Each sample is injected into the gas chromatograph and its acceptable data is evaluated for Aroclor patterns and surrogate recovery. Spike recovery is also evaluated in spiked samples.

10.2 Sample Preparation

10.2.1 The most commonly used extraction procedures are SW-846 Methods 3510 Sepfunnel (waters SOP # BF-OP-003) , 3550 Sonication (soils SOP # BF-OP-005), and 3546 Microwave (soils SOP # BF-OP-018),

10.2.2 Prior to sample analysis, the extracts should be screened on a GC with an ECD setup, to better judge any potential dilutions, cleanups, or high level contamination dangers. This one-time analysis will be based loosely upon the response seen from a midrange standard analyzed in the same manner.

10.3 Sample Analysis

10.3.1 MB: A laboratory method blank must be analyzed with every set of 20 samples at a minimum of 1 per batch. Acceptance criteria are less than the report limit. If the acceptance criteria are met, the QC sample indicates no contamination due to the preparation procedure and is considered acceptable. If analyte is measured above the reporting limit, reanalyze. If reanalysis is acceptable, continue. If reanalysis again indicates contamination the sample results are not useable for drinking water samples. Results for other sample matrices may be used if they are greater than 10 times the blank contamination.

10.3.2 Blank contamination and recoveries outside this range may lead to: Re-extraction if within holding time and volume available, noting recoveries in case narrative or flagging values as estimated. The spike results, sample matrix, and reported positives in the prep batch are also to be considered. The Project Manager will be notified with a job exception, and acceptability may be determined by citing historical, sample, and method results on a case by case basis.

10.3.3 LCS: A laboratory control sample (lab fortified blank) must be analyzed with every batch of 20 samples or a minimum of 1 per day. The routine matrix spiking solution is an Aroclor 1016/1260 mixture prepared at 5.0ng/ul. During preparation, 1000ul of this solution is added to all quality control samples (LCS/MS/MSD). The resulting expected concentration for both aqueous and soil sample is 0.50ng/ul in the 10ml extract.

10.3.4 Statistical in-house acceptance limits are updated annually and are maintained in the laboratory LIMS system. If the required recovery limits are met, the QC sample indicates control of the preparation procedure and is considered acceptable. If the recovery limits are not met, reanalyze. If reanalysis yields acceptable recovery, continue. If the recovery limits are again not met the batch results are not useable unless the control sample recovery is high and the sample concentrations are below the reportable limit.

10.3.5 MS: A matrix spike sample must be set for one in every batch of 20 samples. Statistical in-house acceptance limits are updated annually and are maintained in the laboratory LIMS system. If the acceptance criteria are met, no adverse matrix effects are indicated. If acceptance criteria are not met, continue and this result will be noted in the case narrative in reference to a compliant Matrix Spike

Blank. To minimize bias, samples for matrix spike analysis shall be chosen at random. All analytes in the spike solution shall be measured unless they are not of interest in the spiked sample.

10.3.6 MSD: Along with every matrix spike sample, a duplicate MS must also be set. This sample is the matrix spike duplicate (MSD). Acceptance criteria are <30% RPD. If the acceptance criteria are met, continue. If the acceptance criteria are not met, continue and this result will be noted in the case narrative in reference to a compliant Matrix Spike Blank.

10.3.7 When QC results, unknown positives, or sample matrix present the analyst with questionable data, the spike results, sample matrix, and reported positives in the prep batch are all to be considered. Acceptability may be determined by citing historical, sample, and method results on a case by case basis. The project manager shall be notified of any method anomalies, and can then contact the client as to specific instructions on the usability of the data and any further actions.

10.3.8 Sample analysis is primarily based upon a single primary column. The results from the column chosen are deemed to be the best data chromatographically, and yield the most consistent values. The PCB analysis primarily is focused upon correct identification from the patterns to match Aroclors. From these pattern matches, a determination can then be accomplished to verify the presence above a reporting limit for any given Aroclor. This is then confirmed on the secondary column, via a positive result above the MDL, as long as the confirmatory column is not out of compliance in a decreased value. Confirmatory patterns are key to assessing a true PCB pattern match, therefore this is the primary focus of the dual column approach. Matrix effects, Degradation, Multiple Aroclor presence, and Non-Target compounds can complicate the quantitation to where the actual unfettered number of any single Aroclor can only at best be estimated. It is also best practice not to remove high level peaks from a summarized total, given the fact that it is not known whether some peaks are lower due to degradation, elevated due to dechlorination, overlap, or a combination of the three. It is the conservative approach to identify as many potential Aroclors present, even given to bias high results, to best serve the environmental decisions made from the results.

10.4 Example Analysis Queue ISTD Method

ID	Comments
Priming Runs	*Startup*
All Individual Aroclors	*CCV(1660) other Aroclors for RT update only*
IBLK/Hexane	*Instrument Blank*
20 Environmental Samples(IS method)	*10 injections for ESTD method*
Ar1660 & IBLK	*Closing CCV only required for ESTD or 608.3*
20 Environmental Samples (IS method)	*10 injections for ESTD method*
Ar1660 & IBLK	*Closing CCV only required for ESTD or 608.3*
20 Environmental Samples (IS method)	*10 injections for ESTD method*
Ar1660 & IBLK	*Closing CCV only required for ESTD or 608.3*

11.0 Calculations / Data Reduction

11.1 Include all formulas used to calculate/interpret data. Other documents may be referenced. The QA Manual may contain many of the more frequently used formulas. Include any guidance to be used when interpreting the data. You may include examples in the Attachment section.

11.2 *Examples:*

Accuracy

$$\text{CCV / CCV, LCS \% Recovery} = \frac{\text{observed concentration}}{\text{known concentration}} \times 100$$

$$\text{MS \% Recovery} = \frac{\text{(spiked sample) - (unspiked sample)}}{\text{spiked concentration}} \times 100$$

Precision (RPD)

$$\text{Matrix Duplicate (MD)} = \frac{|\text{orig. sample value - dup. sample value}|}{[(\text{orig. sample value + dup. sample value})/2]} \times 100$$

$$\textbf{Concentration} = \text{mg/kg or L} = \frac{C \times V \times D}{W}$$

Where:

C = sample concentration in extract (ppm)
V = Volume of extract (mL)
D = Dilution Factor
W = Weight/Volume of sample aliquot extracted (grams or mLs)

NOTE: All dry weight corrections are made in LIMS at the time the final report is prepared.

Calculating the ng amount of Aroclor in each peak:

$$\frac{\text{Area of the peak (a)}}{\text{Calibration factor of peak (a)}} = \text{ng amount of peak (a)}$$

(or the ng amount from the curve equation If linear calibration)

Calculating the ng amount of Aroclor in the sample:

$$\frac{\text{Peak(n)ng + peak(n+1)ng + peak(n+2)ng +}}{\text{Total Peaks}} = \text{ng amount of sample}$$

Converting ng amount to ug/Kg, ug/L and ug/wipe:

$$\text{ug/Kg} = \frac{\text{(ng) x (final volume in ml) x (dilution factor)}}{\text{(injection vol. in ul) x (sample wt.) x (\% Dry)}} \times \frac{1}{1000}$$

For Oils % dry = 100

$$\text{ug/L} = \frac{\text{(ng) x (final volume in ml) x (dilution factor)}}{\text{(injection volume in ul) x (sample volume in L)}}$$

$$\text{ug/wipe} = \frac{\text{(ng) x (final volume in ml) x (dilution factor)}}{\text{(injection vol. in ul) x (sample wt.) x (\% Dry)}}$$

For wipes, sample weight = 1, % Dry = 100

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

12.1.1 MDL studies are performed annually on a matrix and instrument type basis

12.1.2 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.

12.1.3 MDL studies are to be preformed using Aroclor1016/1260 as the representative mixture for each applicable matrix, and then for the range of biphenyls found in all of the remaining reported Aroclors. The MDLs generated for Aroclor 1016 will be reflective for the ranges for Aroclors 1221, 1232, 1242, & 1248. The MDLs generated for Aroclor 1260 will be reflective for the ranges for Aroclors 1254, 1262, & 1268.

12.1.4 MDLVs (Verifications) will be analyzed for all Aroclors, for every matrix, on all Instruments, to verify the recovery and allowable reporting of the applied MDLs above to each representative Aroclor. These should be spiked at no greater than the RL equivalent concentration on-column, and should show a positive ng value on the analysis report for all Aroclors.

12.2 Demonstration of Capabilities

12.2.1 An initial demonstration of capability (IDOC) is performed for either aqueous or soil matrices per analyst and compared to the method criteria. The concentration used is either equal to a CCV or a LCS.

12.2.2 The analyst will run, analyze, and report 4 standards or spikes. Reporting the expected concentrations of each in a summary report. This is usually entered into a LIMs data system for reporting, and a final copy is submitted to the QA department for record keeping

12.2.3 A continuing demonstration of capability (DOC) will be performed on a annual basis for each analyst, for each operational method they run and analyze.

12.3 Training Requirements

12.3.1 The QA Manual or a Training SOP may be referenced for training requirements. If applicable, state required concentration of samples prepared for Precision and Accuracy study or alternate training procedure.

13.0 Pollution Control

13.1 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)

13.2 Waste streams produced by this method

13.2.1 Acidic waste generated in the lab.
13.2.2 Solvent waste generated by the extraction
13.2.3 Expired primary and working PCB standards
13.2.4 Vials containing sample extracts
13.2.5 Solid Wastes

14.0 Waste Management

14.1 If the published method does not include this section, a statement similar to the following may be inserted:

14.2 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."

14.3 All solvent waste generated by the extraction is to be disposed of in a labeled "C" waste container.

14.4 All acidified aqueous waste is to be disposed of into a labeled "A" waste container

14.5 All Solid Wastes are to be disposed of in to the labeled "BE" waste containers.

15.0 References/Cross- References

15.1 Methods," 3rd edition, SW-846, update III, Dec. 1996.Method 8082A U.S. Environmental Protection Agency, Office of Solid Waste and Energy Response, "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," 3rd edition, SW-846, update IV, February 2007.

16.0 Method Modifications:

- Designation of a Primary Column for quantification, and the secondary column for confirmation only.

17.0 Attachments

17.1 Table 1: 608.3 CCV & LCS acceptance Criteria

18.0 Revision History:

- Revision 4, dated July 19, 2018
  - Added method 608.3 method references and criteria to sections;
    - 9.2.5.11.1
    - 9.2.5.11.2
    - 9.2.5.11.12
    - 10.1.6.1
    - 10.4
  - Added Table for 608.3 CCV & LCS recoveries
  - Updated Quality Manager, signature added.

- Revision 3, dated August 17, 2016
  - Reformed section 9.2.5 for incorporate newly formed policy on Retention Time window determination and assessment.

- Revision 2, dated July 30, 2015
  - Updated Lab Director, signature added
  - Integrated ISTD options into method
  - Added Microwave extraction option
  - Added TestAmerica Minimum Standard requirements
  - Specified 8082A/8082/608 individual requirements

- Revision 1, dated February 11, 2013
  - Updated QA Manager
  - Revised section 1.1 to include 1ppm Waste extraction.
  - LVI references added
  - Enhancement of dual column assessment, confirmatory data, and quantification.

`

- Revision 0, dated March 31, 2008
  - Integration for TestAmerica and STL operations.

Table 1: 608.3 CCV & LCS acceptance Criteria

TABLE 4 – QC ACCEPTANCE CRITERIA

Analyte	Calibration verification (%)	Test concentration (µg/L)	Limit for s (% SD)	Range for $\bar{X}$ (%)	Range for P (%)	Maximum MS/MSD RPD (%)
Aldrin	75 - 125	2.0	25	54 - 130	42 - 140	35
alpha-BHC	69 - 125	2.0	28	49 - 130	37 - 140	36
beta-BHC	75 - 125	2.0	38	39 - 130	17 - 147	44
delta-BHC	75 - 125	2.0	43	51 - 130	19 - 140	52
gamma-BHC	75 - 125	2.0	29	43 - 130	32 - 140	39
alpha-Chlordane	73 - 125	50.0	24	55 - 130	45 - 140	35
gamma-Chlordane	75 - 125	50.0	24	55 - 130	45 - 140	35
4,4'-DDD	75 - 125	10.0	32	48 - 130	31 - 141	39
4,4'-DDE	75 - 125	2.0	30	54 - 130	30 - 145	35
4,4'-DDT	75 - 125	10.0	39	46 - 137	25 - 160	42
Dieldrin	48 - 125	2.0	42	58 - 130	36 - 146	49
Endosulfan I	75 - 125	2.0	25	57 - 141	45 - 153	28
Endosulfan II	75 - 125	10.0	63	22 - 171	D - 202	53
Endosulfan sulfate	70 - 125	10.0	32	38 - 132	26 - 144	38
Endrin	5 - 125	10.0	42	51 - 130	30 - 147	48
Heptachlor	75 - 125	2.0	28	43 - 130	34 - 140	43
Heptachlor epoxide	75 - 125	2.0	22	57 - 132	37 - 142	26
Toxaphene	68 - 134	50.0	30	56 - 130	41 - 140	41
PCB-1016	75 - 125	50.0	24	61 - 103	50 - 140	36
PCB-1221	75 - 125	50.0	50	44 - 150	15 - 178	48
PCB-1232	75 - 125	50.0	32	28 - 197	10 - 215	25
PCB-1242	75 - 125	50.0	26	50 - 139	39 - 150	29
PCB-1248	75 - 125	50.0	32	58 - 140	38 - 158	35
PCB-1254	75 - 125	50.0	34	44 - 130	29 - 140	45
PCB-1260	75 - 125	50.0	28	37 - 130	8 - 140	38

S = Standard deviation of four recovery measurements for the DOC (Section 8.2.4).
$\bar{X}$ = Average of four recovery measurements for the DOC (Section 8.2.4)
P = Recovery for the LCS (Section 8.4.3)

Note: *These criteria were developed from data in Table 5 (Reference 2). Where necessary, limits for recovery have been broadened to assure applicability to concentrations below those in Table 5.*

Title: Analytical Methods for GC/MS Semivolatile Samples by SW846 3rd Edition 8270C

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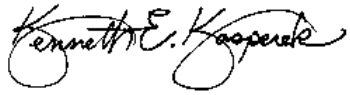
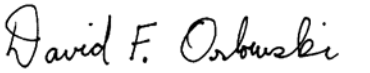
Approvals (Signature/Date):

12/14/16
Michelle Page — Date
Department Manager



12/14/16
Kenneth Kasperek — Date
Laboratory Director



12/14/16
David Orlowski — Date
Interim Quality Manager

12/14/16
Gary Rudz — Date
Organic Operations Manager

Facility Distribution No. _____ **Distributed To:_____**

1.0 Scope and Application

This SOP contains the procedures for the determination of extractable semi-volatile organic compounds (SVOC) by gas chromatography/mass spectrometry (GC/MS).

Procedures for analyzing via Large Volume Injection (LVI) and Low Level analysis are also included in this SOP.

The routine matrices performed by this procedure are waters and soils. Other matrices which may be performed include wipes, leachates, tissues and wastes.

A complete target analyte list, the reporting limits (RL), the method detection limits (MDL) and the accuracy and precision criteria associated with this procedure are provided in the LIMS Method Limit Groups (MLGs).

2.0 Summary of Method

A measured volume or weight of sample is extracted using separatory funnels (3510C, 3510C_LVI), sonication (3550C) or microwave (3546) extraction procedures. The extract is then analyzed by GC/MS. Qualitative identification of the target compounds in the extract is based on the retention time and the relative abundance of the characteristic masses as compared to component reference spectra determined from standards analyzed on the same GC/MS under the same conditions. Quantitative analysis of the target compounds is performed by the internal standard technique using a single characteristic ion.

3.0 Definitions

Additional definitions can be found in Appendix 2 of the Glossary/Acronym Section of the TestAmerica Buffalo Quality Assurance Manual (QAM).

4.0 Interferences

Some of the possible interferences that arise during GCMS Semivolatile analysis include, but are not limited to:

1. Glassware contamination
2. Matrix interference
3. Aldol condensation
4. System air leaks
5. Injection port/liner contamination
6. Warped filament, and/or dirty source

Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Determine if the source of interference is in the preparation of the samples and take corrective action to eliminate the problem.

Phthalate contamination is commonly observed in LVI and Low Level analysis and its occurrence should be carefully evaluated as an indicator of a contamination problem in the sample preparation step of the analysis.

All sample collection containers are single-use disposable containers which limits the potential for contamination. All non-disposable labware must be cleaned in accordance with TestAmerica Buffalo SOP BF-GP-003, current revision, to ensure it is free from contaminants and does not contribute artifacts.

High purity reagents and solvents are used to help minimize interference problems. Acetone and methylene chloride must be verified prior to use in accordance with the TestAmerica Solvent Lot Testing Program (SOP CA-Q-S-001, current revision) and TestAmerica Buffalo SOP BF-OP-013, current revision.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001, current revision) 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

Chemicals that have been classified as carcinogens or potential carcinogens in association with this method, defined by OSHA include: Acrylamide, Benzo(a)anthracene, Benzidine, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoroanthene, Dibenz(a,h)acridine, Dibenz(a,h)anthracene, Dibenzo(a,e)pyrene, 1,4-Dichlorobenzene, 3,3'-Dichlorobenzidine, 1,4-Dioxane, Hexachlorobenzene, Hexachloroethane, Kepone, Methyl Methanesulfonate, Methylene Chloride, Naphthalene, 1-Naphthylamine, 2-Naphthylamine Nitrobenzene, n-Nitrosodimethylamine, n-Nitrosodiethylamine, n-Nitrosodi-n-butylamine, n-Nitrosodi-n-propylamine, n-Nitrosopiperidine, n-Nitrosopyrrolidine, Safrole, o-Toluidine and 2,4,6-Trichlorophenol. This list can be obtained from the TestAmerica Corporate Safety Manual CW-E-M-001, Appendix XII (current revision). Primary standards should be purchased in solution. If neat materials must be obtained, they shall be handled in a hood.

Exposure to chemicals must be maintained as low as reasonably achievable; therefore, unless they are known to be non-hazardous, all samples should be opened, transferred, and prepared in a fume hood, or under other means of mechanical ventilation. Solvent and waste containers should be kept closed unless transfers are being made.

Analysts are expected to use caution and common sense while working in a laboratory environment. Each employee is required to read the TestAmerica Corporate Safety Manual (CW-E-M-001). All of the samples to be analyzed have the potential to contain hazardous substances. Most standards also contain hazardous chemicals and many do contain known carcinogens. Employees must use protective equipment when handling standards, samples and extracts including gloves, lab coats and safety glasses. It is the analyst's responsibility to read and familiarize themselves with the SDS of each chemical and/or reagent involved in this method.

Samples, standards and/or extracts should never be opened or transferred outside of a fume hood.

Waste disposal is all C waste with the exception of some acids used in the cleaning of equipment which is disposed of in AN waste.

Spills should be cleaned up promptly and waste should be disposed of as per the Chemical Hygiene Plan.

There is also the danger of burns while doing repair or maintenance on a gas chromatograph. One must use caution while working on or near the injection port or transfer line.

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 Safety Data Sheets (SDS) 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 SDS for each material before using it for the first time or when there are major changes to the SDS.

Chart 1

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.
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.

Sodium Hydroxide	Corrosive	2 Mg/M3-Ceiling	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent impairment of vision, even blindness.
Sulfuric Acid	Corrosive Oxidizer Dehydrator Poison Carcinogen	1 Mg/M3-TWA	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
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

6.1 Micro syringes 10, 25, 50, 100, 500, 1,000 microliter.

6.2 2ml amber and clear glass vials and caps.

6.3 Disposable pipettes and pipette bulbs.

6.4 Volumetric flasks.

6.5 Instrumentation

Gas Chromatograph/Mass Spectrometer (GC/MS) System

6.5.1 Gas Chromatograph
Hewlett Packard 6890
Carrier gas Helium UPC grade or equivalent

6.5.2 Gas Chromatography Column
Analysis: Restek 5Sil MS with or without Integra-Guard cat# 13623 (without guard) 13623-127 (with guard) or equivalent

6.5.3 Mass Spectrometer
HP5973
Tuning Compound PFTBA
Scan Range 35-500 AMU/second

6.5.4 Data System
HP Chemstation for data acquisition
Chrom software for chromatography analysis
TALS LIMS system for data reporting

7.0 Reagents and Standards

7.1 Methylene Chloride – high purity

7.2 Stock Standards

7.2.1 Corporate approved Restek mixtures:

8270 List1/Std #1 MegaMix	8270 List2/Std #1	8270 List2/Std #5
8270 List1/Std #9	8270 List2/Std #2	8270 List2/Std #7
8270 List1/Std #10	8270 List2/Std #3	8270 Internal Standard
8270 List1/Std #11	8270 List2/Std #4	8270 Surrogate Standard

7.2.2 Equivalent vendor mixtures:

Semi-Volatile GC/MS Tuning Standard (Ultra Scientific)
Custom List 3 Mix (Supelco)
Custom ADD#3 Mix (Absolute Standards, Inc.)
Dicyclohexylamine (Absolute Standards, Inc.)
Tributyl Phosphate (Absolute Standards, Inc.)
TetraEthyl Lead (Absolute Standards, Inc.)

All Certificates of Analysis received from the manufacturer are maintained in the laboratory's LIMS system. Stock standards are prepared every twelve months or sooner, if necessary.

7.3 Working Standards

7.3.1 Surrogate Standard Spiking Solution

Surrogate Standard spiking solution is prepared by the extractions department that contains Nitrobenzene-d5, p-Terphenyl-d14, 2-Fluorobiphenyl, Phenol-d5, 2,4,6-Tribromophenol and 2-Fluorophenol at a concentration of 40ug/mL for the 3510C, 3550C and 3546 extractions and 8ug/mL for the 3510C_LVI and low level extractions. Surrogate standards are added to all samples and calibration solutions. Additional surrogates may be added at the laboratory's discretion.

7.3.2 Laboratory Control Sample and Matrix Spiking Solution

Laboratory Control Sample and Matrix spiking solution is prepared by the extractions department that contains each of the base-neutral compounds and acid compounds at 50ug/mL for the 3510C, 3550C and 3546 extractions and 4ug/mL for the 3510C_LVI and low level extractions.

7.3.3 Instrument Performance Check Solution (DFTPP)

A solution of Decafluorotriphenylphosphine (DFTPP) is prepared at a concentration of 50ug/mL in methylene chloride for 3510C, 3550C and 3546 (1 Liter and soil) analysis.

For LVI and Low Level analysis, the concentration of this solution is prepared at 10ug/mL.

The instrument performance check solution contains 50ug/mL or 10ug/mL respectively of Benzidine, Pentachlorophenol and 4,4'-DDT for use in evaluating chromatographic performance.

Chart 2 – DFTPP Check Solution

DFTPP Working reagent (MB_DFTPP_WRK)	Solvent	Stock Conc. (ug/mL)	Initial Volume (uL)	Final Volume (mL)	Final Conc. (ug/mL)
1L Water/Soil	$MeCL_2$	1000	500	10	50
LVI/LL Water	$MeCL_2$	1000	100	10	10

7.3.4 Initial and Continuing Calibration Standards

Calibration standards are prepared at a minimum of five concentration levels from a working intermediate mix. For the main list of compounds, List 1, each calibration standard shall contain each compound of interest and each surrogate. A six and seventh level may be added for 2nd order quadratic curves.

Chart 3 – 8270 List 1 Working Intermediate Mix

8270 Working Intermediate Calibration Mix (MB_List1_INT)	Solvent	Stock Conc. (µg/ml)	Initial Vol. (µL)	Final Vol. (mL)	Final Conc. (µg/mL)
8270 List 1/Std #1 Mega mix	$MeCl_2$	1000	2000	10	200
8270 List 1/Std #9	$MeCl_2$	2000	1000	10	200
8270 List 1/Std #10	$MeCl_2$	2000	1000	10	200
8270 List1/Std #11	$MeCl_2$	2000	1000	10	200
8270 Surrogate Standard	$MeCl_2$	5000	400	10	200

Chart 4 - 1 Liter Water/Soil Calibration Levels
List 1

Calibration Level (ppm) (MB_LIST1_WRK)	Reagent Added	Solvent	Stock Conc. (µg/mL)	Initial Vol. (µL)	Final Vol. (mL)	Final Conc. (µg/mL)
5	MB_LIST1_INT	$MeCl_2$	200	25	1	5.00
	Internal Standard		2000	20		40.0
20	MB_LIST1_INT	MeCl2	200	100	1	20.0
	Internal Standard		2000	20		40.0
50	MB_LIST1_INT	MeCl2	200	250	1	50.0
	Internal Standard		2000	20		40.0
80	MB_LIST1_INT	MeCl2	200	400	1	80.0
	Internal Standard		2000	20		40.0
100	MB_LIST1_INT	MeCl2	200	500	1	100.0
	Internal Standard		2000	20		40.0
120	MB_LIST1_INT	MeCl2	200	600	1	120.0
	Internal Standard		2000	20		40.0

Chart 5 - LVI/Low Level Water Calibration Levels
List 1

Calibration Level (ppm) (MB_L1LVI_WRK)	Reagent Added	Solvent	Stock Conc. (µg/mL)	Initial Vol. (µL)	Final Vol. (mL)	Final Conc. (µg/mL)
0.25	MB_LIST1_INT	$MeCl_2$	200	12.5	10	0.25
	Internal Standard		2000	20		4.0
1.0	MB_LIST1_INT	MeCl2	200	50	10	1.0
	Internal Standard		2000	20		4.0
2.0	MB_LIST1_INT	MeCl2	200	100	10	2.0
	Internal Standard		2000	20		4.0
4.0	MB_LIST1_INT	MeCl2	200	200	10	4.0
	Internal Standard		2000	20		4.0
8.0	MB_LIST1_INT	MeCl2	200	400	10	8.0
	Internal Standard		2000	20		4.0
10	MB_LIST1_INT	MeCl2	200	500	10	10.0
	Internal Standard		2000	20		4.0
12	MB_LIST1_INT	MeCl2	200	600	10	12.0
	Internal Standard		2000	20		4.0

An additional calibration level is added, when required, for Low Level PAH analysis for 1L water/soil samples and LVI/Low Level water samples. For 1L/soil analysis, a 0.5ug/mL standard is prepared with 12.5uL of MB_List1_INT and 100uL of Internal Standard into 5mL of $MeCl_2$. For LVI/Low Level water samples, a 0.125ug/mL standard is prepared with 6.25uL of MB_List1_INT and 20uL of Internal Standard into 10mL of $MeCl_2$.

Additional calibration standards may be analyzed to include compounds not in the main list (List 1). Surrogate analytes are not added to additional calibration mixes and are only calibrated from List 1. Additional routine calibrations are List 2 and List 3 and are prepared using Charts 6 through 11.

Chart 6 - 8270 List 2 Working Intermediate Mix

8270 Working Intermediate Calibration Mix (MB_List2_INT)	Solvent	Stock Conc. (µg/ml)	Initial Vol. (µL)	Final Vol. (mL)	Final Conc. (µg/mL)
8270 List 2/Std #1	$MeCl_2$	1000	2000	10	200
8270 List 2/Std #2	$MeCl_2$	1000	2000	10	200
8270 List 2/Std #3	$MeCl_2$	2000	1000	10	200
8270 List2/Std #4	$MeCl_2$	1000	2000	10	200
8270 List2/Std #5	$MeCl_2$	2000	1000	10	200

Chart 7 - 1 Liter Water/Soil Calibration Levels
List 2

Calibration Level (ppm) (MB_LIST1_WRK)	Reagent Added	Solvent	Stock Conc. (µg/mL)	Initial Vol. (µL)	Final Vol. (mL)	Final Conc. (µg/mL)
5	MB_LIST2_INT	$MeCl_2$	200	125	5	5.00
	Internal Standard		2000	20		40.0
20	MB_LIST2_INT	MeCl2	200	100	1	20.0
	Internal Standard		2000	20		40.0
50	MB_LIST2_INT	MeCl2	200	1250	5	50.0
	Internal Standard		2000	20		40.0
80	MB_LIST2_INT	MeCl2	200	400	1	80.0
	Internal Standard		2000	20		40.0
100	MB_LIST2_INT	MeCl2	200	500	1	100.0

	Internal Standard		2000	20		40.0
120	MB_LIST2_INT	MeCl2	200	600	1	120.0
	Internal Standard		2000	20		40.0

Chart 8 - LVI/Low Level Water Calibration Levels
List 2

Calibration Level (ppm) (MB_L1LVI_WRK)	Reagent Added	Solvent	Stock Conc. (µg/mL)	Initial Vol. (µL)	Final Vol. (mL)	Final Conc. (µg/mL)
0.25	MB_LIST2_INT	$MeCl_2$	200	12.5	10	0.25
	Internal Standard		2000	20		4.0
1.0	MB_LIST2_INT	MeCl2	200	50	10	1.0
	Internal Standard		2000	20		4.0
2.0	MB_LIST2_INT	MeCl2	200	100	10	2.0
	Internal Standard		2000	20		4.0
4.0	MB_LIST2_INT	MeCl2	200	200	10	4.0
	Internal Standard		2000	20		4.0
8.0	MB_LIST2_INT	MeCl2	200	400	10	8.0
	Internal Standard		2000	20		4.0
10	MB_LIST2_INT	MeCl2	200	500	10	10.0
	Internal Standard		2000	20		4.0
12	MB_LIST2_INT	MeCl2	200	600	10	12.0
	Internal Standard		2000	20		4.0

Chart 9 - 8270 List 3 Working Intermediate Mix

8270 Working Intermediate Calibration Mix (MB_List3_INT)	Solvent	Stock Conc. (µg/ml)	Initial Vol. (µL)	Final Vol. (mL)	Final Conc. (µg/mL)
MB_ADD#3_STK	$MeCl_2$	2000	1000	10	200
MB_DICYCL_STD	$MeCl_2$	1000	2000	10	200
MB_List3_STK	$MeCl_2$	2000	1000	10	200
MB_TBP_STK	$MeCl_2$	1000	2000	10	200
MB_TEL_STK	$MeCl_2$	1000	2000	10	200

Chart 10 - 1 Liter Water/Soil Calibration Levels
List 3

Calibration Level (ppm) (MB_LIST1_WRK)	Reagent Added	Solvent	Stock Conc. (µg/mL)	Initial Vol. (µL)	Final Vol. (mL)	Final Conc. (µg/mL)
5	MB_LIST3_INT	$MeCl_2$	200	125	5	5.00
	Internal Standard		2000	20		40.0
20	MB_LIST3_INT	MeCl2	200	100	1	20.0
	Internal Standard		2000	20		40.0
50	MB_LIST3_INT	MeCl2	200	1250	5	50.0
	Internal Standard		2000	20		40.0
80	MB_LIST3_INT	MeCl2	200	400	1	80.0
	Internal Standard		2000	20		40.0
100	MB_LIST3_INT	MeCl2	200	500	1	100.0
	Internal Standard		2000	20		40.0
120	MB_LIST3_INT	MeCl2	200	600	1	120.0
	Internal Standard		2000	20		40.0

Chart 11 - LVI/Low Level Water Calibration Levels
List 3

Calibration Level (ppm) (MB_L1LVI_WRK)	Reagent Added	Solvent	Stock Conc. (µg/mL)	Initial Vol. (µL)	Final Vol. (mL)	Final Conc. (µg/mL)
0.25	MB_LIST3_INT	$MeCl_2$	200	12.5	10	0.25
	Internal Standard		2000	20		4.0
1.0	MB_LIST3_INT	MeCl2	200	50	10	1.0
	Internal Standard		2000	20		4.0
2.0	MB_LIST3_INT	MeCl2	200	100	10	2.0
	Internal Standard		2000	20		4.0
4.0	MB_LIST3_INT	MeCl2	200	200	10	4.0
	Internal Standard		2000	20		4.0
8.0	MB_LIST3_INT	MeCl2	200	400	10	8.0
	Internal Standard		2000	20		4.0
10	MB_LIST3_INT	MeCl2	200	500	10	10.0
	Internal Standard		2000	20		4.0
12	MB_LIST3_INT	MeCl2	200	600	10	12.0
	Internal Standard		2000	20		4.0

7.3.5 Internal Standard Solution

Internal standard used in the analysis of 1L/soil samples is from the stock standard, which contains the following compounds at a concentration of 2000ug/mL: 1,4-Dichlorobenzene-d4, Acenaphthalene-d10, Chrysene-d12, Naphthalene-d8, Perylene-d12 and Phenanthrene-d10.
Internal standard used in the analysis of LVI/LL samples is from a working standard and is prepared in accordance with Chart 12. The working standard contains the following compounds at a concentration of 200ug/mL: 1,4-Dichlorobenzene-d4, Acenaphthalene-d10, Chrysene-d12, Naphthalene-d8, Perylene-d12 and Phenanthrene-d10.

Chart 12 - LVI/Low Level Water Internal Standard Working Solution

8270 Working Internal Standard Mix (MB_LLIS_WRK)	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
8270 SV Internal Standard Mix (MB_INTSTD_STK)	$MeCl_2$	2000	1000	10	200

7.4 Storage of Standards

Stock, intermediates and working standards are stored at 4ºC ± 2ºC or less in Teflon-lined crimp-cap amber bottles or vials. Standards are stored separately from sample extracts.

Preparations of standards are done in accordance with the TestAmerica Buffalo SOP BF-GP-019, current revision. Stock and working calibration standards are prepared every twelve months or sooner, if the expiration date of any parent precedes 1 year.

The daily continuing calibration standard, DFTPP tuning standard and Reporting Limit check standard are stored at 4ºC ± 2ºC or less in Teflon-lined crimp-cap amber bottles or vials. These standards are prepared every 6 months or sooner, if the expiration date of any parent precedes 6 months.

8.0 Sample Collection, Preservation, Shipment and Storage

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 preservation requirements.

Water samples may be collected in 1L or 250 mL amber glass containers with Teflon lined screw-caps.

Soil/Sediment Samples may be collected in glass containers fitted with Teflon-lined screw-caps or closed end tubes.

All samples are stored at 4ºC± 2ºC from the time of collection until extraction

Aqueous samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.

Soil samples must be extracted within 14 days of collection and analyzed within 40 days of extraction.

Sample extracts are stored at 4ºC± 2ºC in the SVOA sample extract refrigerator prior to analysis.

9.0 Quality Control

9.1 Batch QC - The following quality control samples are prepared with each batch of samples.

Chart 7

Quality Controls	Frequency	Control Limit
Method Blank (MB)	1 in 20 or fewer samples	<Reporting Limit(RL)
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 (LCSD) 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 is randomly selected by the extractions group, unless specifically requested by a client.
[3] Analytical and QC samples (MB, LCS, MS/MSD)
[4] Statistical control limits are updated annually and are updated into LIMS.

9.1.1 Method Blanks

A method blank is a volume of a clean reference matrix (reagent water for water samples, or purified sodium sulfate/clean sand for soil/sediment samples) that is carried through the entire analytical procedure. The volume or weight of the reference matrix must be approximately equal to the volume or weight of samples associated with the blank. The purpose of a method blank is to determine the levels of contamination associated with the processing and analysis of samples.

A method blank must be prepared once for the following, whichever is more frequent:

Each prep batch.
Each 20 Samples in a batch, in addition to matrix spikes/matrix spike duplicates that are of a similar matrix.
Whenever samples are extracted by the same procedure.

9.1.1.1 Preparation of the Method Blank

For semivolatile analysis, a method blank for samples consists of the following volumes/weights and spikes:

1L water analysis: 1L of reagent water is spiked with 1.0mL of the surrogate spiking solution and concentrated to 1mL.

LVI water analysis: 250mL of reagent water is spiked with 1.0mL of the LVI surrogate solution and concentrated to a final volume of 1mL.

Low Level water analysis: 1L of reagent water is spiked with 1.0mL of the LVI surrogate solution and concentrated to a final of 1mL.

Soil/sediment samples: 30g of sodium sulfate/clean sand is spiked with 1.0mL of the surrogate spiking solution.

9.1.1.2 Technical Acceptance Criteria for Method Blank Analysis

All technical acceptance criteria for retention time, surrogate and IS recovery must be met for blank analysis. In addition, the following acceptance criterion applies.

For all target analytes, the method blank must contain less than the reporting limit (RL) of any single target compound.

If any single target compound is detected in the method blank with a concentration above the RL, samples that contain detections below the RL or samples containing detections that are 10X greater than the detection found in the blank will be flagged, noted the job narrative and reported. Final concentrations in the LIMS system are to be used when making this determination.

9.1.1.3 Corrective Actions for Method Blank Analyses

If the acceptance criteria for method blank analysis are not met, the analytical system may be assumed to be out of control.

Any contamination in the method must be investigated. Samples associated with the contaminated blank must be re-extracted and re-analyzed.

If surrogate recoveries in the method blank do not meet the acceptance criteria, first reanalyze the method blank. If the surrogate recoveries do not meet the acceptance criteria after reanalysis, re-extract and re-analyze the blank and all associated samples OR the samples may be reported as estimated, and noted in the case narrative.

If the method blank does not meet internal standard response requirements, check calculations, the internal standard spiking solutions, and the instrument operation. If the calculations were incorrect, correct the calculations and verify that the internal standard responses meet their acceptance criteria. If the internal standard compound spiking solution was improperly prepared, concentrated, or degraded, re-prepare solutions and re-extract/reanalyze samples. If the instrument malfunctioned, correct the instrument problem and reanalyze the method blank. If the instrument malfunction affected the calibration, recalibrate the instrument before reanalyzing the blank.

9.1.2 Laboratory Control Sample/Matrix Spike/Matrix Spike Duplicate

A Laboratory Control Sample (LCS), matrix spike (MS) and matrix spike duplicate (MSD) are analyzed to evaluate the analytical system and the effects of sample matrix on the methods used for semivolatile analysis.

The LCS, matrix spike, and matrix spike duplicate are spiked with the compounds listed in table 2 (at concentrations noted in section 7.3.2).

A LCS, matrix spike and matrix spike duplicate are extracted and analyzed for every batch of 20 samples of a similar matrix. Matrix spike and matrix spike duplicates are not performed for field QC samples such as rinsates, or field/trip blanks.

If insufficient sample amount is received to perform matrix spike and matrix spike duplicate analysis, or is requested by the client, a Laboratory Control Sample Duplicate (LCSD) may be analyzed.

9.1.2.1 Preparation of LCS/MS/MSD Samples

For semivolatile analysis, the laboratory control sample, matrix spike and matrix spike duplicates consists of the following volumes/weights and spikes:

1L water analysis: 1L of reagent water or sample is spiked with 1.0mL of the surrogate spiking solution and 1.0mL of the matrix spiking solution and concentrated to 1mL.

LVI water analysis: 250mL of reagent water or sample is spiked with 1.0mL of the LVI surrogate solution 1.0mL of the LVI matrix spiking solution and concentrated to a final volume of 1mL.

Low Level water analysis: 1L of reagent water or sample is spiked with 1.0mL of the LVI surrogate solution and 1.0mL of the LVI matrix spiking solution and concentrated to a final of 1mL.

Soil/sediment samples: 30g of sodium sulfate/clean sand or sample is spiked with 1.0mL of the surrogate spiking solution and 1.0mL of the matrix spiking solution.

9.1.2.2 Dilutions

Dilutions of MS/MSD samples are performed only if the unspiked sample requires a dilution in order to maintain any target compound concentrations in the upper half of the calibration. MS/MSD samples will not be diluted to get spiked or non-spiked compounds below the highest calibration standard. Any sample diluted 20x or greater will be deemed to have to low a recovery and shall be qualified accordingly.

Preparation of dilutions are described in equation 11 in section 11.2 and Table 9.

9.1.2.3 Calculations for MS/MSD

The concentrations of the spiked compounds are determined using equations 12, 13 and 14 in section 11.4.1. After determining the compound concentrations, the percent recovery is calculated using Equation 1.

Equation 1

$$\text{Matrix Spike Recovery} = \frac{\text{SSR - SR}}{\text{SA}} x100$$

Where,

SSR= Spike Sample Result

SR = Sample Result

SA = Spike Added

The relative percent difference between the matrix spike and matrix spike duplicate is calculated using Equation 2.

Equation 2

$$\text{RPD} = \frac{[\text{MSR - MSDR}]}{1/2\,(\text{MSR} + \text{MSDR})} x100$$

Where,

RPD = Relative Percent Difference

MSR = Matrix Spike Recovery

MSDR = Matrix Spike Duplicate Recovery

The vertical bars in the formula above indicate the absolute value of the difference; hence RPD is always expressed as a positive value.

9.1.2.4 Calculation for LCS/LCSD

The concentrations of the spiked compounds are determined using equations 12, 13 and 14 in section 11.4.1. After determining the compound concentrations, the percent recovery is calculated using Equation 3.

Equation 3

$$\text{LCS} = \frac{\text{SSR}}{\text{SA}} x100$$

Where,

SSR = Spike Sample Result

SA = Spike Added

The relative percent difference between the laboratory control sample and the laboratory control sample duplicate is calculated using Equation 2, where the MSR and MSDR are equivalent to the LCS recovery and the LCSD recovery respectively.

9.1.2.5 Technical Acceptance Criteria for MS/MSD

The acceptance criteria for retention time and IS recovery must be met for matrix spike and matrix spike duplicate analysis.

The matrix spike recovery limits are based on historical data and are updated annually.

The matrix spike recovery limits are advisory. If the recovery limits are not met, no further corrective action will be necessary. However, frequent occurrences of this nature should be investigated.

Re-extraction and re-analysis of the matrix spike and matrix spike duplicate may be necessary if, in the technical judgment of the analyst and/or supervisors, an error was made during the extraction procedure.

9.1.2.6 Technical Acceptance Criteria for LCS/LCSD

The acceptance criteria for retention time, surrogate and IS recovery must be met for the LCS analysis. Any failures in the LCS are flagged automatically in the laboratories TALS LIMS system.

The Laboratory Control Sample recovery limits are based on historical data and are updated annually.

Any single target compound that recovers above the upper control limit is to be considered high bias in all samples associated to that LCS (and/or LCSD). If the analyte in associated samples is either not detected or detected at a concentration below the reporting limit (RL), the deficiency will be noted in the job narrative and the sample(s) will be reported.

The laboratory defines several compounds as poor performers in association to this analytical method. These analytes are identified as such through current and historical performance and are listed in Table 6. Recoveries of poor performers in the laboratory control sample (and/or duplicate) that are below the lower control limit are allowed, provided that the recovery is greater than or equal to 10%, with the exception of Benzidine, which must meet 5%. Any poor performer that meets this condition described will be noted in the job narrative.

9.1.2.7 Corrective Actions for Laboratory Control Sample Analysis

If the acceptance criteria for laboratory control sample/laboratory control sample duplicate analysis are not met, the analytical system may be assumed to be out of control. The following corrective actions may be taken:

If the recovery of any target analyte is above the upper control limit and associated samples contain detections for this analyte greater than the reporting limit, re-extraction and re-analysis must be performed for those samples.

If the recovery of any target analyte is below the lower control limit and is not a poor performer, or if a poor performer recovers below 10% (Benzidine less than 5%), re-analyze the laboratory control sample and/or laboratory control sample duplicate to ensure an issue with the injection did not occur. If the LCS/LCSD fails in the re-

analysis, all samples associated to the LCS/LCSD that require the non-compliant compound must be re-extracted.

If surrogate recoveries in the LCS/LCSD do not meet the acceptance criteria, first reanalyze the LCS/LCSD. If the surrogate recoveries do not meet the acceptance criteria after reanalysis, re-extract and re-analyze the LCS/LCSD and all associated samples OR the samples may be reported as estimated, and noted in the job narrative.

If the LCS/LCSD does not meet internal standard response requirements, check the calculations, the internal standard spiking solutions, and the instrument operation. If the calculations were incorrect, correct the calculations and verify that the internal standard responses meet their acceptance criteria. If the internal standard spiking solution was improperly prepared, concentrated, or degraded, re-prepare solutions and re-extract/re-analyze the LCS and associated samples. If the instrument malfunctions affected the calibration, recalibrate the instrument before reanalyzing the LCS.

An exception to corrective action for LCSD only failures may be allowed on a case by case basis, depending on client requirements.

9.2 Surrogate Recoveries

The surrogate compound concentrations are determined using equations 12, 13 and 14 in section 11.4.1. The recoveries are then determined using Equation 4.

Equation 4

$$\%\ Recovery = \frac{Concentration\ (\vee\ amount)\ found}{Concentration\ (\vee\ amount)\ spiked} x100$$

Recovery limits for surrogate compounds are based on historical data and are updated annually. Limits are given in Table 8.

9.2.1 Technical Acceptance Criteria for Surrogate Recovery

Up to one acid and/or one base/neutral surrogate can be outside the laboratory derived limits in sample analysis, provided the recovery is greater than or equal to 10%.

Multiple surrogates of the same class (acid and/or base/neutral) may recover above the upper control limit as long as sample detections are below the reporting limit for any compound associated to that surrogate class.

Multiple surrogates of the same class may recover below the lower control limit provided the requested target analyte list does not contain any compounds in that failing surrogate class.

Surrogate recoveries in samples diluted by a factor of 20X or greater are to be considered estimated as they are below the lowest calibration level. Any recovery outside control limits will be qualified and noted in the job narrative.

9.2.2 Corrective Actions for Surrogate Recovery

Calculations, injection volumes and preparation volumes are checked to ensure an error was not made. If all calculations, volumes, etc., are correct the analyst will proceed to the next step in the corrective action process.

The sample is re-injected to verify an error was not made during the original analysis. If after re-injection, surrogate recoveries are outside of the acceptance criteria, the analysis will proceed to the next step in the corrective action process.

The sample is re-extracted. Exceptions for this are either in the case where MS/SD and parent surrogate recoveries all agree, there is significant matrix identified at the retention time of the surrogate or insufficient volume of the sample remains. In either case, the situation will be documented in the job narrative.

After re-extraction, the sample is re-injected. If after re-analysis surrogate recoveries are within criteria limits, this extract is considered the first because the original problem may have been due to a laboratory error during extraction. If, after re-analysis surrogate recoveries are not within criteria limits, a matrix effect may be assumed. If this should occur, the original analysis may be reported. The instance will be documented in the job narrative.

9.3 Internal Standard Recoveries

Internal standards are added to all initial calibration standards, initial calibration verification (ICV) and continuing calibration verification (CCV) standards, batch QC (MB/LCS/MS/MSD) and client samples. For the ICV and CCV, the internal standard responses are compared to the mid-level calibration standard. For batch QC and samples, internal standards are compared to the daily CCV. The recoveries are determined using Equation 5.

Equation 5

$$\%\text{Recovery} = \frac{\text{Area of IS in Sample}}{\text{Area of IS in Standard}} \text{ X } 100$$

9.3.1 Technical Acceptance Criteria for Internal Standard Recoveries

Internal standard recovery for instrument QC must be within 50-200% of the mid-range calibration level (ICIS).

Internal standard recovery for batch QC and samples must be within 50-200% of the daily continuing calibration verification (CCV).

Retention time shifts for each Internal Standard must be within ±0.5 min between the continuing calibration verification and the mid-level standard of the most recent initial calibration.

Retention time shifts for each Internal Standard must be within ±0.5 min between the sample and the most recent continuing calibration verification.

9.3.2 Corrective Actions for Internal Standard Recoveries

Calculations, internal standard solution volumes and injected volumes are checked to ensure that an error was not made. If all calculation and volumes were correct, the analyst will proceed to the next step in the corrective action process.

The sample is re-injected to ensure that the instrument was working properly. If after re-analysis, the internal standard recoveries are within criteria limits, the second analysis will be reported. If after re-analysis the internal standard recoveries are outside of criteria limits, the following steps will be taken:

If an instrument QC standard fails internal standard recovery, the electron multipler (EM) voltage can be adjusted accordingly and the DFTPP and standards must be reanalyzed. Failure again and the reagent will be re-prepared and reanalyzed. Repeat IS failures requires an initial calibration and/or instrument maintenance.

If a batch QC sample fails internal standard recovery, the entire batch will be re-extracted and re-analyzed.

If a client sample fails internal standard recovery, the sample will be re-extracted and re-analyzed.

Exception: If internal standard recoveries of a sample, MS/MSD agree (i.e., recoveries are outside of criteria limits for all three samples), it may be assumed that a matrix effect is involved and no corrective action is necessary. The instance will be documented in the Job Narrative.

10.0 Procedure

10.1 Sample Preparation

For complete procedure on sample preparation, see the following TestAmerica Buffalo SOPs:

3510C:	BF-OP-003, current revision
3510C_LVI:	BF-OP-019, current revision
3550C:	BF-OP-016, current revision
3546:	BF-OP-018, current revision

10.2 Instrument QC

Typical instrument operating conditions are presented below. These may be modified as necessary to accommodate large volume injection (LVI) techniques which may utilize up to a 5uL injection.

OVEN
LVI Suggested Parameters
Initial temp: 45 °C (On) Maximum temp: 340 °C
Initial time: 3.00 min Equilibration time: 0.20 min
Ramps:

#	Rate	Final temp	Final time
1	30.00	280	0.00
2	9.00	325	4.00
3	0.0(Off)		

Post temp: 70 °C
Post time: 0.00 min
Run time: 19.83 min

Note, the run time must be extended so that the instrument acquires at least 1 min after the last compound elutes off the column.

1L Suggested Parameters
Initial temp: 55 °C (On) Maximum temp: 340 °C
Initial time: 2.75 min Equilibration time: 0.20 min
Ramps:

#	Rate	Final temp	Final time
1	23.00	70	0.00
2	20.00	195	0.00
3	30.0	330	5.00
4	0.00 (off)		

Post temp: 70 °C
Post time: 0.00 min
Run time: 19.15 min

Note, the run time must be extended so that the instrument acquires at least 1 min after the last compound elutes off the column. For the analysis of Dibenzo(a,e)pyrene, the Final Time for rate #3 should be adjusted by several minutes to allow this compound to properly elute off the column.

FRONT INLET (SPLIT/SPLITLESS)
LVI Suggested Parameters
Mode: Pulsed Splitless
Initial temp: 280 °C (On)
Pressure: 14.90 psi (On)
Pulse pressure: 30.0psi
Pulse time: 0.55 min
Purge flow: 50.0 mL/min
Purge time: 0.50 min
Total flow: 54.7 mL/min
Gas saver: On

Saver flow: 20.0 mL/min
Saver time: 2.00 min
Gas type: Helium

1L Suggested Parameters
Mode: Splitless
Initial temp: 280 °C (On)
Pressure: 7.00 psi (On)
Purge Flow: 30.0 mL/min
Purge Time: 0.40 min
Total flow: 33.9 mL/min
Gas saver: On
Saver flow: 20.0 mL/min
Saver time: 3.00 min
Gas type: Helium

COLUMN 1
LVI Suggested Parameters
Capillary Column
Model Number: Phenomenex ZB-Semivolatile GUARDIAN
Max temperature: 330 °C
Nominal length: 30.0 m (with integral 10m guard column)
Note, this may be removed or a column without a guard column may be installed.
Nominal diameter: 250.00 um
Nominal film thickness: 0.25 um
Note, a film thickness of 0.5 um may be utilized.
Mode: constant flow
Initial flow: 2.2 mL/min
Nominal initial pressure: 14.91 psi
Average velocity: 59 cm/sec
Inlet: Front Inlet
Outlet: MSD
Outlet pressure: vacuum

1L Suggested Parameters
Capillary Column
Model Number: Phenomenex ZB-Semivolatile GUARDIAN
Max temperature: 330 °C
Nominal length: 30.0 m (with integral 10m guard column)
Nominal diameter: 250.00 um
Nominal film thickness: 0.25 um
Note, a film thickness of 0.5 um may be utilized.
Mode: ramped pressure
Initial pressure: 7.00 psi
Initial time: 0.00 min

#	Rate	Final pres	Final time
1	90.00	30.00	0.10
2	99.00	12.00	2.60
3	2.40	35.00	0.00

Post pressure: 0.00 psi
Nominal initial flow: 0.7 mL/min
Average velocity: 26 cm/sec
Inlet: Front Inlet
Outlet: MSD
Outlet pressure: vacuum

FRONT DETECTOR (NO DET)
LVI and 1L Suggested Parameters

SIGNAL 1	SIGNAL 2
Data rate: 20 Hz	Data rate: 20 Hz
Type: test plot	Type: test plot
Save Data: Off	Save Data: Off
Zero: 0.0 (Off)	Zero: 0.0 (Off)
Range: 0	Range: 0
Fast Peaks: Off	Fast Peaks: Off
Attenuation: 0	Attenuation: 0

COLUMN COMP 1
(No Detectors Installed)

THERMAL AUX 2
LVI Suggested Parameters
Use: MSD Transfer Line Heater
Description: MSD Transfer Line
Initial temp: 325 °C (On)
Initial time: 0.00 min
Rate Final temp Final time
1 0.0(Off)
Post Run
Post Time: 0.00 min

1L Suggested Parameters
Use: MSD Transfer Line Heater
Description: MSD Transfer Line
Initial temp: 310 °C (On)
Initial time: 0.00 min
Rate Final temp Final time
1 0.0(Off)
Post Run
Post Time: 0.00 min

GC INJECTOR
LVI Suggested Parameters
Front Injector:

Sample Washes	2
Sample Pumps	4
Injection Volume	2.00 microliters
Syringe Size	10.0 microliters

PreInj Solvent A Washes	0
PreInj Solvent B Washes	0
PostInj Solvent A Washes	4
PostInj Solvent B Washes	2
Viscosity Delay	0 seconds
Plunger Speed	Fast
PreInjection Dwell	0.00 minutes
PostInjection Dwell	0.00 minutes

1L Suggested Parameters

Front Injector:	
Sample Washes	1
Sample Pumps	4
Injection Volume	1.00 microliters
Syringe Size	10.0 microliters
PreInj Solvent A Washes	0
PreInj Solvent B Washes	0
PostInj Solvent A Washes	2
PostInj Solvent B Washes	2
Viscosity Delay	0 seconds
Plunger Speed	Fast
PreInjection Dwell	0.00 minutes
PostInjection Dwell	0.00 minutes

MS ACQUISITION PARAMETERS
LVI and 1L Suggested Parameters

General Information
Tune File : dftpp.u
Acquisition Mode : Scan

MS Information
Solvent Delay : 2.60 min
Note, this will vary depending on the age of the column.
EM Offset : 0
Resulting EM Voltage : 976.5
Note, this will vary depending on the age of the Electron Multiplier. Once the EM Voltage is ~ 2300-2600, it may need to be replaced. 3000 is the maximum voltage of an EM.

[Scan Parameters]

Low Mass : 35.0
High Mass : 500.0
Threshold : 100
Sample # : 2
A/D Samples : 4

[MSZones]
MS Quad : 150 °C maximum 200 °C
MS Source : 230 °C maximum 250 °C

10.3 Instrument Performance Check

The GC/MS system is tuned using Perfluorotributylamine (PFTBA) such that an injection of 50ng (for 1L/Soils) or 10ng (for LVI/Low Level) of DFTPP will meet the abundance criteria listed in Table 3.

Prior to the analysis of standards or samples, the mass calibration and resolution of the GC/MS system is verified by the analysis of DFTPP. This analysis will verify the proper tuning of the system for 12 hours. After 12 hours, the instrument performance must be verified before standard and sample analysis may continue.

The average of the apex, the scan before and scan after the apex of the DFTPP peak is used to assess ion abundances. If the criterion listed in Table 3 is not met, a single scan of the apex may be evaluated. This is performed automatically in the Chrom system.

The mass spectrum of DFTPP may be background subtracted to eliminate column bleed or instrument background ions. The background spectrum is selected as one scan before the start of the integrated DFTPP peak.

Breakdown of 4,4'-DDT into 4,4'-DDD and 4,4'-DDE may be used to assess GC column performance and injection port inertness and must be less than 20%.

The compounds Benzidine and Pentachlorophenol should be present and at their normal responses for this concentration. Peak tailing should not be visible (PCP tailing factor <5 and Benzidine <3). If responses are poor and excessive peak tailing is present, corrective actions for the GC/MS instrument performance check solution may be required. Benzidine and Pentachlorophenol tailing may also be verified in the CCV.

All subsequent standards and samples must be acquired under the same GC/MS tuning conditions that were used for the analysis of the instrument performance check solution.

10.3.1 Technical Acceptance Criteria for the GC/MS Instrument Performance Check

DFTPP is listed in Table 3.

10.3.2 Corrective Actions for the GC/MS Instrument Performance Check

If any of the acceptance criteria are not met, the DFTPP should be re-injected to ensure that the injection made was not a cause for failure. If, after reinjection, acceptance criteria has not been met, one or more of the following corrective actions may be taken:

1. Replace the injection port liner
2. Replace the septum in the injector
3. Cut the column at the injector end
4. Re-prepare the DFTPP working standard and re-analyze
5. Clean injection port with $MeCl_2$
6. Change injection port seal
7. Retune the GC/MS
8. Replace the column

9. Clean the source; replace parts, etc.
10. An instrument service call may be placed.

10.4 Initial Calibration

After the instrument performance check criteria has been met and prior to the analysis of samples, the GC/MS system is calibrated at a minimum of five concentration levels in order to establish instrument sensitivity and linearity

The initial calibration shall be performed when major instrument maintenance has been performed or if continuing calibration criteria cannot be met.

Major instrument maintenance may consist of source cleaning, column changing, or quadrapole rod adjustment. Preventative maintenance such as septum changes, injector liner changes or column cutting may not require an initial calibration to be performed.

10.4.1 Procedure for Initial Calibration

Calibration standards for common target semivolatile compounds are prepared to contain all target, internal standard and surrogate compounds. Additional calibration mixes may be prepared that contains an extra list of target compounds and internal standards only. Surrogates are not required in additional mixes. A 20µl aliquot of the 2000 ug/mL internal standard solution is added to a 1mL aliquot of each calibration standard solution for 1L/soil analysis. The resulting concentration of internal standards is 40ng/uL. LVI/LL calibration standards are spiked with 20uL of the 2000 ug/mL internal standard solution into a 10mL aliquot of each calibration standard solution, resulting in a concentration of 4 ng/uL. The internal standards used are given in Table 4.

The relative response factors (RRF) for each target and surrogate compound is determined using equation 6. The characteristic ions for a given compound are listed in Tables 5. Internal standard assignments are listed in Table 4.

Equation 6

$$RRF = \frac{A_x}{A_{is}} x \frac{C_{is}}{C_x}$$

Where,
A_x = Area of the characteristic ion for the compound to be measured (see Table 5)
A_{is} = Area of the characteristic ion for specific internal standard (see Table 5)
C_{is} = Amount of the internal standard injected (ng)
C_x = Amount of the compound to be measured injected (ng)

The mean relative response factor (RRF) must be calculated for all compounds. Calculate the % Relative Standard Deviation (%RSD) of the RRF values for the initial calibration using the following equation:

Equation 7

$$\%RDS = \frac{Standard\ \ Deviation}{Mean}\ x\ 100$$

Where,

$$Standard\ \ Deviation = \sqrt{\frac{\sum_{i+1}^{n} (X_i - \overline{X})^2}{(n-1)}}$$

x_i = each individual value used to calculate the mean
x = the mean of n values
n = the total number of values

10.4.2 Technical Acceptance Criteria for Initial Calibration

The average response factor (RRF) for each System Performance Check Compound (SPCC) (listed in Table 7) must be greater than or equal to the compound's minimum acceptable relative response factor of 0.050.

The %RSD for each Calibration Check Compound (CCC) (Table 7) must be less than or equal to the 30%.

The %RSD for all compounds must be less than or equal to 15%. If the relative standard deviation is greater than 15%, a least squares regression (linear) calibration fit may be used. The criterion for this is a correlation coefficient (r^2) value greater than or equal to 0.990.

If the relative standard deviation and least squares regression fails to meet criteria, a non-linear coefficient of determination (quadratic) may be used. The criterion for this is a correlation coefficient (r^2) value greater than or equal to 0.990. For a 2nd order non-linear regression, 6 calibration points must be used and for a 3rd order non-linear regression, 7 calibration points must be used.

Identification of analytes in all calibration levels can be made only if there are 5-10 scans of the quantitation ion across the entirety of the peak. All minor ions where the expected abundance set from the mid-level standard is greater than 10% must also be present.

Internal Standard responses of each calibration level should be within 50%-200% of the mid-level standard.

Relative retention times of Internal Standards, surrogates and compounds must be within ±0.06 mins of the RT set in the mid-level point of the calibration.

Additional Initial Calibration requirements are described in TestAmerica Buffalo SOP BF-GP-012 (current revision), beginning with section 5.5: Initial Calibration Review.

10.4.3 Corrective Actions for Initial Calibration

If any of the acceptance criteria for initial calibration are not met, it may be necessary to reanalyze one or more of the calibration standards. If after reanalysis, the acceptance criteria have not been met, it may be necessary to take further corrective actions.

The following corrective actions may be taken if the acceptance criteria for initial calibration cannot be met.

1. Replace the septum on the injector
2. Replace the injector liner
3. Cut column at the injector end
4. Prepare fresh standards and reanalyze the initial calibration
5. Re-tune the GC/MS system and reanalyze the instrument performance check
6. Replace the analytical column
7. Clean the source
8. An instrument service call may be placed

The acceptance criteria must be met before sample analysis may proceed.

10.4.4 Initial Calibration Verification

To verify the accuracy of the initial calibration, a standard is obtained from a source different from the calibration standards. Alternatively, if a different source is not available, a differing lot number of the standards used in the initial calibration may substitute as the second source.

Immediately following analysis of an acceptable initial calibration curve, an aliquot of this independent standard is injected. For 1 Liter and soil analysis, a concentration of 50 ug/mL is analyzed. For LVI and Low Level analysis, this concentration is 4 ug/mL.

10.4.5 Technical Acceptance Criteria for Initial Calibration Verification

Recoveries of all compounds shall fall within ±25% of the expected value; however, recoveries of up to 40% are allowable for up to four compounds.

Internal Standard retention times and responses are evaluated after acquisition of the initial calibration verification. If the retention time of any internal standard shifts by more than 30 seconds from that in the mid-point standard level of the initial calibration or the response of any internal standard is outside of the 50% to 200% range compared to the mid-point standard level of the initial calibration, the system shall be inspected and corrected as needed. The ICV will be reanalyzed after inspection. If the problem is not resolved, a new initial calibration must be performed.

10.4.6 Corrective Action for Initial Calibration Verification

If the Technical Acceptance Criteria for Initial Calibration Verification is not met, the following corrective action steps should be taken.

Re-inject the ICV to verify there was not an error made during the original analysis.

Re-prepare the ICV to verify an error was not made during the original preparation.

Perform instrument maintenance and re-calibrate.

Re-prepare initial calibration standards and re-calibrate.

Prepare the ICV and/or initial calibration reagents from different lot numbers to verify degradation hasn't occurred.

Re-order either initial calibration or ICV reagents.

10.4.7 Continuing Calibration

If there is no time left in the 12-hour time period after initial calibration, the instrument performance check may be analyzed and a standard at the middle of the calibration range may be analyzed to verify the calibration of the instrument.

The continuing calibration check must be analyzed once every 12-hour time period of operation. This check must be analyzed prior to the analysis of samples for a given 12-hour time period.

10.4.8 Procedure for Continuing Calibration

The mid-level standard is used for the continuing calibration verification (CCV). The relative response factor is calculated using Equation 6 in section 10.4.1. The relative response factor is compared to the minimum response factor required for SPCC compounds listed in Table 7.

If quantitation is performed using response factor, calculate the percent difference between the mean relative response factor from the most recent initial calibration and the continuing calibration relative response factor for each semivolatile target and surrogate compound using Equation 8.

Equation 8

$$\%\ Difference_{RRF} = \frac{RRF_c - \overline{RRF_i}}{\overline{RRF_i}} \times 100$$

Where,

$\overline{RRF_i}$ = Mean relative response factor from the most recent initial calibration meeting technical acceptance criteria

RRF_c = Relative response factor from continuing calibration standard

If quantitation is performed using a least squares regression (linear) or a non-linear model (quadratic), calculate the concentration of all analytes and surrogates in the continuing calibration using equations 12,13 and 14 in section 11.4.1. Calculate the percent drift using Equation 9.

Equation 9:

$$\%\text{Drift} = \frac{\text{Conc}_E - \text{Conc}_A}{\text{Conc}_E} x100$$

Where:
Conc_E = Expected Concentration
Conc_A = Actual Concentration

10.4.9 Technical Acceptance Criteria for Continuing Calibration

The relative response factor (RRF) for each System Performance Check Compound (SPCC) must be greater than or equal 0.050. SPCC compounds are defined in Table 7.

The percent difference or percent drift for Calibration Check Compounds (CCC) must be less than 20%. The percent difference or percent drift for all other EPA TCL compounds must be within ±20%, with up to four compounds within ±40%D. For expanded list and additional compounds not on the EPA TCL list, a percent difference or drift of ±40% is allowed. Any analyte may have an elevated response greater than +40%D if it is not detected in the associated samples, with the exception of APIX and priority pollutant compounds, which allows ±100%D. CCV acceptance criteria can be found in Table 10.

Internal Standard retention times and responses are evaluated after acquisition of the continuing calibration check. If the retention time of any internal standard shifts by more than 30 seconds or the response of any internal standard is outside of the 50% to 200% range compared to the mid-level standard of the most recent initial calibration, the system shall be inspected and corrected as needed. The CCV will be reanalyzed after inspection. If the problem is not resolved, a new initial calibration must be performed.

10.4.10 Corrective Actions for Continuing Calibration

If any of the technical acceptance criteria for continuing calibration are not met, it may be necessary to reanalyze the continuing calibration standard. If after reanalysis the acceptance criteria cannot be met, further corrective actions may be required.

The following corrective actions may be taken if the acceptance criteria for continuing calibration cannot be met.

1. Replace the septum on the injector
2. Replace the injector liner
3. Replace injection port seal

4. Cut the column at the injector end
5. Retune the GC/MS system and reanalyze the instrument performance check
6. Prepare fresh standards
7. Reanalyze the initial calibration

11.0 Sample Analysis

11.1 Procedure

Sample extracts shall be analyzed only after the GC/MS system has met the instrument performance check, initial calibration, second source calibration verification and continuing calibration verification requirements. The same instrument conditions must be employed for the analysis of samples as were used for calibration.

Internal standard solution is added to each sample extract. 20µL of internal standard solution is added to each accurately measured 1.0mL of water sample extract so that the expected concentration for 1L and soil samples is 40 ng/uL and 4 ng/uL for LVI and LL samples. The amount of internal standard needs to be adjusted according to how much extract volume was present in the extract vial. The exact volume of extract is measured using a syringe. The amount of Internal Standard solution to be added is then adjusted accordingly. The calculation to determine the amount of IS to add is provided below:

Equation 10

$$\frac{\text{Vol. Extract (ul)} \times 20\ \text{uL}}{1000} = \text{FV of IS (uL)}$$

Necessary dilutions are made prior to adding internal standard solution.

11.2. Dilutions

Dilutions of sample extracts are required if any target compound exceeds the initial calibration range.

The dilution chosen should keep the response of the largest target compound within the calibration range.

Dilutions of sample extracts may be performed due to the matrix of the sample. Any coating of the vial by the sample will be diluted appropriately to the level of viscosity observed.

Dilutions are prepared according to equation 11:

Equation 11:

$$\text{Dilution Factor} = \frac{\text{Final Volume}}{\text{Sample extract volume added}}$$

Dilutions are performed by adding a volume of sample extract and bringing to a final volume of 1mL with $MeCl_2$. Internal standards are added after and are not included in the calculation for final volume.

The final volume may be adjusted accordingly for cases where the sample extract volume received after extraction is not enough to perform a dilution to reach a 1mL final volume.

Dilutions that are greater than 100X must be performed by serial dilutions.

For routine dilutions, see Table 9 for volumes used in performing these dilutions.

Dilutions above 20x will be deemed to have to low a surrogate recovery and shall be qualified accordingly.

11.3. Qualitative Identification

11.3.1 Target Compounds

Target compound identification is done by comparing the sample mass spectrum to that of the standard. The following criteria must be satisfied in order to verify identifications.

Elution of the sample analyte within GC relative retention time unit window established from the 12-hour continuing calibration standard.

To establish correspondence of the GC relative retention time (RRT), the sample component RRT must compare within $\pm$0.06 RRT units of that of the standard RRT. If samples are analyzed within the same 12-hour period as the initial calibration, the 50ng (1 Liter/soils) or 4ng (LVI/LL) standard is used to verify relative retention times.

Correspondence of the sample analyte and calibration standard component mass spectra.

To establish correspondence of the sample component mass spectra to that of the standard, the following criteria must be met:

All ions present in the standard mass spectrum at a relative intensity greater than 10.0 percent (most abundant ion in the spectrum equals 100.0 percent) must be present in the sample spectrum.

The relative intensities of ions specified in the paragraph above must agree within $\pm$20.0 percent between the standard and sample spectrum. (Example: For an ion with an abundance of 50.0 percent in the standard spectrum, the corresponding sample ion abundance must be between 30.0 and 70.0 percent).

Ions greater than 10.0 percent in the sample spectrum but not present in the standard spectrum must be considered and accounted for by the analyst making the comparison. The verification process should favor false positives.

All compounds meeting the identification criteria must be reported with their spectra.

When target compounds are above the method detection limit (MDL) but are below the reporting limit (RL) but the spectrum meets the identification criteria, report the concentration with a "J".

If a compound does not meet all of the above criteria, but in the technical judgment of the mass spectral interpretation specialist the identification is correct, the compound will be identified.

11.3.2 Non-Target Compounds

A library search may be executed for non-target sample components for the purpose of tentative identification. For this purpose, the NIST/EPA/NIH mass spectral library is used to identify non-target compounds of greatest apparent concentration by a forward search of the library. A background subtraction method may be employed to better match a peak's spectrum to the library. TIC processing is performed only on client requested samples and the Method Blank (MB) associated to those samples. The following compounds will not be identified by a library search routine:

Internal standard compounds
Surrogate compounds
Volatile target compounds

11.3.3 Guidelines for Making Tentative Identifications

After samples have been processed for Target compounds, any unidentified peak in a sample which has an area count of 10% or greater of the closest Internal Standard will be eligible for TIC identification.

A start and end retention time is set to 0, which allows the entire chromatogram to be searched.

Note, if the solvent delay is not set appropriately during sample acquisition, the solvent may be collected. This should not be reported as a TIC.

Major ions in the reference spectrum (ions greater than 10 percent of the most abundant ion) should be present in the sample spectrum.

The relative intensities of the major ions should agree within $\pm$20 percent. Molecular ions present in reference spectrum should be present in sample spectrum.

Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting compounds.

Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting compounds.

Sample spectra are compared to the NIST/EPA/NIH library for tentative identification. A criterion of 85% or greater confidence is used in determining IDs.

These settings are entered into the data processing software (Chrom). For routine work, these settings perform the bulk of TIC identification. Manual review of all TIC matches are not part of the standard review, except in the following situations:

CO_2 should be removed as a TIC

Any aldol condensation product should be reported as “Aldol Condensation Products”. These include the following compounds: 4-hydroxy-4-methyl-2-pentanone, 4-methyl-2-penten-2-one and 5,5-dimethyl-2(5H)-furanone.

Siloxanes should be reported as “Column Bleed”

Multiple peaks may result in the same ID from the library. In this case, every effort should be made to identify the peak with the greatest confidence for that ID. The other shall be re-identified with the next ID listed, or re-identified as unknown.

If, in the technical judgment of the mass spectral interpretation specialist, no tentative identification can be made, the compound will be reported as unknown. Further identification may be possible, such as molecular weights or classifications (i.e., unknown hydrocarbon, unknown acid, etc.)

Further information on TICs is documented in TestAmerica Corporate Quality Policy Memorandum No. CA-Q-QM-001.

11.3.4 Targeted TICs

Targeted Tentatively Identified Compounds may be requested and reported on occasion. Unlike TICS, Targeted TICs are searched and reported even if they are not detected.

These are included in the client requested compound list, but are not calibrated.

Identification is made using the NIST/EPA/NIH spectral library to compare all peaks in a chromatogram that are not identified as part of the client target analyte list.

An Internal Standard is a pre-determined based on the proximity of a detected peak to the closest internal standard.

A match threshold of 50% is used for identification of the sample spectrum versus the reference spectrum assigned for that compound.

A response factor of 1 is assumed for quantitation.

11.4 Quantitative Identification

11.4.1 Target Compounds

Target compounds identified shall be quantitated by the internal standard method. The internal standard used shall be the one assigned to that analyte for quantitation (see Table 4). The EICP area of primary characteristic ions of analytes listed in Tables 5 are used for quantitation.

The calculation of analyte on-column (raw) concentration is based on equations 12, 13 and/or 14. In each equation, the concentration is designated as “x”.

Average calibration fit:

Equation 12:

$$x = \frac{A_c \times C_I}{A_I \times RF}$$

Where:

Ac = Area of the compound
C_I = Expected concentration of the Internal Standard
A_I = Area of the Internal Standard
RF = Response Factor from the initial calibration

Linear calibration fit:

Equation 13:

$$y = mx + b$$

Where:

m = slope of the line
b = y-intercept
y = response factor as determined from equation 14.

Equation 14:

$$y = \frac{A_c \times C_I}{A_I}$$

Where:

A_c, C_I and A_I are given above.

In instances where manual integration is necessary due to co-elution baseline noise or matrix interferences, all instances will be initialed and dated by the analyst. The quantitation report is documented as such by an "m" next to the compound that has been edited. In all instances of manual integration, a hardcopy of the EICP for that compound will be supplied with the raw data, this applies to all target compounds, internal standards and surrogate compounds. Manual Integrations are completed in accordance with TestAmerica Buffalo SOP BF-GP-013.

11.4.2 Water Samples

The following Equation (Eq. 15) is used to determine the final concentration of target compounds identified in water samples:

Equation 15

$$Concentration\ \mu g/L = \frac{(A_x)(I_s)(V_c)(Df)}{(A_{is})(RRFi)(V_o)(V_i)}$$

Where,

A_x = Area of the characteristic ion for the compound to be measured
A_{is} = Area of the characteristic ion for the internal standard
I_s = Amount of internal standard injected in nanograms (ng)
V_o = Volume of water extracted in milliliters (mL)
V_i = Volume of extract injected in microliters (µL)
Note: A value of 1uL should be assumed. LVI injections of 2uL or greater are accounted for in the initial calibration and are consistent through the calculation of the on-column (raw) concentrations.
V_c = Volume of the concentrated extract in microliters (µL)
RRFi= Relative response factor determined from the initial calibration
Df = Dilution factor. The dilution factor for analysis of water samples for semivolatiles by this method is defined in equation 11.

If no dilution is performed, Df = 1.0

11.4.3 Soil/Sediment Samples

The following Equation (Eq. 16) is used to determine the concentration of target compounds in soil/sediment samples:

Equation 16

$$Concentration\ \mu g/Kg\ (Dry\ weight\ basis) = \frac{(A_x)(I_s)(V_c)(Df)}{(A_{is})(RRF_i)(V_i)(W_s)(D)}$$

Where,

A_x, I_s, A_{is} are as given for water, above.
V_c = Volume of the concentrated extract in microliters (µL)
V_i = Volume of the extract injected in microliters (µL)
$D = \frac{100 - \%\ moisture}{100}$
W_s = Weight of sample extracted in grams (g)
RRFi= Relative response factor determined from the initial calibration.
Df = Dilution factor. The dilution factor for analysis of soil/sediment samples for semivolatile by this method is defined in equation 11.

11.4.4 Tentatively Identified Compounds

Non-Target Compounds

An estimated concentration for non-target tentatively identified compounds is quantitated by the internal standard method. For quantitation, the nearest internal standard free of interferences is to be used. The equations for calculating final concentrations are the same as equations 15 and 16. Total area counts from the total ion chromatograms are used for both the compounds to be measured and the internal standard. A relative response factor (RRF) of one (1) is assumed. The resulting concentration is to be qualified as "J" (estimated, due to lack of a compound specific response factor), and "N" (Presumptive evidence of presence), indicating the quantitative and qualitative uncertainties is calculated for all tentatively identified compounds as well as those identified as unknowns.

11.5 Technical Acceptance Criteria For Sample Analysis

The samples must be analyzed on a GC/MS system meeting the DFTPP, initial calibration and continuing calibration criteria.

The sample must be extracted and analyzed within the holding times.

The sample must have an associated method blank meeting the technical acceptance criteria for a MB, defined in section 9.1.1.2.

The sample must have an associated laboratory control sample meeting the technical acceptance criteria for a LCS, defined in section 9.1.2.6.

A matrix spike/matrix spike duplicate should be prepared with samples. If insufficient volume for a MS/SD, a laboratory control sample duplicate must be analyzed and meet the technical acceptance criteria for a LCS, defined in section 9.1.2.6.

All surrogates must meet the technical acceptance criteria for Surrogate Recoveries, defined in section 9.2.1.

The relative retention time of each compound must be within $\pm$0.06 RRT units of its relative retention time in the continuing calibration standard.

The instrumental response (EICP area) for each of the internal standards must meet the technical acceptance criteria for Internal Standard recoveries, defined in section 9.3.1.

Excluding those ions in the solvent front, no ion may saturate the detector. No target compound concentration may exceed the upper limit of the 12-hour standard calibration range unless a more dilute aliquot of the sample extract is also analyzed.

11.6 Corrective Actions for Sample Analysis

The technical acceptance criteria must be met before data are reported. If any of the criteria listed above are not met, either re-analyze the sample on an instrument meeting all technical

criteria, refer to corrective actions defined throughout sections 9.0 and 10.0, or re-extract and re-analyze the sample.

If the technical acceptance criteria for the relative retention times of the internal standard, surrogate or target compounds are not met, the following corrective actions are taken in the given order:

Carrier gas, zone temperatures and instrument temperature programs are checked to ensure that an error was not made or that the gas tank was not dry or clogged. If no errors are found the analyst will proceed to the next step in the corrective action process.

The sample is re-analyzed to ensure that an error was not made during the first injection. If, after reanalysis, the relative retention times are not within the technical acceptance criteria, it may be assumed that a matrix effect was involved. Both analyses will be reported and the instance will be documented in the job narrative. If, after re-analysis, the relative retention times are within the technical acceptance criteria, the second analysis will be reported only.

Exception: If the relative retention times of a sample, MS/MSD agree (i.e., relative retention times are outside of criteria limits for the sample, MS and MSD), it may be assumed that a matrix effect was involved and further corrective action is not necessary.

12.0 Documentation

12.1 Instrument Logbook

A logbook must be maintained to track major maintenance as well as daily maintenance to an instrument. The log book must contain the date of the maintenance, the initials of the analyst performing the work, the reason for the maintenance and the maintenance completed. If any parts are replaced, catalog and lot numbers must be recorded. If maintenance either resolves the issue or further maintenance is required, this should be notated as well.

12.2 Reagents

All standards must be entered into LIMS. Each ampule will receive a LIMS ID# for traceability.

The certificate of analysis (COA) for each box of standards is then initialized, dated and given the corresponding LIMS ID#. It is then scanned and attached to the reagent in LIMS.

When intermediates or working mixes are created, they are to be logged into LIMS and will be assigned an unique LIMS reference number.

12.3 Sample Logbook

Prior to the start of the analysis, QC and samples are logged into a unique Chrom worklist which serves as an electronic run log. This is accomplished with a barcode scanner which uses the unique sample ID supplied directly from TALS via the prep batch.

Run Logs must contain the following information:
- Date, time, and analyst initials
- File number, sample ID, vial #, and job #
- Injection volume, final volume, initial volume and dilution factor
- References for the standards, tune mix, IS mix

All samples injected must be added to a LIMS worklist. If injections are not used, they are labeled accordingly in the worklist. Files must not remain in the Missing Samples list in Chrom and must not be deleted from this list. These must be entered into the worklist, properly linked and processed.

12.4 Calibration/Batch Checklists

Calibration checklist CA-Q-WI-046 (current revision) is to be completed by first and second level review. This is scanned and attached to the batch in LIMS.

Data Review checklist CA-Q-WI-045 (current revision) is to be completed by first and second level review. This is scanned and attached to the batch in LIMS.

13.0 Data Review

Technical data review of initial calibrations, instrument/batch QC and client data criteria is defined in TestAmerica Buffalo SOP BF-GP-012 (current revision).

13.1 Method Detection Limit Study (MDL)

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 Corporate 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.

13.2 Demonstration of Capabilities

Initial Demonstration of Capability (IDOC): The initial demonstration with each sample preparation technique and analytical method combination utilized must be performed by generating data of acceptable accuracy and precision for target analytes in a clean matrix. This is also done for new staff or when significant changes in instrumentation are made. Demonstration of Capability (DOC) will be performed annually for those analysts whom have passing IDOCs.

14.0 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."

15.0 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 section 13 of the Corporate Safety Manual. The following waste streams are produced when this method is carried out.

There are two types of aqueous waste generated in the lab:

A-Waste: All non-nitric acid and alkaline aqueous waste.
AN-Waste: All aqueous waste containing nitric acid.

These types of waste are to be disposed of into appropriately market plastic containers.

The following are the other types of lab waste and where to dispose of:

C-Waste: all solvent waste gets dumped into appropriately marked metal cans. These cans need to be grounded whenever they are emptied to reduce explosion hazards. Discarded standards will also be dumped into C-waste cans.

Solid Waste: all contaminated paper, solid sample waste, sodium sulfate and all other non-glass material that has been contaminated is to be wrapped in foil and gathered to be dumped into 55 gallon drums.

Glass: contaminated glass needs to be rinsed off with methylene chloride and disposed of with all other glass in glass specific containers with special extra thick polypropylene liners. These containers are for glass only.

Extract Vials: extract vials are to be archived after they have been shot. After archival period, vials are to be crushed into a 55 gallon drum.

16.0 References / Cross-References

16.1 USEPA Methods for Evaluating Solid/Waste: SW-846, Third Edition, Update III, Method 8270C, 12/96.

17.0 Method Modifications N/A

18.0 Attachments

18.1 Table 1: Semi-volatile Target Compound List and Reporting Limits
18.2 Table 2: LCS/MS/MSD Spike Analytes
18.3 Table 3: DFTPP Key Ions and Ion Abundance Criteria
18.4 Table 4: Semivolatile Internal Standards and Corresponding Target Compounds and Surrogates Assigned for Quantitation
18.5 Table 5: Characteristic Ions for Semivolatile Target Compounds, Surrogates and Internal Standards
18.6 Table 6: Poor Performing Compounds
18.7 Table 7: Relative Response Factor Criteria for Initial and Continuing Calibration of Semivolatile Target compounds
18.8 Table 8: Surrogate Recovery Limits
18.9 Table 9: Sample Dilutions
18.10 Table 10: CCV %D Limits

19.0 Revision History

Revision 8, dated December 14, 2016

- Updated Department Manager, QA manager, signatures added.
- Added Organic Operations Manager, signature added
- Added 8270C_LL method techniques and requirements to multiple sections.
- Reformatted multiple sections, primarily section titles and numbers.
- Renumbered charts, equations and tables.
- Added SOP and Corporate Policy numbers when applicable.
- Replaced all references to MSDS with SDS.
- Section 5.1: Updated list of carcinogens or potential carcinogens.
- Section 6.5.2: Added current column information.
- Updated Reagents to include Corporate approved Restek Standards and other equivalent vendor mixes.
- Chart 2: revised to include preparation information for DFTPP mixes.
- Included preparation information for working calibrations for Lists 1,2 and 3 in Charts 3-11.
- Added Internal Standard preparation information for LVI/LL in Chart 12.
- Added Section 7.4: Storage of Standards
- Section 9.1.2: Added preparation and calculation information for LCS/MS/MSD samples. Added criteria to Technical Acceptance and Corrective Actions sections.
- Added Equation 3: LCS/LCSD %Recovery calculation.
- Added Section 9.2.1/9.2.2: Technical Acceptance Criteria/Corrective Actions for Surrogate Recovery.
- Added Section 9.3: Calculation, Technical Acceptance Criteria and Corrective Actions for Internal Standards.
- Section 10.1: Added sample Preparation SOP numbers.
- Section 10.2: Updated parameters to match current LVI instrument parameters. Added parameters for 1L acquisition parameters.
- Added analyte identification criteria to Initial Calibration Technical Acceptance Criteria in Section 10.4.2.

- Added Technical Acceptance Criteria and Corrective Actions for Initial Calibration Verification (Sections 10.4.5 and 10.4.6).
- Updated the ICV criteria to ±25%D.
- Section 11.2: Added dilution factor calculation equation.
- Section 11.3.2: Included background subtraction to TIC identification.
- Updated TIC qualification procedures in accordance with Corporate Quality Policy Memorandum CA-Q-QM-001 (Section 11.3.3).
- Added Targeted TIC procedures (Section 11.3.4).
- Section 11.4.1: Added equations for calculating concentrations based on an average and linear calibration model.
- Removed references for GPC.
- Added Section 12 to include Instrument, Reagent and Sample logbook documentation.
- Section 13: Replaced Method Performance with Data Review.
- Updated Table 1 to include all routinely calibrated compounds and their Water, Soil, and Low Level RLs.
- Added Table 2: LCS/MS/MSD Spike Analytes.
- Updated Table 4 to include all routinely calibrated compounds and current IS assignments.
- Update Table 5 to include all routinely calibrated compounds and current quantitation/qualifying ions.
- Table 6: Updated the list of poor performers.
- Added Table 8: Surrogate Recoveries for Water, Soil and LL matrices.
- Added Table 9: Sample Dilutions.
- Added Table 10: CCV %D Limits.
- Removed Attachment A: SOP Procedure Summary.
- Removed Attachment C: Job Summary Checklist.

Revision 7, dated April 02, 2015

- Section 1.1 Removed air matrix added waste matrix and LVI volumes
- Section 9.2.8 MSB to LCS
- Section 9.5.1 Included LVI
- Changed Lab Director, signature added.
- Changed Department Manager, signature added.

Revision 6, dated February 18, 2013

- Update Quality Assurance Manager, signature added
- Changed verbiage under GC run conditions

Revision 5, dated December 27, 2012

- In Section 9.5.4 and in the table for Section 9.6, ICV and CCV recoveries were changed to ±20% of the expected value from ±25%.
- Changed Quality Officer, signature added.

Revision 4, dated October 26, 2012

- 1.1 Large Volume Injection reference
- 6.5.2 Changed column vendor to Phenomenex
- 8.1 Large Volume Injection sample size reference
- 9.1.1 LVI (Large Volume Injection) MBLK criteria
- 9.3 Injection volume change under instrument conditions for LVI
- 9.2 Changed MSB references to LCS
- 9.2.4 Added LCSD requirement for MCP/RCP work
- 9.2.10 Removal of AFCEE/ACE references
- 9.3 Injection volume change under instrument conditions for LVI
- 9.5 Added ICAL requirements for RCP/MCP work
- 11.4 Added MCP/RCP TIC requirement for drinking waters

Revision 3, dated January 12, 2012

- Changed Quality Manager, signature added.
- Removed all references to Army Corp of Engineers and AFCEE
- Removed all Element data processing references
- Removed all manual logbook references
- Added Chrom and TALS references throughout as needed
- Added analytes to Table 1.
- Added new Summary sheet

Revision 2, dated February 01, 2010

- Removed AFCEE attachment
- Removed ACOE attachment
- Added log book copy attachments, referenced in section 10.2.1
- Addition of 69 ion criteria to table
- Section 11.2 and 11.3 updated to state that the relative response factor is taken from the initial calibration
- Equations in section 11.2 and 11.3 were updated to reflect correct subscript for (RRF) to (RRFi) and for (Vc) to (Vt) and for (I3) to (Is)
- Updated attachment 1 to include Element and deleted AIMS reference
- Added APIX ,TCL list and priority pollutant %D statement in section 9.5.7
- Added Table 6. Poor Performers

Revision 1, dated June 10, 2009

- Removal of grand mean reference
- Integration for TestAmerica and STL operation
- Change to QA Manager, signature updated
- Change to Department Manager, signature update

18.1 TABLE 1
Semivolatiles Target Compound List and Reporting Limits

CAS #	Analytes	Water Limits (1L/LVI) ug/L	Soil Limits (3550C/3546) ug/kg	Water Limits (LL) ug/L	Water Limits (LL_PAH) ug/L	Soil Limits (LL_PAH) ug/kg
92-52-4	1,1'-Biphenyl	5	170	5		
95-94-3	1,2,4,5-Tetrachlorobenzene	5	170	5		
120-82-1	1,2,4-Trichlorobenzene	10	330	0.5		
95-50-1	1,2-Dichlorobenzene	10	330	0.5		
122-66-7	1,2-Diphenylhydrazine	10	330	5		
99-35-4	1,3,5-Trinitrobenzene	10	330			
541-73-1	1,3-Dichlorobenzene	10	330			
99-65-0	1,3-Dinitrobenzene	20	330			
106-46-7	1,4-Dichlorobenzene	10	330	0.5		
81-64-1	1,4-Dihydroxyanthraquinone	40	660			
100-25-4	1,4-Dinitrobenzene	10	330			
123-91-1	1,4-Dioxane	10	200			
130-15-4	1,4-Naphthoquinone	10	330			
90-13-1	1-Chloronaphthalene	10	330	0.5		
129-43-1	1-Hydroxyanthraquinone	20	660			
90-12-0	1-Methylnaphthalene	5	330	5		
134-32-7	1-Naphthylamine	10	330			
108-60-1	2,2'-oxybis[1-chloropropane]	5	170	5		
58-90-2	2,3,4,6-Tetrachlorophenol	5	170	5		
935-95-5	2,3,5,6-Tetrachlorophenol	20	660			
95-95-4	2,4,5-Trichlorophenol	5	170	5		
88-06-2	2,4,6-Trichlorophenol	5	170	5		
120-83-2	2,4-Dichlorophenol	5	170	0.5		
105-67-9	2,4-Dimethylphenol	5	170	1		
51-28-5	2,4-Dinitrophenol	10	1660	5		
121-14-2	2,4-Dinitrotoluene	5	170	5		
87-65-0	2,6-Dichlorophenol	10	330			
606-20-2	2,6-Dinitrotoluene	5	170	5		
53-96-3	2-Acetylaminofluorene	10	330	0.5		
95-51-2	2-Chloroaniline	10	330			
91-58-7	2-Chloronaphthalene	5	170	0.5		
95-57-8	2-Chlorophenol	5	170	5		
91-57-6	2-Methylnaphthalene	5	170	0.5	0.5	17
95-48-7	2-Methylphenol	5	170	1		
91-59-8	2-Naphthylamine	10	330			
88-74-4	2-Nitroaniline	10	330	5		

88-75-5	2-Nitrophenol	5	170	5		
109-06-8	2-Picoline	80	330			
95-53-4	2-Toluidine	10	330			
15831-10-4	3 & 4 Methylphenol	10	330	1		
91-94-1	3,3'-Dichlorobenzidine	5	330	5		
119-93-7	3,3'-Dimethylbenzidine	40	660			
56-49-5	3-Methylcholanthrene	10	330			
99-09-2	3-Nitroaniline	10	330			
101-14-4	4,4'-Methylene bis(2-chloroaniline)	10	330			
534-52-1	4,6-Dinitro-2-methylphenol	10	330	5		
92-67-1	4-Aminobiphenyl	10	330			
101-55-3	4-Bromophenyl phenyl ether	5	170	5		
59-50-7	4-Chloro-3-methylphenol	5	170	5		
106-47-8	4-Chloroaniline	5	170	5		
7005-72-3	4-Chlorophenyl phenyl ether	5	170	5		
106-49-0	4-Methylbenzenamine	10	330			
106-44-5	4-Methylphenol	10	330	1		
100-01-6	4-Nitroaniline	10	330	5		
100-02-7	4-Nitrophenol	10	330	5		
56-57-5	4-Nitroquinoline-1-oxide	10	660			
1705-85-7	6-Methylchrysene	10	330	0.5		
57-97-6	7,12-Dimethylbenz(a)anthracene	10	330			
301-02-0	9-Octadecenamide	100	3300			
83-32-9	Acenaphthene	5	170	0.5	0.5	17
208-96-8	Acenaphthylene	5	170	0.3	0.5	17
98-86-2	Acetophenone	5	170	5		
79-06-1	Acrylamide	5	330			
15972-60-8	Alachlor	10	330	1.5		
122-09-8	alpha,alpha-Dimethyl phenethylamine	100	330			
98-55-5	Alpha-Terpineol	10	330			
62-53-3	Aniline	10	330	0.5		
120-12-7	Anthracene	5	170	0.5	0.5	17
84-65-1	Anthraquinone	10	330			
140-57-8	Aramite, Total	20	330			
1912-24-9	Atrazine	5	170	2		
103-33-3	Azobenzene	10	330	0.5		
100-52-7	Benzaldehyde	5	170	5		
92-87-5	Benzidine	80	5000	5		
56-55-3	Benzo[a]anthracene	5	170	0.3	0.5	17
50-32-8	Benzo[a]pyrene	5	170	0.18	0.5	17
205-99-2	Benzo[b]fluoranthene	5	170	0.3	0.5	17
191-24-2	Benzo[g,h,i]perylene	5	170	0.5	0.5	17

207-08-9	Benzo[k]fluoranthene	5	170	0.3	0.5	17
65-85-0	Benzoic acid	150	4800	5		
100-51-6	Benzyl alcohol	20	330	5		
111-91-1	Bis(2-chloroethoxy)methane	5	170	5		
111-44-4	Bis(2-chloroethyl)ether	5	170	5		
117-81-7	Bis(2-ethylhexyl) phthalate	5	170	5		
85-68-7	Butyl benzyl phthalate	5	170	3		
105-60-2	Caprolactam	5	170	5		
86-74-8	Carbazole	5	170	5		
510-15-6	Chlorobenzilate	20	330	0.5		
218-01-9	Chrysene	5	170	0.5		
2303-16-4	Diallate	10	330			
53-70-3	Dibenz(a,h)anthracene	5	170	0.5	0.5	17
226-36-8	Dibenz[a,h]acridine	10	330	0.5		
192-65-4	Dibenzo[a,e]pyrene	10	330			
132-64-9	Dibenzofuran	10	170	5	0.5	17
101-83-7	Dicyclohexylamine	10	3000			
84-66-2	Diethyl phthalate	5	170	0.5		
60-51-5	Dimethoate	10	330			
131-11-3	Dimethyl phthalate	5	170	0.5		
84-74-2	Di-n-butyl phthalate	5	170	2		
117-84-0	Di-n-octyl phthalate	5	170	5		
88-85-7	Dinoseb	10	330			
122-39-4	Diphenylamine	10	330	5		
298-04-4	Disulfoton	10	330			
62-50-0	Ethyl methanesulfonate	10	330			
56-38-2	Ethyl Parathion	10	330	1		
52-85-7	Famphur	40	660			
206-44-0	Fluoranthene	5	170	0.5	0.5	17
86-73-7	Fluorene	5	170	0.5	0.5	17
118-74-1	Hexachlorobenzene	5	170	0.5		
87-68-3	Hexachlorobutadiene	5	170	1.0		
77-47-4	Hexachlorocyclopentadiene	5	170	1		
67-72-1	Hexachloroethane	5	170	5		
70-30-4	Hexachlorophene	310	5000			
1888-71-7	Hexachloropropene	10	330			
544-76-3	Hexadecane	10	330	0.5		
95-13-6	Indene	60	3000	5		
193-39-5	Indeno[1,2,3-cd]pyrene	5	170	0.5	0.5	17
465-73-6	Isodrin	10	330			
78-59-1	Isophorone	5	170			
120-58-1	Isosafrole	10	330	0.5		

143-50-0	Kepone	50	660			
91-80-5	Methapyrilene	50	1500			
66-27-3	Methyl methanesulfonate	10	330			
298-00-0	Methyl parathion	10	330			
91-20-3	Naphthalene	5	170	1	0.5	17
124-18-5	n-Decane	5	330			
98-95-3	Nitrobenzene	5	170	0.5		
99-55-8	N-Nitro-o-toluidine	10	330			
55-18-5	N-Nitrosodiethylamine	10	330			
62-75-9	N-Nitrosodimethylamine	10	330	5		
924-16-3	N-Nitrosodi-n-butylamine	10	330			
621-64-7	N-Nitrosodi-n-propylamine	5	170	5		
86-30-6	N-Nitrosodiphenylamine	5	170	5		
10595-95-6	N-Nitrosomethylethylamine	10	330			
59-89-2	N-Nitrosomorpholine	10	330			
100-75-4	N-Nitrosopiperidine	10	330			
930-55-2	N-Nitrosopyrrolidine	10	330			
593-45-3	n-Octadecane	5	330			
126-68-1	o,o',o"-Triethylphosphorothioate	10	330			
60-11-7	p-Dimethylamino azobenzene	10	330			
608-93-5	Pentachlorobenzene	10	330			
76-01-7	Pentachloroethane	10	330			
82-68-8	Pentachloronitrobenzene	10	330			
87-86-5	Pentachlorophenol	10	330	1		
62-44-2	Phenacetin	10	330			
85-01-8	Phenanthrene	5	170	0.2	0.5	17
108-95-2	Phenol	5	170	1		
298-02-2	Phorate	10	330			
85-44-9	Phthalic anhydride	500	10000			
106-50-3	p-Phenylene diamine	800	800			
23950-58-5	Pronamide	10	330			
129-00-0	Pyrene	5	170	0.5	0.5	17
110-86-1	Pyridine	25	330			
91-22-5	Quinoline	10	330			
94-59-7	Safrole, Total	10	330			
122-34-9	Simazine	10	330	0.5		
3689-24-5	Sulfotepp	10	330			
78-00-2	Tetraethyl lead	10	1000			
297-97-2	Thionazin	10	330			
126-73-8	Tributyl phosphate	10	330			

Note, The most current reporting limits are maintained in the laboratory's LIMS system. These may be updated in LIMS as MDL studies are performed.

18.2 TABLE 2
LCS/MS/MSD Spike Analytes

1,1'-Biphenyl	4-Bromophenyl phenyl ether	Chrysene
1,2,4,5-Tetrachlorobenzene	4-Chloro-3-methylphenol	Dibenz(a,h)anthracene
1,2,4-Trichlorobenzene	4-Chloroaniline	Dibenzofuran
1,2-Dichlorobenzene	4-Chlorophenyl phenyl ether	Diethyl phthalate
1,2-Diphenylhydrazine	4-Methylphenol	Dimethyl phthalate
1,3-Dichlorobenzene	4-Nitroaniline	Di-n-butyl phthalate
1,4-Dichlorobenzene	4-Nitrophenol	Di-n-octyl phthalate
1,4-Dioxane	Acenaphthene	Diphenylamine
1-Methylnaphthalene	Acenaphthylene	Fluoranthene
2,2'-oxybis[1-chloropropane]	Acetophenone	Fluorene
2,3,4,6-Tetrachlorophenol	Aniline	Hexachlorobenzene
2,3-Dimethylphenol	Anthracene	Hexachlorobutadiene
2,4,5-Trichlorophenol	Atrazine	Hexachlorocyclopentadiene
2,4,6-Trichlorophenol	Azobenzene	Hexachloroethane
2,4-Dichlorophenol	Benzaldehyde	Hexadecane
2,4-Dimethylphenol	Benzidine	Indene
2,4-Dinitrophenol	Benzo[a]anthracene	Indeno[1,2,3-cd]pyrene
2,4-Dinitrotoluene	Benzo[a]pyrene	Isophorone
2,6-Dinitrotoluene	Benzo[b]fluoranthene	Naphthalene
2-Chloronaphthalene	Benzo[g,h,i]perylene	Nitrobenzene
2-Chlorophenol	Benzo[k]fluoranthene	N-Nitrosodimethylamine
2-Methylnaphthalene	Benzoic acid	N-Nitrosodi-n-propylamine
2-Methylphenol	Benzyl alcohol	N-Nitrosodiphenylamine
2-Nitroaniline	Bis(2-chloroethoxy)methane	Pentachlorophenol
2-Nitrophenol	Bis(2-chloroethyl)ether	Phenanthrene
3,3'-Dichlorobenzidine	Bis(2-ethylhexyl) phthalate	Phenol
3-Methylphenol	Butyl benzyl phthalate	Pyrene
3-Nitroaniline	Caprolactam	Pyridine
4,6-Dinitro-2-methylphenol	Carbazole	

18.3 Table 3
DFTPP Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
51	30.0 – 60.0 percent of mass 198
68	Less than 2.0 percent of mass 69
69	0-100 percent of mass 198
70	Less than 2.0 percent of mass 69
127	40.0 – 60.0 percent of mass 198
197	Less than 2.0 percent of mass 198
198	Base peak, 100 percent relative abundance
199	5.0-9.0 percent of mass 198
275	10.0-30.0 percent of mass 198
365	Greater than 1.0 percent of mass 198
441	Present but less than mass 443
442	40.0-110.0 percent of mass 198
443	17.0 – 23.0 percent of mass 442

18.4 TABLE 4
Semivolatile Internal Standards with Corresponding Target Compounds and Surrogates Assigned for Quantitation

1,4-Dichlorobenzene-d4	**Naphthalene-d8**	**Acenaphthene-d10**	**Phenanthrene-d10**	**Chrysene-d12**	**Perylene-d12**
1,2,3,4-Tetrachlorobenzene	1,2,4-Trichlorobenzene	1,1'-Biphenyl	1,2-Diphenylhydrazine	2-Methylanthracene	3-Methylcholanthrene
1,2-Dichlorobenzene	1,3-Dinitrobenzene	1,2,4,5-Tetrachlorobenzene	1,4-Dihydroxyanthraquinone	3,3'-Dichlorobenzidine	Benzo[a]pyrene
1,3,5-Trichlorobenzene	1,4-Dinitrobenzene	1,3,5-Trinitrobenzene	1-Hydroxyanthraquinone	4,4'-Methylene bis(2-chloroaniline)	Benzo[b]fluoranthene
1,3-Dichlorobenzene	1-Methylnaphthalene	1,4-Naphthoquinone	2,3,5,6-Tetrachlorophenol	6-Methylchrysene	Benzo[g,h,i]perylene
1,4-Dichlorobenzene	2,4-Dichlorophenol	1-Chloronapthalene	2,4,6-Tribromophenol (surr)	7,12-Dimethylbenz(a)anthracene	Benzo[k]fluoranthene
1,4-Dioxane	2,4-Dimethylphenol	1-Naphthylamine	2-Acetylaminofluorene	Benzidine	Dibenz[a,h]acridine
2,2'-oxybis-(1-Chloropropane)	2,6-Dichlorophenol	2,3,4,6-Tetrachlorophenol	3.3'-Dimethylbenzidine	Benzo[a]anthracene	Dibenzo(a,h)anthracene

2-chloroaniline	2-Methylnaphthalene	2,4,5-Trichlorophenol	4,6-Dinitro-2-methylphenol	bis(2-ethylhexyl) phthalate	Dibenzo[a,e]pyrene
2-Chlorophenol	2-Nitrophenol	2,4,6-Trichlorophenol	4-Aminobiphenyl	Butyl benzyl phthalate	Indeno[1,2,3-cd]pyrene
2-Fluorophenol(surr)	4-Chloro-3-methylphenol	2,4-Dinitrophenol	4-Bromophenyl phenyl ether	Chrysene	
2-Methylphenol	4-Chloroaniline	2,4-Dinitrotoluene	4-Nitroquinoline-1-oxide	Di-n-octyl phthalate	
2-Picoline	alpha,alpha-Dimethyl phenethylamine	2,6-Dinitrotoluene	9-Octadecenamide	Hexachlorophene	
2-Toluidine	Alpha-Terpineol	2-Chloroaphthalene	Alachlor	p-Dimethylamino azobenzene	
4-Methylbenzenamine	Benzoic acid	2-Fluorobiphenyl (surr)	Anthracene	Pyrene	
4-Methylphenol	bis(2-Chloroethoxy)methane	2-Naphthylamine	Anthraquinone	Terphenyl-d14 (surr)	
Acetophenone	Caprolactam	2-Nitroaniline	Aramite, Total		
Acrylamide	Hexachlorobutadiene	3-Nitroaniline	Atrazine		
Aniline	Hexachloropropene	4-Chlorophenyl phenyl ether	Azobenzene		
Benzaldehyde	Isophorone	4-Nitroaniline	Carbazole		
Benzyl Alcohol	Naphthalene	4-Nitrophenol	Chlorobenzilate		
bis(2-Chloroethyl)ether	Nitrobenzene	Acenaphthene	Di-n-butyl phthalate		
Ethyl methanesulfonate	Nitrobenzene-d5 (surr)	Acenaphthylene	Dinoseb		
Hexachloroethane	N-Nitrosodi-n-butylamine	Diallate	Diphenylamine		
Methyl methanesulfonate	N-Nitrosopiperidine	Dibenzofuran	Disulfoton		
n-Decane	Phthalic Anhydride	Dicyclohexylamine	Ethyl parathion		

N-nitrosodiethylamine	Quinoline	Diethyl phthalate	Famphur		
N-nitrosodimethylamine	Safrole, Total	Dimethoate	Fluoranthene		
N-Nitrosodi-n-propylamine	TetraEthyl Lead	Dimethyl phthalate	Hexachlorobenzene		
N-Nitrosomethylethylamine		Fluorene	Isodrin		
N-Nitrosomorpholine		Hexachlorocyclopentadiene	Kepone		
N-nitrosopyrrolidine		Hexadecane	Methyapyrilene		
o,o',o"-Triethylphosphorothioate		Isosafrole	Methyl parathion		
Pentachloroethane		N-Nitro-o-toluidine	N-nitrosodiphenylamine		
Phenol		Pentachlorobenzene	n-Octadecane		
Phenol-d5 (surr)		Phorate	Pentachloronitrobenzene		
p-Phenylene diamine		Simazine	Pentachlorophenol		
Pyridine		Sulfotepp	Phenacetin		
		Thionazin	Phenanthrene		
		Tributyl phosphate	Pronamide		

Note: Internal Standard assignments are by suggestion only. Assignments may vary slightly between instrument methods.

18.5 Table 5
Characteristic Ions for Semivolatile
Target Compounds, Surrogates and Internal Standards

Analytes	Primary Quantitation Ion	Secondary Ion(s)	Analytes	Primary Quantitation Ion	Secondary Ion(s)	Analytes	Primary Quantitation Ion	Secondary Ion(s)
1,1'-Biphenyl	154	153, 152	4-Methylphenol	108	107	Famphur	218	125, 93
1,2,4,5-Tetrachlorobenzene	216	214, 179	4-Nitroaniline	138	92, 108	Fluoranthene	202	101, 203

1,2,4-Trichlorobenzene	180	182, 145	4-Nitrophenol	109	139, 64	Fluorene	166	165, 167
1,2-Dichlorobenzene	146	111, 75	4-Nitroquinoline-1-oxide	190	160, 89	Hexachlorobenzene	284	142, 249
1,2-Diphenylhydrazine	77	182, 51	6-Methylchrysene	242	239, 119	Hexachlorobutadiene	225	223, 227
1,3,5-Trichlorobenzene	180	182, 184	7,12-Dimethylbenz(a)anthracene	256	241, 239	Hexachlorocyclopentadiene	237	235, 272
1,3,5-Trinitrobenzene	213	75, 74	9-Octadecenamide	59	72, 55	Hexachloroethane	117	201, 199
1,3-Dichlorobenzene	146	111, 75	a.a.-Dimethyl phenethylamine	58	91, 134	Hexachlorophene	196	198, 209
1,3-Dinitrobenzene	168	50, 76	Acenaphthene	153	152, 154	Hexachloropropene	213	215, 117
1,4-Dichlorobenzene	146	111, 75	Acenaphthylene	152	151, 153	Hexadecane	57	43, 71
1,4-Dihydroxyanthraquinone	240	239, 128	Acetophenone	105	77, 51	Indeno(1,2,3-cd)pyrene	276	138, 277
1,4-Dinitrobenzene	168	75, 50	Acrylamide	71	55, 44	Isodrin	193	195, 66
1,4-Dioxane	88	58	Alachlor	160	188, 146	Isophorone	82	95, 138
1,4-Naphthoquinone	158	102, 130	Aniline	93	66, 39	Isosafrole	162	104, 131
1-Chloronaphthalene	162	127, 164	Anthracene	178	179, 176	Kepone	272	237, 357
1-Hydroxyanthraquinone	224	139, 168	Anthraquinone	180	208, 152	Methapyrilene	58	97, 191
1-Methylnaphthalene	142	141, 115	Aramite, Total	185	63, 135	Methyl parathion	109	125, 263
1-Naphthylamine	143	115, 116	A-Terpineol	59	93, 121	Naphthalene	128	129, 127
2,2'-oxybis[1-chloropropane]	45	77, 79	Atrazine	200	215, 202	n-Decane	57	43, 41
2,3,4,6-Tetrachlorophenol	232	230, 131	Azobenzene	77	182, 51	Nitrobenzene	77	123, 65
2,3,5,6-Tetrachlorophenol	232	230, 234	Benzaldehyde	77	105, 106	N-Nitro-o-toluidine	152	106, 77
2,4,5-Trichlorophenol	196	198, 200	Benzidine	184	92, 156	N-Nitrosodiethylamine	102	42, 44
2,4,6-Trichlorophenol	196	198, 200	Benzo[a]anthracene	228	229, 226	N-Nitrosodimethylamine	42	74, 43
2,4-Dichlorophenol	162	164, 98	Benzo[a]pyrene	252	253, 125	N-Nitrosodi-n-butylamine	84	57, 116
2,4-Dimethylphenol	107	121, 122	Benzo[b]fluoranthene	252	253, 125	N-Nitrosodi-n-propylamine	70	42, 130
2,4-Dinitrophenol	184	63, 154	Benzo[g,h,i]perylene	276	138,277	N-Nitrosodiphenylamine	169	168, 167

2,4-Dinitrotoluene	165	63, 182	Benzo[k]fluoranthene	252	253, 125	N-Nitrosomethylethylamine	88	42, 43
2,6-Dichlorophenol	162	164, 166	Benzoic Acid	105	122, 77	N-Nitrosomorpholine	56	86, 116
2,6-Dinitrotoluene	165	89, 121	Benzyl Alcohol	108	79, 77	N-Nitrosopiperidine	114	55, 42
2-Acetylaminofluorene	181	180, 223	bis(2-Chloroethoxy)methane	93	95, 123	N-Nitrosopyrrolidine	100	41, 42
2-Chloroaniline	127	129, 65	bis(2-Chloroethyl)ether	93	63, 95	n-Octadecane	57	43, 71
2-Chloronaphthalene	162	164, 127	bis(2-Ethylhexyl) phthalate	149	167, 279	o,o'o"-Triethylphosphorothioate	198	121, 97
2-Chlorophenol	128	64, 130	Butyl benzyl phthalate	149	91, 206	p-Dimethylamino azobenzene	120	225, 77
2-Methylanthracene	192	191, 193	Caprolactam	113	85, 84	Pentachlorobenzene	250	252, 254
2-Methylnaphthalene	142	141, 115	Carbazole	167	139, 166	Pentachloroethane	167	165, 169
2-Methylphenol	108	107, 77	Chlorobenzilate	251	139, 111	Pentachloronitrobenzene	237	214, 295
2-Naphthylamine	143	115, 116	Chrysene	228	226, 229	Pentachlorophenol	266	264, 268
2-Nitroaniline	65	92, 138	Diallate	43	234, 236	Phenacetin	108	179, 137
2-Nitrophenol	139	65, 109	Dibenz[a,h]acridine	279	139, 125	Phenanthrene	178	179, 176
2-Picoline	93	66, 39	Dibenzo(a,h)anthracene	278	139, 279	Phenol	94	65, 66
2-Toluidine	106	107, 77	Dibenzo[a,e]pyrene	302	151, 150	Phorate	75	121, 97
3,3’-Dichlorobenzidine	252	254, 154	Dibenzofuran	168	139, 169	Phthalic Anhydride	104	76, 148
3,3'-Dimethylbenzidine	212	106, 196	Dicyclohexylamine	138	56, 55	p-Phenylene diamine	108	107, 80
3-Methylcholanthrene	268	252, 126	Diethyl phthalate	149	177, 150	Pronamide	173	175, 177
3-Nitroaniline	138	92, 65	Dimethoate	87	125, 93	Pyrene	202	101, 100
4,4'-Methylene bis(2-chloroaniline	231	266, 268	Dimethyl phthalate	163	194, 164	Pyridine	52	79, 51
4,6-Dinitro-2-methylphenol	198	121, 105	Di-n-butyl phthalate	149	150, 104	Quinoline	129	128, 102
4-Aminobiphenyl	169	168, 170	Di-n-octyl phthalate	149	150, 167	Safrole, Total	162	131, 104
4-Bromophenyl-phenylether	248	250, 141	Dinoseb	211	163, 147	Simazine	201	186, 173
4-Chloro-3-methylphenol	107	144, 142	Diphenylamine	169	168, 167	Sulfotepp	322	202, 97
4-Chloroaniline	127	129, 65	Disulfoton	88	97, 61	TetraEthyl Lead	237	295, 208

4-Chlorophenyl phenyl ether	204	206, 141	Ethyl methanesulfonate	79	109, 97	Thionazin	97	107, 143
4-Methylbenzenamine	106	107, 77	Ethyl parathion	97	109, 291	Tributyl phosphate	99	155, 211
SURROGATES			**INTERNAL STANDARDS**					
Phenol-d5	99	42, 71	1,4-Dichlorobenzene-d4	152	115, 150			
2-Fluorophenol	112	64, 92	Naphthalene-d8	136	68, 108			
2,4,6-Tribromophenol	330	332, 141	Acenaphthene-d10	164	162, 160			
Nitrobenzene-d5	82	128, 54	Phenanthrene-d10	188	94, 80			
2-Fluorobiphenyl	172	171, 170	Chrysene-d12	240	120, 236			
Terphenyl-d14	244	122, 212	Perylene-d12	264	260, 265			

Note: Quantitation and/or secondary qualifying ions are by suggestion only. Assignments may vary slightly between instrument methods.

18.6 Table 6
Poor Performing Compounds

Poor Performers	LCS %R Limit
3,3'-Dichlorobenzidine	10
9-Octadecenamide	10
a,a-Dimethyl phenethylamine	10
Acrylamide	10
Benzaldehyde	10
Benzidine	5
Benzoic Acid	10
Caprolactam	10
Isosafrole	10
Kepone	10
Methapyrilene	10
n-Nitrosodimethylamine	10
p-Phenylene diamine	10
Phthalic Anhydride	10
Pyridine	10
Safrole, Total	10

The laboratory’s GC/MS semi-volatiles group identified this list of compounds based on current and historical performance. The recovery performance was reviewed against full spike recovery data as well as calibration data to validate each compound as a “poor performer”.

18.7 TABLE 7
Relative Response Factor Criteria for Initial and Continuing
Calibration of Semivolatile Target Compounds

Semivolatile Compounds	Minimum RRF	Maximum % RSD	Maximum % Diff
Acenaphthene (CCC)	none	30	±20
1,4-Dichlorobenzene (CCC)	none	30	±20
Hexachlorobutadiene (CCC)	none	30	±20
N-Nitrosodiphenylamine (CCC)	none	30	±20
Di-n-octyl phthalate (CCC)	none	30	±20
Fluoranthene (CCC)	none	30	±20
Benzo(a)pyrene (CCC)	none	30	±20
4-Chloro-3-methylphenol (CCC)	none	30	±20
2,4-Dichlorophenol (CCC)	none	30	±20
2-Nitrophenol (CCC)	none	30	±20
Phenol (CCC)	none	30	±20
Pentachlorophenol(CCC)	none	30	±20
2,4,6-Trichlorophenol (CCC)	none	30	±20
N-Nitroso-di-n-propylamine (SPCC)	0.050	None	none
Hexachlorocyclopentadiene (SPCC)	0.050	None	none
2,4-Dinitrophenol (SPCC)	0.050	None	none
4-Nitrophenol (SPCC)	0.050	None	none

18.8 TABLE 8
Surrogate Recovery Limits

Surrogate	**% Recovery Limit (1L, LVI)**	**% Recovery Limit (3350C/3546)**	**% Recovery Limit (LL)**	**% Recovery Limit (LL_PAH)**
2,4,6-Tribromophenol	52-132	39-146	39-146	
2-Fluorobiphenyl	48-120	37-120	37-120	48-120
2-Fluorophenol	20-120	18-120	18-120	
Nitrobenzene-d5	46-120	34-132	34-132	46-120
Phenol-d5	16-120	11-120	11-120	
p-Terphenyl-d14	67-150	65-153	58-147	24-136

Note: Limits are updated and entered annually into LIMS.

18.9 TABLE 9
Sample Dilutions

Dilution Factor	uL of Sample Extract	uL of $MeCl_2$	Total Volume (uL)	uL of IS
2	500	500	1000	20
4	250	750	1000	20
5	200	800	1000	20
10	100	900	1000	20
20	50	950	1000	20
25	40	960	1000	20
40	25	975	1000	20
50	20	980	1000	20
100	10	990	1000	20

Dilutions greater than 100X must be performed by serial dilution.

18.10 TABLE 10
CCV %D Limits

Analytes	%D Limit	Analytes	%D Limit
1,1'-Biphenyl	40	Benzyl alcohol	100
1,2,4,5-Tetrachlorobenzene	40	Bis(2-chloroethoxy)methane	20
1,2,4-Trichlorobenzene	20	Bis(2-chloroethyl)ether	20
1,2-Dichlorobenzene	20	Bis(2-ethylhexyl) phthalate	20
1,2-Diphenylhydrazine	25	Butyl benzyl phthalate	20
1,3,5-Trinitrobenzene	100	Caprolactam	40
1,3-Dichlorobenzene	20	Carbazole	20
1,3-Dinitrobenzene	100	Chlorobenzilate	100
1,4-Dichlorobenzene	20	Chrysene	20
1,4-Dihydroxyanthraquinone	40	Diallate	100
1,4-Dinitrobenzene	100	Dibenz(a,h)anthracene	20
1,4-Dioxane	100	Dibenz[a,h]acridine	40
1,4-Naphthoquinone	100	Dibenzo[a,e]pyrene	40
1-Chloronaphthalene	40	Dibenzofuran	20
1-Hydroxyanthraquinone	40	Dicyclohexylamine	100
1-Methylnaphthalene	40	Diethyl phthalate	20
1-Naphthylamine	100	Dimethoate	100
2,2'-oxybis[1-chloropropane]	20	Dimethyl phthalate	20
2,3,4,6-Tetrachlorophenol	40	Di-n-butyl phthalate	20
2,3,5,6-Tetrachlorophenol	40	Di-n-octyl phthalate	20
2,4,5-Trichlorophenol	20	Dinoseb	100

2,4,6-Tribromophenol	25	Diphenylamine	100
2,4,6-Trichlorophenol	20	Disulfoton	100
2,4-Dichlorophenol	20	Ethyl methanesulfonate	100
2,4-Dimethylphenol	20	Ethyl Parathion	100
2,4-Dinitrophenol	20	Famphur	100
2,4-Dinitrotoluene	20	Fluoranthene	20
2,6-Dichlorophenol	100	Fluorene	20
2,6-Dinitrotoluene	25	Hexachlorobenzene	20
2-Acetylaminofluorene	100	Hexachlorobutadiene	20
2-Chloroaniline	25	Hexachlorocyclopentadiene	20
2-Chloronaphthalene	25	Hexachloroethane	20
2-Chlorophenol	20	Hexachlorophene	100
2-Fluorobiphenyl	25	Hexachloropropene	100
2-Fluorophenol	25	Hexadecane	40
2-Methylnaphthalene	20	Indeno[1,2,3-cd]pyrene	20
2-Methylphenol	20	Isodrin	100
2-Naphthylamine	100	Isophorone	20
2-Nitroaniline	20	Isosafrole	100
2-Nitrophenol	20	Kepone	100
2-Picoline	100	Methapyrilene	100
2-Toluidine	100	Methyl methanesulfonate	100
3,3'-Dichlorobenzidine	20	Methyl parathion	100
3,3'-Dimethylbenzidine	100	Naphthalene	20
3-Methylcholanthrene	100	n-Decane	40
3-Nitroaniline	20	Nitrobenzene	20
4,4'-Methylene bis(2-chloroaniline)	40	Nitrobenzene-d5	25
4,6-Dinitro-2-methylphenol	20	N-Nitro-o-toluidine	100
4-Aminobiphenyl	100	N-Nitrosodiethylamine	100
4-Bromophenyl phenyl ether	20	N-Nitrosodimethylamine	25
4-Chloro-3-methylphenol	20	N-Nitrosodi-n-butylamine	100
4-Chloroaniline	20	N-Nitrosodi-n-propylamine	20
4-Chlorophenyl phenyl ether	20	N-Nitrosodiphenylamine	20
4-Methylbenzenamine	40	N-Nitrosomethylethylamine	100
4-Methylphenol	20	N-Nitrosomorpholine	100
4-Nitroaniline	20	N-Nitrosopiperidine	100
4-Nitrophenol	20	N-Nitrosopyrrolidine	100
4-Nitroquinoline-1-oxide	100	n-Octadecane	40
6-Methylchrysene	40	o,o',o''-Triethylphosphorothioate	100
7,12-Dimethylbenz(a)anthracene	100	p-Dimethylamino azobenzene	100
9-Octadecenamide	40	Pentachlorobenzene	100
Acenaphthene	20	Pentachloroethane	100

Acenaphthylene	20	Pentachloronitrobenzene	100
Acetophenone	40	Pentachlorophenol	20
Acrylamide	40	Phenacetin	100
Alachlor	40	Phenanthrene	20
alpha,alpha-Dimethyl phenethylamine	100	Phenol	20
Alpha-Terpineol	40	Phenol-d5	25
Aniline	100	Phorate	100
Anthracene	20	Phthalic anhydride	100
Anthraquinone	40	p-Phenylene diamine	100
Aramite, Total	100	Pronamide	100
Atrazine	25	p-Terphenyl-d14	25
Azobenzene	40	Pyrene	20
Benzaldehyde	40	Pyridine	100
Benzidine	25	Quinoline	40
Benzo[a]anthracene	20	Safrole, Total	100
Benzo[a]pyrene	20	Simazine	40
Benzo[b]fluoranthene	20	Sulfotepp	100
Benzo[g,h,i]perylene	20	Tetraethyl lead	40
Benzo[k]fluoranthene	20	Thionazin	100
Benzoic acid	25	Tributyl phosphate	40

Title: Thermo Scientific ICAP 6500 Analysis
Method No(s). 6010C/CLP/200.7/6010B/6010D

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Approvals (Signature/Date):

10/18/17	10/18/17
Jason Kacalski	Kenneth Kasperek
Department Manager	Laboratory Director
Date	Date

10/18/17
Michael Mosscrop
Quality Assurance Manager
Date

Facility Distribution No. _____ **Distributed To:_____**

1.0 Scope and Application

1.1 This SOP is specific for methods (SW-846) 6010B, 6010C, 6010D, 200.7, and CLP and discusses the procedures as they are performed at TestAmerica Buffalo. It contains the procedures for the daily operation of the ICAP 6500 ICP-OES Spectrometer, and also contains procedures for calibration, standard, and sample preparation, instrument maintenance, data handling, and quality control.

1.2 At TestAmerica Buffalo, there are two ICAP 6500 ICP-OES Spectrometers equipped with ESI SC autosamplers. They are designated as ICAP1 and ICAP2. The ICAPs have both axial and radial viewing angles.

1.3 **Analytes, Matrix(s), and Reporting Limits**

1.3.1 This SOP is used for the analysis of dissolved (soluble) water samples, digestates of total and dissolved waters, TCLP extracts, total recoverables, and digestates of soils, sludge, sediments, and other wastes.

1.3.2 The following elements are analyzed on each ICAP. Table 17.4 lists the wavelengths used for each ICAP.

Analyte Element	Symbol	Analyte Element	Symbol
Aluminum	Al	Manganese	Mn
Arsenic	As	Molybdenum	Mo
Antimony	Sb	Nickel	Ni
Barium	Ba	Sodium	Na
Beryllium	Be	Potassium	K
Boron	B	Selenium	Se
Cadmium	Cd	Silicon	Si
Calcium	Ca	Silver	Ag
Chromium	Cr	Strontium	Sr
Cobalt	Co	Thallium	Tl
Copper	Cu	Tin	Sn
Iron	Fe	Titanium	Ti
Lead	Pb	Vanadium	V
Lithium	Li	Zinc	Zn
Magnesium	Mg	Sulfur	S

1.3.3 Tables 17.2 and 17.3 list approximate Instrumental Detection Limits (IDLs) for each ICAP and achievable Method Detection Limits (MDLs). The laboratory IDLs are updated quarterly and the MDLs are updated annually, or when a significant change in instrumentation or methodology occurs. Current IDLs and MDLs are maintained in the laboratory LIMS.

1.3.4 The laboratory standard Practical Quantitation Limits (PQLs) are also listed in Tables 17.2 and 17.3. The standard laboratory PQLs are only changed if there is a major update to the analytical system.

1.3.5 The linear range is the concentration range over which the instrument response to an analyte is linear. Table 17.5 lists the approximate linear ranges of each ICAP. Linear ranges are verified quarterly or when a significant change in instrumentation occurs.

1.4 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 Samples and standards to be analyzed are digested or matrix matched to achieve an acidic aqueous solution containing 6% HNO_3 and 5% HCl by volume.

2.2 Samples are introduced to the instrument through an autosampler, combined with an internal standard, nebulized with argon gas to produce an aerosol, and transported to an argon plasma torch where sample excitation occurs. Characteristic atomic line emission spectra are produced by radio frequency inductively coupled plasma (ICP). Emission line intensity is measured by the instrument and processed by the instrument software (iTEVA). A background correction technique is required to compensate for variable background contribution to the determination of trace elements. Background must be measured adjacent to analyte lines during analysis. The position selected for the background intensity measurement, on either or both sides of the emission line, are determined by the complexity of the spectrum adjacent to the analyte line. The position used must be free of spectral interferences and reflect the same change in background intensity as occurs at the analyte wavelength measured.

2.3 Normal steps in the daily operation of the ICAPs include:

- Perform any routine maintenance, if required.
- Instrument start-up and warm-up, if instrument is not already conditioned
- Preparation of standards (as needed). All calibration standards and quality control standards are prepared from stock solutions, with a 6 month expiration date.
- Prepare all the samples for analysis including the required spikes, serial dilutions, and other quality control samples.
- Set up an analysis run: a run is simply a sequence of samples to be analyzed with all required quality control samples, which are analyzed as a single unit.
- Set-up the autosampler.
- Analyze the samples.
- When the analysis is complete, check the data for applicable method.
- Enter analysis data into the LIMS.
- Dispose of samples and standards appropriately. Clean-up lab area.

2.4 If the instrument is not operating properly or requires any maintenance, refer to Section 10.3 for help with routine maintenance and troubleshooting.

3.0 Definitions

3.1 ICAP – Inductively coupled argon plasma. Abbreviation used for Thermo Scientific ICAP 6500 ICP-OES Spectrometer.

3.2 IECs – Interfering Element Correction factors. Used to correct for interferences caused by spectral overlap of elemental lines. See Section 9.3.1 for procedures on determining IECs.

3.3 LDR - Linear Dynamic Range - also referred to as Linear Range (LR). The linear range is the concentration range over which the instrument response to an analyte is linear. Refer to Section 9.3.3 for the determination of linear ranges.

3.4 IDL - Instrument detection limit. The IDL of an element is the lowest calculated concentration that the instrument can measure. See section 9.3.2 for procedures on determining IDLs.

3.5 MDL – Method Detection Limit. The minimum concentration of an analyte that can be measured with a specified degree of confidence that the concentration is greater than zero.

3.6 PQL – Practical Quantitation Limit. The minimum concentration of an analyte that can be *quantitatively* measured with a specified degree of confidence and within *accuracy and precision guidelines*. Commonly referred to as the *laboratory* reporting limit (RL). Also equivalent to the lower limit of quantitation (LLOQ).

3.7 Calibration Standards - A series of solutions containing known amounts of each analyte within a matrix similar to samples. These solutions are used to calibrate the instrument.

3.8 ICV - Initial Calibration Verification – A standard used to verify the accuracy of the calibration, and which must be from a different source from that of the calibration standards

3.9 ICVL – Low Level Initial Calibration Verification. Prepared at the same concentration as the low calibration point for each analyte. Formerly the CRI standard.

3.10 ICB - Initial calibration blank.

3.11 ICSA - Interference check sample containing only high levels of Al, Fe, Ca, and Mg.

3.12 ICSAB - Interference check sample containing high levels of Al, Fe, Ca, and Mg, and low levels of other elements that are analyzed by the ICAP.

3.13 ICEX1-ICEX4 – Interference Check samples containing elements with known interferences at the LDR which are determined quarterly and not covered by the ICSA and ICSAB.

3.14 LDRCK – LDR daily check

3.15 CCV - Continuing calibration verification. Prepared at the mid-range of the calibration

3.16 CCVL – Low Level Continuing Calibration standard. Prepared at the same concentration as the low calibration standard for each analyte.

3.17 CCB - Continuing calibration blank.

3.18 LCS - Laboratory Control Sample -A quality control sample containing known concentration of analytes that is taken through the entire digestion and analysis procedure.

3.19 Calibration Blank - A blank solution containing 6% HNO_3 and 5% HCl for calibration.

3.20 Total Metals – The concentration determined on an unfiltered and acidified sample following vigorous digestion.

3.21 Dissolved or Soluble Metals – The concentration determined on a sample after passing through a 0.45um membrane filter, typically at the time of sample collection. Acidification and digestion are performed after filtration.

3.22 ELGA water – Reagent water that is deionized, filtered, and has a resistivity of 18 $M\Omega cm^{-1}$

3.23 LLQC- Lower Limit of Quantitation Check - Digested and analyzed to confirm the quantitation limit. Also called Limit of Quantitation Verification (LOQV)

3.24 MB- Method Blank – A blank sample that is taken through each step of the analytical procedure, including the digestion procedure if it is used.

4.0 Interferences

There are four main types of interferences which affect ICP-OES: spectral, physical, chemical and memory interferences.

4.1 Spectral Interferences

These types of interferences are caused primarily from the overlap of elemental lines and background contributions. Interferences from spectral overlap are eliminated by the use of interfering element correction factors (IECs). Interferences caused by background contributions are eliminated by the use of background correction. `

4.2 Physical Interferences

These types of interferences are caused by differences in the physical between the standards and the sample matrix. The major source of these interferences is a high dissolved solids concentration in a sample. Physical interferences are minimized by using an internal standard, diluting the samples and/or performing the method of standard addition.

Additionally, high salt concentrations can cause a buildup of salt at the tip of the nebulizer. This effect can be reduced by use of an argon saturator and/or a V-Groove nebulizer designed for high dissolved solid use.

4.3 Chemical Interferences

These are generally caused by molecular compound formation, ionization effects, and solvent evaporation effects. These effects can be minimized by careful selection of the operating conditions, by sample dilution, by buffering the sample, or by standard addition procedures. At TestAmerica Buffalo, an internal standard technique, which involves adding yttrium and indium that are both not found in the samples and verified to not cause an

interelement spectral interference to the samples, standards, and blanks is used to minimize the ionization effects of the high level of easily ionized elements such as K and Na. The element intensity is used by the instrument as an internal standard to ratio the analyte intensity signals for both calibration and quantitation.

4.4 Memory Interferences

Memory interferences (also referred to as carryover) result when analytes present in a sample contribute to the signals measured in one or more following samples. To minimize memory effects, appropriate rinse time must be allowed between all samples and standards. If memory interference is suspected, the sample must be reanalyzed after a rinse period of sufficient length.

4.5 The following tests may be performed to check for physical and chemical interferences. A serial dilution and a post-digestion spike is performed on a representative sample from each sample batch.

4.5.1 Serial Dilution (SD)

A serial dilution (1:5 dilution) is performed on a representative sample of each matrix of each sample group. If the analyte concentration is high enough, the serial dilution must agree within 10% (200.7, 6010B, 6010C) or 20% (6010D) of the original sample. If the serial dilution is outside the control limit, a chemical or physical interference effect is suspected.

4.5.2 Post-digestion Spike (PDS)

A post-digestion spike is performed on a representative sample within the sample group (client job) is spiked. Generally, the spike is performed on the same sample as the one on which the serial dilution is performed, unless there is limited volume. Spiking a sample consists of adding a specified amount of spike solutions to the unknown sample. Each spike solution contains various elements of interest.

4.5.3 The six spike solutions for Non-CLP samples are:

- **Spike 1 (Custom Inorganic Standard) Made by Ultra Scientific (ICUS-1370)** This ULTRAgrade ™ standard was gravimetrically prepared and the true value listed is the concentration calculated from gravimetric and volumetric measurements performed during the preparation of the standard.

ANALYTE	TRUE VALUE
Antimony	40.0 µg/mL
Arsenic	40.0 µg/mL
Beryllium	40.0 µg/mL
Cadmium	40.0 µg/mL
Chromium	40.0 µg/mL
Cobalt	40.0 µg/mL
Copper	40.0 µg/mL
Lead	40.0 µg/mL
Manganese	40.0 µg/mL
Molybdenum	40.0 µg/mL
Nickel	40.0 µg/mL

Selenium	40.0 µg/mL
Thallium	40.0 µg/mL
Vanadium	40.0 µg/mL
Zinc	40.0 µg/mL
Titanium	40.0 µg/mL
Calcium	2000.0 µg/mL
Iron	2000.0 µg/mL
Magnesium	2000.0 µg/mL

Matrix: 5% HNO_3 in water. All weights are traceable to NIST traceable weight.

NOTE: These concentrations may vary slightly different between different lots. Exact concentrations may be found in the Certificates of Analysis and in TALS. This NOTE is also applicable to Spike 2, Spike 3, Spike 4, and Spike 5.

- **Spike 2 (Custom Inorganic Standard) Made by Ultra Scientific (ICUS-3097)**
  This ULTRAgrade ™ standard was gravimetrically prepared and the true value listed is the concentration calculated from gravimetric and volumetric measurements performed during the preparation of the standard.

ANALYTE	TRUE VALUE
Barium	40.0 µg/mL
Boron	40.0 µg/mL
Aluminum	2000 µg/mL
Potassium	2000 µg/mL
Sodium	2000 µg/mL
Lithium	40.0 µg/mL
Strontium	40.0 µg/mL

Matrix: 5% HNO_3 in water. All weights are traceable to NIST traceable weights.

- **Spike 3 (prepared by lab)**

ANALYTE	TRUE VALUE
Silver	10 µg/mL

Matrix 2% HNO_3 in water. See 7.10 for preparation.

- **Spike 4 (prepared by lab)**

ANALYTE	TRUE VALUE
Tin	40 µg/mL

Matrix: 5% HNO_3 in water. See 7.11 for preparation.

- **Spike 5 (prepared by lab)**

ANALYTE	TRUE VALUE
Silicon	2000 µg/mL

Matrix: 5% HNO_3 in water. See 7.12 for preparation.

- **Spike 6 (prepared by lab)**

ANALYTE	TRUE VALUE
Sulfur	2000 µg/mL

Matrix: 5% HNO_3 in water. See 7.12 for preparation.

Table 17.6 lists the final concentration of each element spiked.

To prepare a post-spike, add 0.05 mL of Spike 1, Spike 2, Spike 3, Spike 4, Spike 5 , and Spike 6 to 9.70 mL of sample. Mix thoroughly and analyze.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate 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

Many of the metallic elements analyzed for in this method are known to be hazardous to health. Care should be taken in the handling and disposing of all standards and samples. See section 14.0 for procedures on the disposal of standard and sample waste.

The matrix of all prepared standards and samples is 6% HNO_3, 5% HCl by volume. Preserved metals samples contain 1-2% HNO_3 and have a pH < 2. Gloves must be used when handling all standards and samples. Safety glasses and lab coats must be worn at all times within laboratory areas. Extra care should be taken when dispensing concentrated acids. Concentrated acids should be dispensed only in the fume hood.

The ICAP's plasma emits strong UV light and is harmful to vision. **AVOID LOOKING DIRECTLY AT THE PLASMA.**

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 Safety Data Sheets (SDS) 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 SDS for each

material before using it for the first time or when there are major changes to the SDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Nitric Acid	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
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.
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

6.1 Instrumentation

Thermo Scientific ICAP 6500 ICP-OES Spectrometer, equipped with an ESI SC autosampler, computer, printer, and source of Argon gas. There are two ICAP Analyzers at TestAmerica Buffalo. They are designated as ICAP 1 and ICAP 2.

- Spare parts for the ICAP:
  - nebulizers
  - torches
  - spray chambers
  - rotors
  - stators
  - fast switches
  - duo radial plasma view window

- White/White or Gray/Gray pump tubing (drain)
- Orange/Green pump tubing (IS)
- Black/Black pump tubing (carrier)
- Internal Standard tubing mixing kit (green-T)
- Autosampler, Carrier, and Internal Standard probes
- Sample loading coil

6.2 **Supplies**

- Volumetric flasks and graduated cylinders in various sizes from 50 mL to 2000 mL. These are used for standard preparation and sample dilution.

- Eppendorfs in various sizes. These are used for standard and sample preparation. The Eppendorfs and re-pipettors are verified using an analytical balance on a daily basis. They are calibrated on a quarterly basis along with the re-pipettors. An electronic spreadsheet contains the calibration results. At least one Eppendorf in each of the following ranges are used:

  10 µL → 100 µL
  50 µL → 200 µL
  50 µL → 250 µL
  100 µL → 1000 µL
  500 µL → 2500 µL
  2000 µL → 10000 µL

- Disposable polypropylene pipette tips for the Eppendorfs in various sizes.

- Disposable 17x100 mm polypropylene culture tubes used for samples in the autosampler.

- 50 mL sample vials used for calibration and control standards in the autosampler.

- Repipettors and bottles for dispensing acids and blank for dilutions.

- Parafilm for covering some samples and standards when not in use.

7.0 Reagents and Standards

7.1 All standards and samples are prepared using 18 $M\Omega cm^{-1}$ ELGA water. The metals lab has an ELGA water system attached to a deionized water system. The ELGA water is monitored daily by the Wet Chemistry department and maintenance is performed as needed.

7.2 All standards are prepared with class A volumetric flasks, and calibrated Eppendorf pipettes.

7.3 All standards and samples are prepared with Trace Metals Grade Nitric and Hydrochloric Acids.

7.4 All the working standards and samples are prepared in the same matrix containing 6% HNO_3 and 5% HCl (by volume). All standards and samples are prepared such that the matrix is matched.

7.5 Standards are prepared as needed (about every 7-10 days for Calibration Standards).

Table 17.7 lists all purchased reagents and stock standards that are used. All purchased stock standards and solutions are certified by the manufacturer and the certificates kept on record. All stock and prepared solutions are logged into the LIMS.

The multi-element calibration standards and other solutions required (except for those used for quality control ICVs and CCVs) are prepared from stock solutions purchased from ULTRA SCIENTIFIC and INORGANIC VENTURES. The standard solutions used to prepare ICVs and CCVs purchased from HIGH PURITY or CPI. The use of two vendors of different lots ensures a second source verification of standards.

7.6 There are two types of solutions that are prepared from the purchased stock standards. They are prepared stock solutions and the working standards. Prepared stock solutions are used as intermediate standards for preparing the working standards. All prepared stock solutions and working standards are documented in the LIMS and are labeled with their name, preparation date, expiration date, and the initials of the analyst preparing the solution. They expire after six months or when the original starting stock standards expire, whichever is earlier.

The following information is recorded in the LIMS for each standard or solution:

- Name or concentration of the solution
- Preparation date
- Name or Initials of analyst preparing the solution
- The manufacturer of the starting stock solution
- The lot number of the starting stock solution
- The name or concentration of the starting stock solution
- The volume of the starting stock solution used
- The final volume of the solution being prepared
- The source acid or blank solution used

7.7 Blank solutions contain 6% HNO_3 and 5% HCl in ELGA water. The blank solution is used for the following:

- Calibration Blank
- ICB and CCBs
- Sample dilutions
- Preparation of matrix matched solutions and standards
- Instrument rinse and carrier

7.8 The Blank Solution is prepared by adding 1500 mL concentrated HNO_3 and 1250 mL concentrated HCl to a 25 liter plastic carboy half filled with ELGA water. Bring up to volume with ELGA water. This procedure may be scaled up or down. Use a graduated cylinder to add the acids. Be extremely careful when handling concentrated acids in these amounts (work in the fume hood wearing lab coat, gloves, and safety glasses).

7.9 The following spike solutions are prepared from ULTRA SCIENTIFIC single element stock standards: Spike 3, containing 10 μg/mL Ag; Spike 4, containing 40 μg/mL Sn; Spike 5, containing 2000 μg/mL Si, and Spike 6, containing 2000 μg/mL S .

7.10 Spike 3 (or Ag Spike), containing 10 μg/mL Ag, is prepared by adding 2.0 mL of 1,000 μg/mL Ag stock standard to a 200 mL volumetric flask half filled with 2% HNO_3 Blank Solution. Bring to the final volume with 2% HNO_3 Blank Solution. This spike is used for the post-spike.

7.11 Spike 4 (or Sn Spike), containing 40 μg/mL Sn, is prepared by adding 8.0 mL of 1,000 ug/ml Sn stock standard to a 200 mL volumetric flask filled with blank solution. Bring up the final volume with Blank solution. This spike is used for the post-spike.

7.12 Spike 5 (or Si Spike), containing 2000 μg/mL Sn, is prepared by adding 40.0 mL of 10,000 ug/mL Si standard to a 200 ml volumetric flask filled with blank solution. Bring up the final volume with Blank solution. This spike is used for the post-spike.

7.13 Spike 6 (or S Spike), containing 2000 μg/mL S, is prepared by adding 40.0 mL of 10,000 ug/mL S standard to a 200 ml volumetric flask filled with blank solution. Bring up the final volume with Blank solution. This spike is used for the post-spike.

7.14 The following calibration standards and quality control standards are prepared in the laboratory from custom stock standards:

- IC2 (calibration standard)
- IC3 (calibration standard)
- IC4 (calibration standard)
- ICSA (interference check standard A)
- ICSAB (interference check standard AB)
- CRI / ICVL / CCVL (low level verification standard)
- IS (internal standard)

7.14.1 IC2 is prepared by adding 20 mL of both CRI stock Spikes and 0.04 mls of Sulfur spike to a 2000 mL volumetric flask half filled with Blank Solution. Bring up to final volume with Blank Solution. See Table 17.8 for concentrations of elements in IC2.

7.14.2 IC3 is prepared by adding 100 mL of IC4 (Section 7.14.3) to a 200 mL volumetric flask half filled with Blank Solution. Bring up to final volume with Blank Solution. See Table 17.8 for concentrations of elements in IC3.

7.14.3 IC4 is prepared by adding 5.0 mL ICUS-3098; 5.0 mL TA-23, 5.0 mL TA-21, 0.5 mL each of 1000 μg/mL Ag, Sn; and 2.5 mL 10,000 μg/mL Si, S to a 500 mL volumetric flask half filled with Blank Solution. Bring up to final volume with Blank Solution. See Table 17.8 for concentrations of elements in IC4.

7.14.4 The ICSA is prepared by adding 25.0 mL of Al, Ca, and Mg (10,000 mg/ml Ultra Scientific stock solution) and 10.0 mL of Fe (10,000 mg/mL Ultra Scientific) to a 500 mL volumetric flask half filled with Blank Solution. Bring up to final volume with Blank Solution. See Table 17.9 for concentrations of elements in the ICSA.

7.14.5 The ICSAB is prepared by adding 50.0 mL of ICSAB stock solution (ICUS-3482), 0.1 mL 1,000 μg/mL Ag stock standard, and .05 ml S 10,000 μg/mL to a 500 mL volumetric flask half filled with Blank Solution. Bring up to final volume with Blank Solution. See Table 17.9 for concentrations of elements in the ICSAB.

7.14.6 ICEX 1-4 are prepared as needed at the LDR's for all elements not in the ICSA/ICSAB determined to cause interferences as determined by Quarterly LDR evaluation. Four standards are needed due to cross interferences between elements in each standard.

7.14.7 The Low Level Verification standard (CRI/ICVL/CCVL) is prepared by adding 20 mL of CRI stock standard, CRI stock standard 2 and 0.04 mL Sulfur stock to a 2000 mL volumetric flask half filled with Blank Solution. Bring up to final volume with Blank Solution. See Table 17.12 for concentrations of elements in the CRI/ICVL/CCVL.

7.14.8 Internal Standard: The IS is prepared by adding 0.25 mL of 10,000 μg/mL Y stock standard, and 2.5 mL of 10,000 μg/mL In stock standard to a 1000 mL volumetric flask half filled with Blank Solution. Bring up to final volume with Blank Solution. The final concentration of the Internal Standard is 2.5 μg/mL Y and 25 μg/mL In.

7.15 The following quality control standards are prepared in the laboratory from HIGH PURITY stock standards:

7.15.1 The Continuing Calibration Verification (CCV) is prepared by adding 10.0 mL CAL STD #2–R Solution A; 10.0 mL CAL STD.#2-R Solution B; 1.0 mL each of 1000 μg/mL Ag, and 1.0 mL of 1000 μg/mL Sn, and 5.0 ml of 10,000 μg/mL S to a 2000 mL volumetric flask half filled with Blank Solution. Bring up to volume with Blank Solution. See Table 17.10 for concentrations of elements in the CCV.

7.15.2 The Initial Calibration Verification (ICV) is prepared using the same stock as the CCV. It is prepared by adding 75.0 mL of the CCV to a 100 ML volumetric flask and bringing it up to volume with Blank Solution. . See Table 17.10 for concentrations of elements in the ICV.

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 The maximum holding time for metals samples is 180 days from sample collection. Aqueous samples are preserved with nitric acid to a pH<2. Soil samples do not require additional preservation, but are kept refrigerated.

8.2 Samples are prepared by a digestion procedure in the digestion lab. The digestates are brought to the instrumental lab by the digestion analyst. The digestates are stored on a shelf in the instrumental lab. When analysis on the digestates is complete, the digestates are placed in a main sample storage area. The main storage area is located in the garage near the digestion lab. The main storage area is used to store the original total samples, dissolved samples, digestates, and TCLP extracts. Digestates are kept for a minimum of 3 months before disposal. For CLP work the digestates are stored for 365 days after delivery of the data package. CLP samples must be refrigerated at 4 degrees C from the time of collection until digestion.

8.3 **Controlled Access Storage**: CLP samples require controlled access storage with strict Chain-of-Custody procedures. Digestates for these samples are obtained from and returned to the cooler custodian. The custodian maintains both the original samples and the digestates in the locked controlled access storage cooler.

8.3.1 For CLP, the original samples are retained for 60 days following delivery of the final report package.

8.3.2 For CLP, digestates are retained for 365 days before disposal.

8.4 Most total and dissolved samples are preserved in the field at the time of sampling, or preserved by sample control when they are received. When sample preservation is required by the laboratory analyst (typically in cases where samples require laboratory filtration prior to preservation), a comment listing lot numbers of the preservation acid (and filter used if applicable) is attached to the affected samples. Samples preserved by the laboratory analyst are held for 24 hours (TestAmerica best practice to cover all applicable requirements) and the pH rechecked prior to preparation. The recheck date and time are recorded in the prep batch.

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 [1]	Reference
Waters	HDPE	50 mLs	HNO_3, pH < 2;	180 Days	40 CFR Part 136.3
Soils	Glass	3 grams	Cool 4 $\pm$ 2°C	180 Days	N/A

[1] Inclusive of digestion and analysis.

9.0 Quality Control

**Refer to the TestAmerica Corporate Quality Assurance Plan 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 QAP or the following criteria. The following criteria are subsequently presented as the minimum criteria of those criteria deemed applicable in the absence of project-specific DQO's.*

Overview: This section provides the guidelines of the quality controls that are used to determine if data are acceptable or not. Depending on the clients' requests and each specific protocol, some QC samples may not be prepared and/or analyzed to each job. Any observed deviations must be documented for future references. If the analyst cannot make a decision about the acceptability of data, the supervisor must be consulted and the resolution must be documented. If data are unusable, the samples must be re-digested and/or re-analyzed depending on the situation. To insure quality data, all intermediate and working standards are prepared from high quality certified stock standards. All stock and prepared standards and solutions are logged into the LIMS to insure traceability. Stock solutions are purchased as often as necessary to insure a fresh source.

9.1 **Sample QC** - The following quality control samples are prepared as appropriate with each batch of digested samples:

9.1.1 Method Blank (MB) - For each digestion batch, one method blank is prepared for every 20 samples or fewer. Section 9.1.8 summarizes method blank compliance criteria.

9.1.2 Laboratory Control Sample (LCS) - For each digestion batch of aqueous matrix samples, a LCS prepared for every 20 or fewer samples. Refer to section 9.1.8 for

compliance criteria. If the LCS for an element is outside of control limits for an element, then all the samples in the batch requiring that element must be re-digested. See Table 17.6 for the concentrations of each element.

9.1.3 Standard Reference Material (SRM) - For each digestion batch of soil (or other non-aqueous) matrix samples, an SRM is prepared for every 20 or fewer samples. The certified values for each element vary by manufacturer lot; can be found in the Certificate of Analysis and in the LIMS. The acceptance limits for recovery are provided by the manufacturer. If the SRM for an element is outside of control limits for an element, then all the samples in the batch requiring that element must be re-digested.

9.1.4 Matrix Duplicate (DU or MD) - For CLP methods (or per client request), one matrix duplicate is performed per digestion batch. See section 9.1.8 for duplicate compliance criteria. If the RPD is outside the control limits for an element, the data should be reviewed to determine cause. If lab error suspected, reanalyze or re-digest. Generally Matrix Duplicate analysis is performed only for CLP samples.

9.1.5 Matrix Spike (MS) and Matrix Spike Duplicate (MSD) – For 200.7, one Matrix Spike is required for every 10 samples (10% frequency). Every batch of 20 samples will have two Matrix Spikes and two Matrix Spike Duplicates. For SW846 methods, one Matrix Spike is required for every 20 samples (5%). Every batch of 20 samples will have one Matrix Spike and one Matrix Spike Duplicate. See Table 17.6 for the concentrations of the matrix spikes for each element. See section 9.1.8 for criteria for spike recovery and precision. If the RPD is outside the control limits for an element, the data should be reviewed to determine cause. If lab error suspected, reanalyze or re-digest. If the recovery for an element is outside the control limits, matrix effect is suspected for digestion and/or the determination. Generally MSD is performed for SW-846 and MCAWW protocols. For MCP/RCP, MS and MSD are redigested and reanalyzed if recoveries are less than 30%. Narrate with confirmation if recoveries are still less than 30%.

9.1.6 Post Digestion Spike (PDS) - A post digestion spike is performed based on client requirements. It is performed on the base sample that has the MS associated with it, and is used to verify matrix effect on element recovery in the MS/MSD. The post spike recovery must agree within the limits specified in section 9.1.8. If the post spike for an element is outside the control limits, the matrix effect is suspected in the analysis. For CLP, a post-digestion spike is analyzed if the pre-digestion spike recovery is outside control limits and the sample result does not exceed 4 times the spike added.

9.1.7 Serial Dilution (SD) - A serial dilution is performed on the base sample in the batch of 20 that has a matrix spike. The serial dilution is a 1:5 (one part of the sample to four parts of blank solution). The serial dilution should analyze within 10% of the undiluted sample (provided the level of analyte in the diluted sample is quantitative), or matrix effects are suspected in the analysis.

9.1.8 Sample QC frequency and control limits summary:

Sample QC	Frequency	Control Limit
Method Blank (MB)	1 in 20 or fewer samples	< Reporting Limit (SW846); < 2.2x MDL (200.7) < CRDL (CLP) or < 10% sample results
Laboratory Control Sample (LCS)[1]	1 in 20 or fewer samples	80-120% recovery (6010 & CLP); 85-115% recovery (200.7)
Matrix Spike (MS)[2] and Matrix Spike Duplicate (MSD)[2]	1 in 20 or fewer (SW846); 1 in 10 or fewer (200.7)	75-125% recovery (6010 & CLP) 70-130% recovery (200.7)
Matrix Spike Duplicate (MSD)[2] Matrix Duplicate (MD)[2]	1 in 20 or fewer samples	RPD < 20% (duplicates)
Std Reference. Material (SRM)	1 in 20 or fewer samples (3050 preps)	Specified by manufacturer on a per lot basis
Serial Dilution (SD)	1 per digestion batch	+/- 10% of original result or +/- 20% of original result (6010D)
Post Digestion Spike (PDS)	1 per digestion batch	80-120% recovery (6010B,6010C) 75-125% recovery (6010D) 85-115% recovery (200.7)

[1] An LCS Duplicate (LCSD) or LCDSRM is performed only when insufficient sample is available for the MS/MSD or when requested by the client/project/contract (ex. MCP).
[2] THE base sample for MS/MSD is arbitrarily selected, unless specifically requested by a client.
A Matrix Duplicate may be used in place of a Matrix Spike Duplicate for some methods

9.2 **Instrument QC** - The following instrument quality control samples are analyzed with each analytical run:

9.2.1 Initial Calibration Verification (ICV) - The ICV is prepared from separate source standards than the calibration standards. The ICV is analyzed following instrument calibration. If the ICV is outside the control limits for an element, then the instrument must be recalibrated or that element cannot be used from that analytical run. The measured values must be within +/- 10% of the true value for CLP and method 6010, or within +/- 5% of the true value for method 200.7. The RSD must be within 3%. See Table 17.10 for the true values of the ICV.

9.2.2 Continuing Calibration Verification (CCV) - The ICV is prepared from separate source standards than the calibration standards. The CCV is analyzed at a frequency of every ten samples and at the end of each analytical run, and verifies the continued accuracy of the calibration. If the CCV is outside the control limits for an element, the 10 samples before and after that CCV should be reanalyzed for that element. Sample results may be accepted when the CCV indicates a high bias for an element, provided the sample result is a non-detect for that element. See Table 17.10 for the true values of the CCV.

9.2.3 Initial Calibration Blank (ICB) and Continuing Calibration Blank (CCB) - The ICB is analyzed following the ICV. CCBs are analyzed following each CCV. Instrument blank analysis results should be less than the laboratory reporting limit (RL) (200.7, 6010B, 6010C), and half the reporting limit (RL) (6010D). If the CCB is outside of control limits for an element, the 10 samples before and after that CCB should be

evaluated. Sample results may be accepted when they are non-detect for that element, or when the result is greater than 10x the high bias in the CCB. Otherwise, the samples should be reanalyzed for that element.

9.2.4 ICSA – See section 9.2.9 for recovery criteria for the ICSA standard. If the ICSA is outside of control limits for an element, that element cannot be used from that analytical run. See Table 17.9 for the true values of the ICSA. (RCP guidelines require ICSA be run at the beginning and end of run with their samples)

9.2.5 ICSAB - After analyzing the ICSA, analyze an ICSAB. See section 9.2.9 for recovery criteria. If the ICSAB is outside of control limits for an element, that element cannot be used from that analytical run. See Table 17.9 for the true values of the ICSAB. (RCP guidelines require ICSAB be run at the beginning and end of run with their samples)

9.2.6 Interference Check Extra (ICEX 1-4) – Known Interfering elements not covered by the ICSA and ICSAB run at the LDR for those elements.

9.2.7 Low Level Verification (CRI/ICVL/CCVL) – Analyzed at the beginning of each analytical run following the ICV/ICB. Analysis frequency and criteria for this standard varies by method and by client requirements. If the CRI/ICVL/CCVL is outside of control limits for an element, that element cannot be used for any affected samples. See Table 17.12 for true values of the CRI/ICVL/CCVL.

9.2.8 Internal Standard (IS) - The internal standard counts are monitored for each analysis. The internal standard counts must fall between 50 and 150 percent of the counts of the internal standard in the initial calibration blank. If the internal standard fails to fall between 50 and 150 percent of the initial blank the data from that particular sample may not be used from that analytical run. Recalibrate and reanalyze the sample. Dilute the sample if necessary.

9.2.9 Instrument QC frequency and control limits summary:

Instrument QC	Frequency	Control Limit
ICV	Start of each analytical run following a calibration	90-100% for SW846, CLP 95-105% for 200.7
ICB	Start of each analytical run following the ICV	+/- RL (200.7, 6010B, 6010C) +/- ½ RL for 6010D
CRI / ICVL / CCVL	- Start of each analytical run for all methods; - End of each analytical run for CLP, 6010C, or by client QAPP; - Every 20 samples for CLP; - Recommended every 10 samples (with each CCV/CCB) for 6010C	50-150% recovery for 6010B, 200.7 70-130% recovery for 6010C, CLP 80-120% recovery for 6010D (initial)
ICSA	- Start of each analytical run for all methods; - End of each analytical run for CLP, or by client QAPP;	80-120% recovery for spiked analytes +/- 2x RL for non-spiked analytes (200.7, 6010B, 6010C) +/- 1x RL for non-spiked analytes

Instrument QC	Frequency	Control Limit
	- Every 20 samples for CLP	(6010D)**
ICSAB	- Start of each analytical run for all methods	80-120% recovery
ICEX 1-4	Start of each analytical run	+/- 10% LDR for spiked analytes (6010D) +/- 2x RL for non-spiked analytes
CCV	Every 10 samples, and at the end of each analytical run	90-110% recovery
CCB	Every 10 samples, and at the end of each analytical run	+/- RL
LDRCK	Start of each analytical run	+/- 10% LDR for elements not included in ICEX 1-4 (6010D)

** Adjustments to this limit are allowed under 6010D for *documentable* impurities in the source standards.

9.3 IEC, IDL,LDR, and LLQC

9.3.1 Interelement Correction Factors (IECs) are determined quarterly for each ICAP. The following solutions containing interfering elements are prepared from Ultra Scientific 10,000 µg/mL individual element stock standards (except 1000 µg/mL for Sn), and analyzed with corrections turned off. False positive or negative results for other elements indicate an IEC calculation is necessary. The solutions are prepared and analyzed at the established linear dynamic ranges.

To calculate the IEC factor, divide the false result for an element to be corrected by the actual reading of the interfering element.

Example Calculation: The following results are obtained after analyzing a 1000 µg/mL Fe solution: Fe = 1028.0 µg/mL and Cd = 1.21 µg/mL

The IEC factor for Cadmium would be: $\frac{1.21}{1028.0} = 0.001$

9.3.2 Instrument Detection Limits (IDLs) are determined quarterly for each ICAP as described in SOP BF-ME-018. The IDL is the minimum concentration of an analyte that can be measured with a high degree of confidence that the analyte concentration measured on a specific instrument is greater than random instrument noise. IDLs for the ICAPs are analyzed and calculated as described in SOP BF-ME-018.

9.3.3 Linear Ranges (LDR) are determined quarterly for each ICAP as described in SOP BF-ME-018. The linear range is the highest concentration of an analyte that an instrument can measure within ±10% of the known value. Linear ranges are verified daily for 6010D analysis.

9.3.4 Lower Limit of Quantitations (LLQC) are verified quarterly by digesting and analyzing the low-level calibration verification standard within +/-30% of the true values.

9.4 Contingencies for Handling Out-of-Control or Unacceptable Data

9.4.1 Data is to be evaluated in accordance with SOPs BF-GP-012 and BF-ME-013. When an out of control situation occurs, the analyst must use his/her best judgment and use any available resources to determine the corrective action to be taken. The analyst may need to seek immediate assistance from the supervisor, laboratory director, project manager, QA personnel or other experienced members of the staff if he/she is uncertain of the proper course of action. The test may need to be stopped until the problem is corrected since the problem may be instrumental and not chemical. Out of control data will never be released without the approval of the Supervisor, QA Manager, or Laboratory Director.

9.4.2 In the event acceptable data cannot be obtained, a Job Exception Form must be filed with the project manager and the client notified.

9.4.3 If the calibration or initial calibration checks fail for any analyte(s), (i.e., correlation coefficient is lower than 0.998; ICV, ICVL and/or ICB are out of control limits; ICSA or ICSAB are outside of control limits), the analytical run should be terminated, problems must be solved, the instrument recalibrated, and the restarted. Otherwise, the analytical run cannot be used for the out of control analyte(s).

9.4.4 If a CCV, CCVL, and/or CCB are out of control limits for any analytes, affected analytes in the 10 samples before and after that CCV and/or CCB must be reanalyzed with the following exceptions:

- Results may be accepted when the CCV or CCB indicates a high bias, and the affected analytes are less than the reporting limit (<RL).
- Results may be accepted when the CCB indicates a high bias, and the affected analytes are greater than 10x the CCB result.

9.4.5 If the LCS or SRM do not meet criteria for any analyte(s), the batch must be reanalyzed. If the reanalysis still does not meet criteria, that batch must be re-prepared and reanalyzed for the affected analyte(s).

9.4.6 If the Method Blank (MB) fails for an analyte, but samples do not contain that analyte higher than the reporting limit or samples contain that analyte higher than 10x the Method Blank result, the data is acceptable. Otherwise, the batch must be re-prepared and reanalyzed for that analyte.

9.4.7 If the RPD for the MSD (or MD) is out of control limits, the data should be reviewed to determine cause. If redigestion and reanalysis are still out of limits, the sample might be inhomogeneous and the data should be reported with qualification. Refer to table 17.15 for RPD criteria.

9.4.8 If Post Spike or Serial Dilution are outside of control limits, matrix effects in determination are suspected.

9.4.9 If the LCS, Post Spike and Serial Dilution are within QC limits, but the MS and/or MSD are out of control limits, matrix interference can be assumed and corrective action is not required.

9.4.10 For CLP and MCP/RCP, if the percent recovery of the CRI/ICVL falls outside the control limits of 70-130% (50-150% for Sb, Pb, Tl), the CRI/ICVL must be re-analyzed for the outlying analytes. The same is true if the ICVL falls outside the control limits of 50-150% for 6010B and 200.7, and if the ICVL/CCVL falls outside the control limits of 70-130% for 6010C or 80-120% for 6010D.

9.4.11 If the internal standard counts for any analysis fall outside of 50-150% of the internal standard counts in the Calibration Blank (ICIS), recalibrate and reanalyze the affected sample/samples (200.7, 6010B, 6010C), do a fivefold dilution and re-analyze (6010D).

9.4.12 When a value is more negative than the analytes Reporting Limit (RL), it is the laboratory's procedure to dilute the sample until the value is less negative than the Reporting Limit (RL), or it is a positive value. The dilution is performed to demonstrate lessened affects of the interference present, enabling the analyst to view if the element of interest is present. The value from the dilution will be reported.

9.4.13 Dilutions are required for an element that is included in an IEC calculation if it exceeds the linear range. If a dilution is not performed, the IEC may be inaccurately applied. Therefore, even if an over-range analyte may not be required to be reported for a sample, if that analyte is an interferent for any requested analyte in that sample, the sample must be diluted to a level at or below the working range. See tables 17.15 and 17.16 for interfering elements for each ICAP.

10.0 Procedure

The matrix of all standards and samples for ICP are acidic. Nitrile gloves must be worn when handling all standards and samples. Safety glasses must be worn at all times in the laboratory. Extra care will be taken when dispensing concentrated acids and are to be dispensed only in a fume hood.

10.1 Sample Preparation

10.1.1 All samples are checked for the proper preservation at time of sample receipt in the sample receiving area. If the samples were not preserved, they are acidified and held for 24 hours. A sticker is affixed to the sample bottles. The pH is rechecked prior to digestion/analysis following the 24 hour waiting period.

10.1.2 Refer to the following SOPs for sample preparation details: BF-ME-002, BF-ME-003, BF-ME-005, BF-ME-007, and BF-ME-008.

10.2 Calibration

The ICAP is automatically calibrated at the beginning of each analytical run (at least daily). A calibration summary report is included with each analytical run report. A blank (IC1) and three levels of standards (IC2, IC3, IC4) are used to obtain a linear calibration plot for each element. The correlation for each element must be 0.998 or greater. If the correlation is less than 0.998 for a particular element, then the data for that element may not be used from that particular analytical run. See Table 17.8 for concentrations of elements in the calibration standards.

10.3 Sample Analysis

10.3.1 The following is a daily checklist for the operation of the ICAP 6500 analyzer.

1. Empty the instrument and autosampler drain waste, if necessary.
2. Refill the autosampler rinse, if necessary.
3. Refill the internal standard and carrier solution, if necessary.
4. Inspect the pump tubing. Tubing replacement is recommended for approximately every 36 hours of instrument operation time.
5. Change or clean the torch, spray chamber, and sample nebulizer, as necessary. These are cleaned by sonicating them in 2% nitric acid.
6. Check the argon gas pressure, if necessary.
7. Ignite the plasma.
8. Prepare the standards and QC samples as needed (standards should be kept covered or re-poured daily) and place in the appropriate locations in the autosampler. See Section 7.0 for standards preparation.
9. Create an autosampler sequence, and assign it a run file name, and enter IDs for all samples to be analyzed.
10. Run an auto peak, if necessary.
11. Prepare all samples for analysis and place them into the autosampler.
12. Start the analysis.
13. Review raw data results (on screen) for instrument, sample, and QC failures, and to assess the need for any reanalysis.
14. When the analysis is complete, generate and merge PDF reports for the analytical run log, calibration report, and all raw data.
15. Export required sample result data as appropriate for import into the LIMS.
16. Turn off the plasma unless performing an additional analytical run.
17. Import data to the LIMS and perform validation of the data.
18. Empty the samples and standards into an appropriate AN waste receptacle.

10.3.2 **Analysis Sequence**: The calibration standards are automatically analyzed at the beginning of each analytical run.

10.3.2.1 Each Non-CLP, 200.7, 6010C, or 6010B, 6010D analytical run is typed in the following format:

ICV
ICB
ICVL
ICSA
ICSAB

ICEX1
ICEX2
ICEX3
ICEX4
CCV
CCB
CCVL
LDRCK
□
8 samples
□_____
CCV
CCB
CCVL
□
9 samples
□_____
CCV
CCB
CCVL
□
9 samples
□_____
CCV
CCB
CCVL
□
9 samples
□_____
CCV
CCB
CCVL
□
9 samples
□_____
CCV
CCB
CCVL **Client specific (QAPPs)**
ICSA □
ICSAB □
CCV □
CCB
CCVL □

Run a CCV and CCB after every 10 samples and at the end of the analytical run. Run the CCVL, ICSA, and ICSAB at the beginning of the analytical run, and also at the end of the analytical run if required by the client/QAPP.
NOTE: To be compliant with all protocols and clients' particular requests, extensive QC samples are routinely prepared and run. However, not all these QC samples are required for a particular protocol. For example, the ending CCVL, ICSA and ICSAB are not required by SW-864 (6010B) and 200.7. Therefore, a particular run may not include ending CCVL, ICSA and ICSAB if that procedure only involves standard SW-864 and 200.7. This note is also applicable to CLP procedure.

10.3.2.2 Each CLP analytical batch is typed in the following format:

ICV
ICB
CRI
ICSA
ICSAB
CCV
CCB
□
10 samples
□_

CCV
CCB

7 samples
CRI
ICSA
ICSAB

CCV
CCB

10 samples

CCV
CCB

7samples
CRI
ICSA
ICAB

CCV
CCB

Run a CCV and CCB after every 10 samples, and at the end of the analytical run. Run a CRI, ICSA, and ICSAB every 17 samples, and at the end of the analytical run, directly followed by a CCV and CCB.

10.3.3 Typing an Analytical Run

Enter the analytical run into the autosampler table according to the following steps:

- Open Analyst window, choose method
- Click sequence tab at bottom of window
- Create a new autosampler table, replacing the "S_" in autosampler sequence name during table creation.
  Example sequence name: I1031711A
  Key: I1 = ICAP 1 (I2 = ICAP 2)
  03 = month
  17 = day
  11= the last two digits of the year
  A = run # (A, B, C, etc.)
- Enter solution IDs and sample IDs into table

10.3.4 Auto Peak

An auto peak is performed at least once per week, or as needed, following these steps:

- Place carrier probe into IC4 solution and allow to aspirate
- In top toolbar of Analyst window, click "Instrument" and choose "Perform Auto Peak"
- Click run.
- When auto-peak is complete, replace probe into carrier solution bottle.

10.3.5 Preparing Samples for the Autosampler

Using the autosampler table printout, set-up the samples in the autosampler. Use the disposable polypropylene culture tubes. Pour the samples into the culture tubes and place in the autosampler.

For 'Total Metals' and 'Dissolved Metals', the samples consist of the digestates received from the metals preparation department.

10.3.5.1 To prepare post spikes, add the following amounts of each spike solution to 9.7 mL of sample:

50 µL - Spike 1 (Section 4.5.3)
50 µL - Spike 2 (Section 4.5.3)
50 µL – Spike 3 (Section 4.5.3)
50 µL – Spike 4 (Section 4.5.3)
50 µL – Spike 5 (Section 4.5.3)
50 µL – Spike 6 (Section 4.5.3)

Mix each post spike thoroughly and place in autosampler.

10.3.5.2 To prepare the 1:5 serial dilution, add 2.0 mL of sample to 8.0 mL of calibration blank.

10.3.6 **Starting an Analysis**

Once the autosampler table has been prepared, the samples, standard and quality control samples have been placed in the autosampler, and the auto peak has been performed, you are ready to begin the analysis. Use the following steps to begin the analysis.

- Minimize iTEVA software, and open ESI SC Autosampler software. This window must remain open throughout the duration of the run. Click "Initialize Autosampler" button.
- Maximize iTEVA software, and in Sequence tab of Analyst window, click the "Initalize" button that will establish communication between the autosampler and the instrument.
- Turn vacuum on to rinse. Send autosampler probe to rinse prior to calibration, and then send "home."
- To begin calibration, click yellow triangle "play" button in top toolbar of Sequence tab.
- After calibration and the subsequent quality control standards, CCVs and CCBs can be set up to run automatically after every 10 samples.
- View data during the run on the "Analysis" tab of the Analyst window.
- If desired, click the check box to automatically shut down the plasma after the run is completed. This is located in the autosampler setup window.

10.3.7 **Printing Analysis Data**

The ICAP instrument will print data during an analysis directly to a .pdf file, which needs to be merged after run has been completed. A run log is created by generating a sequence report in the Publisher window, and exporting the file to Excel. It is then initialed by the data reviewer, and scanned to a .pdf file. A calibration report is also generated in the Publisher window, and exported to a .pdf file. The three .pdf files are then merged into a complete raw data file.

10.4 Validation of the Data

When the analytical run is complete, the data must be checked for compliance with the method. Using Section 9.0 - Quality Control - check all the quality control samples (ICV, ICB, CCV's, CCB's, ICSA, ICSAB, IC Standards, CRI, CCVL, ICVL, and digested blank and LCS/LCSSRM) for compliance. If a quality control sample falls outside the required limits for an element, then that element must be rerun on another analytical run.

Also check the spikes and serial dilution for any matrix effects that might require a diluted sample run.

11.0 Calculations / Data Reduction

Refer to sections 9.1.8 and 9.2.8 to determine if data are valid for each element. Any sample reading over the linear range must be diluted. Diluted samples must be run on required samples. Analyzing the sample and a series of spiked aliquots of the sample at different known concentrations performs an MSA.

11.1 The following calculations are illustrated:
Relative Percent Difference (RPD) (See Section 11.1.1).
Post spike calculation (See Section 11.1.2).
Method of Standard Addition (MSA) calculation (See Section 11.1.3).

$$\%RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

11.1.1 The formula for calculating the relative percent difference is:Where,
RPD = relative percent difference
D_1 = first sample value
D_2 = second sample value (replicate)

Sample calculation: A sample gave a reading of 2.51 μg/mL and the replicate reading was 2.39 μg/mL.

$$\%\ RPD = \frac{(2.51-2.39)}{(2.51+2.39)/2} \times 100$$

$$RPD = 4.90\%.$$

11.1.2 The formula for calculating the post spike recovery is:

$$\%Recovery = \frac{S_2 - S_1}{SA}$$

Where, S_2 = the post spiked sample reading
S_1 = the sample reading
SA = the spike added

Sample Calculation: A sample gave a reading of 0.250 µg/mL. The sample was post spiked with 2.000 µg/mL and gave a reading of 2.289 µg/mL.

$$\%\,Recovery = \frac{2.289}{2.000}$$

% Recovery =102.0%

11.1.3 The formula for calculating the simplest version of MSA (single-addition method) is:

$$C_x = \frac{S_A V_S C_S}{(S_B - S_A)V_x}$$

Where,

S_B = the concentration of the spiked sample
S_A = the concentration of the unspiked sample
V_S = volume of spike solution added.
C_S = concentration of spike solution
V_x = volume of sample before adding spike
C_x = the unknown sample concentration

Sample calculation: A sample gave a reading of 0.792 µg/mL. 50 µL of a 200 µg/mL spike solution was added to 10.0 mL of the sample. The spiked sample reading was 1.512 µg/mL.

$$C_x = \frac{(0.792)(0.050)(200)}{(1.512 - 0.792)(10.0)}$$

$$C_x = \frac{7.92}{7.20}$$

$$C_x = 1.10\ \mu g/mL$$

12.0 Method Performance

This SOP is applicable to digested sample matrices and soluble water samples.

12.1 Extensive quality control is used to insure compliance with method 6010B, 6010C, 6010D, 200.7 and CLP protocol.

12.2 Thorough documentation is employed to insure traceability of reagents and standards.

12.3 Approximate detection and reporting limits for ICAP 1 and ICAP 2 are found in Tables 17.2 and 17.3.

12.4 Samples that read above the instrument's linear range must be diluted.

12.5 Method Detection Limit Study (MDL)
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. Refer to SOP BF-QA-001: Determination of Method Detection Limits.

12.6 Demonstration of Capabilities

Reference the corporate QA Manual. All employees analyzing the methods listed in the sop have documented Initial demonstration of capabilities, as well as demonstration of capabilities each year after. This documentation is forwarded to QA for approval and record keeping.

12.7 Training Requirements

The QA Manual or a Training SOP may be referenced for training requirements. If applicable, state required concentration of samples prepared for Precision and Accuracy study or alternate training procedure.

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 AWM-HAZ.MG-01. The following waste streams are produced when this method is carried out.

14.1 All acidic waste consisting of sample and rinse solution: Dispose of as HNO_3 waste in an "AN" waste container.

15.0 References / Cross-References

15.1 Method 6010B Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-

846, 3rd Edition, Final Update III, Revision 2, December 1996. Method 6010C Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Update IV, Revision 3, February 2007, Method 6010D Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Update V, Revision 4, July 2014.

15.2 ICAP 6500 Analyzer Operator's Manual.

15.3 ILM04.1, USEPA Contract Laboratory Program, Statement of Work for Inorganic Analysis and Classical Chemistry Parameters.

15.4 ILM05.2, USEPA Contract Laboratory Program, Statement of Work for Inorganic Analysis and Classical Chemistry Parameters.

15.5 ILM05.3, USEPA Contract Laboratory Program, Statement of Work for Inorganic Analysis and Classical Chemistry Parameters.

15.6 Method 200.7, “Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry”, Revision 3.3, 40CFR Part 136, Appendix C, April 1991. (Approved for CWA compliance testing)

15.7 Method 200.7, “Determination of Metals and Trace Elements in Water and Wastes by Inductively Couple Plasma-Atomic Emission Spectrometry”, Revision 4.4, US EPA / EMSL, May 1994. (Approved for SDWA compliance testing)

16.0 Method Modifications:

Item	Method xx	Modification
1	3005A	Adopted prep method for preparation of water samples for 6010B, 6010C, 6010D and 200.7. See SOP BF-ME-002 for modifications.

17.0 Attachments

17.1 Elements which are analyzed on ICP’s
17.2 Approximate Water Detection Limits for the ICAP 6500 Analyzers
17.3 Approximate Soil Detection Limits for the ICAP 6500 Analyzers
17.4 Wavelengths and Background Points Used for Each Element on the ICAP 6500 Analyzer
17.5 Approximate Linear Dynamic Range of Each Element on the ICAP 6500 Analyzer
17.6 Concentration of each analyte for LCS, SRM, Post-digestion Spike, Non-CLP matrix spike and CLP matrix spike.
17.7 Reagents and Stock Solution which are purchased as Starting Materials for Preparation of Trace Standards
17.8 Concentration of Calibration Standards
17.9 Values for ICSA and ICSAB
17.10 Values for CCV and ICV
17.11 CLP Contract Required Detection Limits (CRDLs)
17.12 Concentration of Each Element in the CRI/CCVL/ICVL solution
17.13 Example of Batch Sheet for Metals
17.14 Certificates of Analysis for Custom Blend Standards

17.15 Interfering elements for ICAP 1
17.16 Interfering elements for ICAP 2

Revision History

- **Revision 10, Dated October 18, 2017**
    - Section 1.1 Added 6010D
    - Section 3.6 Added reference to RL and LLOQ being synonymous with PQL
    - Section 3.13 Added ICEX 1-4
    - Section 3.14 Added LDRCK
    - Section 7.14.6 Added ICEX 1-4
    - Section 8.4 Added preservation recheck and record in batch following 24h hold after analyst preservation of samples received unpreserved.
    - Section 9.2.6 ICEX 1-4
    - Section 9.2.9 Added 6010D to table
    - Section 9.3.3 Added daily verification of LDRs for 6010D
    - Section 10.3.2.1 Changed Sequence
    - Section 12.1 Added 6010D
    - Fixed page headers & footers & replaced references to MCAWW with 200.7

- **Revision 9, Dated July 28, 2017**
    - Changed Department Manager and Quality Manager, signatures added.
    - Removed MS/MSD counting towards 20 sample batch size statements from sections 4.4 and 9.15.
    - Changed Copper Wavelength in Table 17.4
    - Changed Approximate Linear Dynamic Ranges in table 17.5

- **Revision 8, Dated February 1, 2016**
    - Section 3.22 Added definition of MB
    - Section 4.5 Included MS/MSD count as samples
    - Section 7.14.1 Final volume was fixed to be 2000mL instead of 200mL
    - Section 7.14.4 Changed Fe amount from 25mL to 10mL
    - Section 7.14.5 Changed S amount from 0.01mL to 0.05mL
    - Section 7.14.6 Added CRI stock 2 and changed amount of CRI stocks from 5mL to 20mL and changed S amount from 0.01mL to 0.04mL and final volume from 500mL to 2000mL
    - Section 7.15.1 Changed final volume from 1000mL to 2000mL
    - Section 9.1.5 Added note about MS/MSD/MD count as samples in a batch
    - Section 9.4.10 Changed LLICV/LLCCV to ICVL/CCVL

- Section 9.4.11 Changed internal standard to calculate from the ICB to the calibration blank (ICIS)
- Section 10.3.2 Removed 200.7/6010B analytical sequence. No longer any difference from 6010C. Removed CRI.
- Section 10.3.2.1 Changed from 10 to 9 samples between CCV,CCB,CCVL
- Section 10.3.5.1 Changed amount of sample from 9.75mL to 9.5mL and added 50uL of Spike 6
- Table 17.2 Removed 200.7 PQLs since 200.7 and 6010 PQLs are the same
- Table 17.3 Updated Soil PQLs for Li and Ag
- Table 17.5 Updated LDRs to current Jan 2016 LDRs
- Table 17.12 Updated CRI concentrations to match ICVL/CCVL
- Changed Laboratory Director, signature added

- **Revision 7, Dated Jan 13, 2015**
  - Section 1.3.2 Added Sulfur to table
  - Section 3.9 Changed LLICV to ICVL
  - Section 3.14 Changed LLCCV to CCVL
  - Section 4.5.3 Changed 5 spikes to 6 and added Sulfur spike info
  - Section 4.5.4 Removed CLP Spike info
  - Section 7.8 Changed HNO3 and HCL volumes added
  - Section 7.10 Changed spike and volume used
  - Section 7.11 Changed spike and volume used
  - Section 7.12 Changed spike and volume used
  - Section 7.13 Added section for sulfur spike preparation
  - Section 7.14.1 Changed IC2 preparation
  - Section 7.14.4 Changed ICSA preparation info
  - Section 7.14.5 Changed ICSAB Preparation info
  - Section 7.14.6 Changed CRI/CCVL preparation info
  - Section 7.15.1 Changed CCV preparation info
  - Section 9.4.4 Changed LLCCV to CCVL
  - Section 10.3.2.2 Changed LLCCV to CCVL
  - Table 17.2 Changed detection limits to include 6010 and 200.7 and add Sulfur
  - Table 17.4 Added Sulfur wavelength
  - Table 17.5 Added Sulfur LDR
  - Table 17.8 Changed concentration of IC2 to match CCVL and add Sulfur
  - Table 17.9 Added Sulfur Concentration in the ICSAB
  - Table 17.10 Added Sulfur concentration
  - Table 17.12 Added concentration for both CRI and CCVL

- **Revision 6, Dated October 23, 2013**
  - Section 3.14 Removed BS
  - Section 3.15 Removed BLK
  - Section 3.17 Removed Method of Standard Additions
  - Section 3.21 Added LLQC and description
  - Section 4.5.1 Changed SRD to SD
  - Section 4.5.3 For Spike 5 changed see 7.11 for preparation to 7.12
  - Section 4.5.4 Renumbered CLP Spikes from 4.5.3

- Section 6.1 Added spare parts for ICAP (stators, rotors, fast switches, duo radial plasma view window)
- Section 7.5 Inserted Multi-element calibration standards are purchased from Ultra Scientific and Inorganic Ventures.
- Section 7.13.3 Changed how IC4 is made. Removed ICUS 575 and added 5mL ICUS 3098, 5mL TA-23, 5 mL TA-21
- Section 7.13.5 Changed how ICSAB is made. 50 mL ICUS 3482 and 0.1 mL Ag stock standard
- Section 9.1.1 Remove BLK
- Section 9.1.4 Remove DU
- Section 9.1.6 Remove PS
- Section 9.1.7 Remove SRD
- Section 9.2.4 Changed MCP to RCP
- Section 9.2.5 Changed MCP to RCP
- Section 9.3.1 Remove table and inserted IECs are ran at the same concentration as the established linear ranges
- Section 9.3.4 Added LLQC and how to prepare and analyze
- Section 9.4.9 Removed BS
- 10.35.1 Changed 9.80 mL to 9.75 mL
- Table 17.7 Added Inorganic Ventures and removed ICUS 575 from Ultra Scientific

- **Revision 5, Dated September 27, 2012**
  - Section 9.1.8 Added MCP/RCP to footnotes as an example for LCSD
  - Sections 9.24 and 9.25, added MCP criteria for ICSA and ICSAB
  - Section 9.4.10 Added MCP/RCP to CRI criteria
  - Section 9.1.5 Added MCP/RCP criteria for MS/MSD; changed MS/MSD criteria for MCAWW

- **Revision 4, Dated February 2, 2012**
  - Section 1.3.2 and 17.4: Removed “background points” from text and table heading
  - Section 4.5.3: Changed four spike solutions to five spike solutions
  - Section 9.1.2: Changed BS to LCS
  - Section 9.1.4: Changed DUP to DU
  - Section 9.3.1: Added 100 μg/mL As to IEC table
  - Section 9.4.12: Deleted “The original negative value will be entered unless the dilution results in a detection above the reporting limit.” and added “The value from the dilution will be reported.”
  - Section 9.4.13: added section on diluting sample for high levels of interfering elements.
  - 10.3.5.1: Added Spike 5
  - 10.3.7: Changed Excel to Open Office.org Calc
  - 17.15 and 17.16: Added Interfering element tables.

- **Revision 3, Dated June 03, 2011**
  - Revised throughout for inclusion of additional analytes: Lithium (Li), Strontium (Sr), and Silicon (Si).
  - ICUS-574 (Spike 2) became ICUS-3097 (Li, Sr added)
  - ICUS-576 (Cal) became ICUS-3098 (Li, Sr added)

- ICUS-1932 (CRI) became ICUS-3099 (Li, Sr, Si added)
- ICUS-919 (ICSAB) became ICUS-3100 (Li, Sr, Si added).
- All analyte information and concentration tables in sections 1 and 17 revised to include Li, Sr, and Si.

- Section 1.0: Reorganized and reworded Scope and Application Section
- 1.3.2 Analyte table added, including lithium, strontium and silicon.
- Section 3.0: Removed section 3.21.
- Section 4.0: Removed reference to lithium nitrate buffer – no longer used
- Section 4.5.3: added Li & Sr to Spike 2; added Spike 5 (for Si); Post Spike sample volume changed from 9.8 mL to 9.75 mL.
- Section 5.0: Section reorganized and renumbered, removed section 5.3.
- Section 6.0: Section changed to pertain to new instrumentation.
- Section 7.0: Removed section 7.8.1 (redundant)
- Removed section 7.12 – no longer use lithium nitrate
- Removed 7.13.6 and 7.13.7 – no longer needed
- Section 7.9: Spike 5 added (for Si).
- Inserted Section 7.12 for Spike 5 preparation – subsequent section 7.x incremented accordingly.
- Section 8.0: Section reorganized and re-worded to reflect current practices.
- Section 8.1 Soils are refrigerated.
- Section 8.2 Digestates are kept for a minimum of 3 months
- Section 8.3 Removed cool preservation from water section of chart.
- Section 9.0: Section reorganized and updated to reflect TestAmerica Method SOP Template.
- Added requirements for 6010C.
- Section 9.2 correlation requirement changed from .995 to .998.
- Added lab procedure for diluting a negative value in section 9.4.12.
- Section 10.0: Updated to reflect new instrumentation and 6010C.
- Deleted sections 10.2.2 through 10.2.6, and sections 10.3.1 through 10.3.7 – from old ICPs.
- Section 12.0: Replaced references to Trace #1 and Trace #2 with ICAP 1 and ICAP 2, included 6010C requirements.
- Section 15.0: Added reference to ICAP 6500 Analyzer Operator's Manual.
- Section 17.0: Removed 17.11 through 17.15 – old ICPs or redundant information.
- Section 17.14: example certificates of analysis updated for new ICUS standards.
- Throughout SOP: New LIMS Nomenclature
    - Cal1 became IC1
    - Cal2 became IC2
    - Cal3 became IC3
    - Cal4 became IC4
    - LCV became CRI
    - IFA became ICSA
    - IFB became ICSAB
    - BLK became MB
    - BS became LCS
    - SRM became LCSSRM
    - PS became PDS
    - SRD became SD
- Throughout SOP: changed procedures and nomenclature to pertain to new instrumentation.

        - ICAP 1 and ICAP 2 replaced Trace #1 and Trace #2
    - Changed Quality Manager, signature changed.

- **Revision 2, Dated January 18, 2010**
    - Removed 3.8 ICL-HCV-The highest calibration standard re-run directly after calibrating the instrument.
    - Section 4.5.1 Removed "such that the analyte in the diluted sample is at least a factor of 10 above the IDL"
    - Section 4.5.3 Added in the Note under the Table "Current concentrations may be found in the binder of the Certificates of Analysis and also in Element."
    - Section 6.1 Changed STL: Buffalo to TestAmerica Buffalo
    - Section 7.6 Removed standard logbook and added in Element
    - Remove 8.3 "Soluble samples are stored in the main storage area with the digestates and the original total samples. All samples taken from the storage area must be logged out in the sample custody logbook that is kept in the digestion lab. Samples are logged back in when complete. The main storage area is kept locked when unattended. The key to the storage area can be obtained from the sample control personnel and returned to them when finished."
    - Remove 9.3 "ICL-The ICL is the highest calibration standard that is analyzed after the instrument is calibrated."
    - Section 9.4 Removed "It is analyzed after the ICL."
    - Section 9.10 Changed LFB to BS. Changed Laboratory Fortified Blank to Blank Spike.
    - Section 9.11 Changed LCS to SRM. Changed Laboratory Control Sample to Sample Reference Material.
    - Section 9.21.5 Changed LFB and LCS to BS and SRM.
    - Section 9.21.9 Changed LCS to BS.
    - Section 10.3.1 Changed STL Buffalo to TestAmerica Buffalo
    - Section 10.3.6.2 Changed "a piece of parafilm" with the lid.
    - Section 10.4.1 Removed HCV
    - Section 10.4.2 Removed HCV
    - Section 16.0 Added method modification
    - Removed Tables 17.19 and 17.20
    - Table 17.4 Added nm next to wavelength
    - Section 2.3 Removed AFCEE reference
    - Section 10.4.1 removed AFCEE references
    - Section 12.4 removed USACE reference
    - Section 7.6 changed 'standards logbook' to LIMS
    - Section 9.1 changed 'standards logbook' to LIMS
    - Section 10.3.6.5 rewords the procedure to clean the torch.
    - Section 17.7 removed ICUS-573 standard. No longer used

- **Revision 1, Dated July 07, 2009**
    - New LIMS nomenclature changes:
        - BLANK became CAL1
        - Std.1 became CAL2
        - Std.2 became CAL3
        - Std.3 became CAL4

  - Std.3 VER became HCV
  - CRI became LCV
  - ICSA became IFA
  - ICSAB became IFB
  - MBLK became BLK
  - LCS became SRM
  - LFB became BS
  - SD became MSD

- 10.3.6.12 Filling Argon Saturator: "Lower neb. pressure" deleted, replaced with "Turn plasma off." "Turn neb. pressure on" deleted, replaced with "Restart plasma."
- 10.4 Typing an Analytical Run: "SEQ-"added before all calibration and QC standards, names updated.
- 17.7 1,000 ug/ml Y replaced with 10,000 ug/ml Y under "From ULTRA SCIENTIFIC;" 10,000 ug/ml Y deleted from "From HIGH PURITY."
- 17.0 Example of a Data Review Summary Form for Metals replaced with an Example of a Bench Sheet for Metals.
- Metals Department manager change, signature.

- **Revision 0, Dated June 09, 2008**
  - Integration for TestAmerica operations
  - Quality Manager change, signature

17.1 Elements Which are Analyzed on the ICAP 6500 Analyzer:

Aluminum	Al	Manganese	Mn
Arsenic	As	Molybdenum	Mo
Antimony	Sb	Nickel	Ni
Barium	Ba	Sodium	Na
Beryllium	Be	Potassium	K
Boron	B	Selenium	Se
Cadmium	Cd	Silicon	Si
Calcium	Ca	Silver	Ag
Chromium	Cr	Strontium	Sr
Cobalt	Co	Thallium	Tl
Copper	Cu	Tin	Sn
Iron	Fe	Titanium	Ti
Lead	Pb	Vanadium	V
Lithium	Li	Zinc	Zn
Magnesium	Mg	Sulfur	S

17.2 Approximate Water Detection Limits for the ICAP 6500 Analyzers.

Element	Estimated IDL (mg/L)	Estimated MDL (mg/L)	Lab PQL (mg/L) 200.7/6010
Al	0.0563	0.060	0.2
Sb	0.0038	0.00679	0.02
As	0.0035	0.0055	0.015
Ba	0.00013	0.0005	0.002
Be	0.00027	0.0003	0.002
B	0.00114	0.004	0.02
Cd	0.00028	0.00033	0.002
Ca	0.0137	0.1	0.5
Cr	0.00062	0.00087	0.004
Co	0.00032	0.00063	0.004
Cu	0.00138	0.0015	0.01
Fe	0.0105	0.0193	0.05
Pb	0.0021	0.003	0.01
Li	0.0046	0.01	0.03
Mg	0.011	0.043	0.2
Mo	0.00045	0.00356	0.01
Ni	0.00091	0.00126	0.01
K	0.060	0.2	0.5
Se	0.0054	0.0087	0.025
Na	0.0920	0.324	1.0
Ag	0.00079	0.0017	0.006
Si	0.029	0.06	0.5
Sr	0.0003	0.001	0.005
Tl	0.0024	0.0102	0.02
V	0.0076	0.00108	0.005
Zn	0.00074	0.0017	0.01
Sn	0.00059	0.00505	0.01
Ti	0.00071	0.0011	0.005

17.3 Approximate Soil Detection Limits for the ICAP 6500 Analyzers.

Element	Estimated IDL (mg/kg)	Estimated MDL (mg/kg)	Lab PQL (mg/kg)
Al	5.6	4.4	10.0
Sb	0.378	0.54	15.0
As	0.353	0.4	2.0
Ba	0.013	0.11	0.5
Be	0.027	0.028	0.2
B	0.114	0.19	2.0
Cd	0.028	0.03	0.2
Ca	1.366	3.3	50.0
Cr	0.062	0.2	0.5
Co	0.032	0.05	0.5
Cu	0.138	0.21	1.0
Fe	1.047	1.1	10.0
Pb	0.210	0.24	1.0
Li	0.460	1.0	30.0
Mg	1.11	.927	20.0
Mo	0.045	0.13	1.0
Ni	0.091	0.23	5.0
K	6.00	20.0	30.0
Se	.543	0.57	4.0
Na	9.20	13.0	140.0
Ag	0.079	0.2	0.5
Si	2.90	6.0	50.0
Sr	0.03	0.1	0.5
Tl	0.241	0.3	6.0
V	0.076	0.11	0.5
Zn	0.074	0.153	2.0
Sn	0.059	0.43	2.0
Ti	0.071	0.08	0.5
Mn	0.018	0.032	0.2

17.4 Wavelengths for Each Element on the ICAP 6500 Analyzer.

Element	Wavelength (nm)
Ag	328.068
Al	308.215
As	189.042
B	208.959
Ba	455.403
Be	313.042
Ca	317.933
Cd	228.802
Co	228.616
Cr	267.716
Cu	327.396
Fe	259.940 / 271.441
K	766.490
Li	670.784
Mg	279.079
Mn	257.610
Mo	202.030
Na	589.592 / 818.326
Ni	231.604
Pb	220.353
Sb	206.833
Se	196.090
Si	288.158
S	182.034
Sn	189.989
Sr	407.771
Ti	334.904
Tl	190.856
V	292.402
Zn	206.200

17.5 Approximate Linear Dynamic Range of Each Element on the ICAP 6500 Analyzer.

Element	ICAP 1 (mg/L)	ICAP 2 (mg/L)
Al	600	600
Sb	10	10
As	5	5
Ba	10	10
Be	25	25
B	20	20
Cd	5	5
Ca	1000	1000
Cr	10	10
Co	20	20
Cu	25	25
Fe	600	600
Pb	120	120
Li	50	50
Mg	500	500
Mo	5	5
Ni	10	10
K	600	600
Se	60	60
Na	5000	5000
Ag	3	3
Si	50	50
Sr	10	10
Tl	20	20
V	5	5
Zn	20	20
Sn	4	4
Ti	20	20
Mn	50	50
S	100	100

17.6 Concentration of each analyte for LCS, SRM, Post-digestion Spike, matrix spike:

Element	LCS, Post-Digestion Spike and Non-CLP Matrix Spike (mg/L)		Soil Post-Digestion Spike and Non-CLP Matrix Spikes (mg/kg)	Representative Soil LCS (mg/kg) changes per lot	
Al	10		200	16300	
Sb	0.20		40	117	
As	0.20		40	138	
Ba	0.20		40	269	
Be	0.20		40	157	
B	0.20		40	90	
Cd	0.20		40	71	
Ca	10		200	9660	
Cr	0.20		40	105	
Co	0.20		40	142	
Cu	0.20		40	110	
Fe	10		200	19100	
Pb	0.20		40	144	
Li	0.20		40	-	
Mg	10		200	4410	
Mo	0.20		40	90.4	
Ni	0.20		40	130	
K	10		200	5000	
Se	0.20		40	200	
Na	10.0		200	653	
Ag	0.20		40	45.1	
Si	10		200	-	
Sr	0.20		40	246	
Tl	0.20		40	161	
V	0.20		40	67	
Zn	0.20		40	268	
Sn	0.20		40	160	
Ti	0.20		40	447	
Mn	0.20		40	539	

17.7 Reagents and Stock Solutions which are Purchased as Starting Materials for Preparation of Trace Standards.

From ULTRA SCIENTIFIC:

ICM-441
ICUS-3098
ICUS-3099
ICUS-3100

1,000 µg/mL Ag	10,000 µg/mL Mn
10,000 µg/mL Al	10,000 µg/mL Mo
10,000 µg/mL As	10,000 µg/mL Ni
10,000 µg/mL B	10,000 µg/mL Na
10,000 µg/mL Ba	10,000 µg/mL Pb
10,000 µg/mL Be	10,000 µg/mL Sb
10,000 µg/mL Ca	10,000 µg/mL Se
10,000 µg/mL Cd	10,000 µg/mL Si
10,000 µg/mL Co	1,000 µg/mL Sn
10,000 µg/mL Cr	10,000 µg/mL Sn
10,000 µg/mL Cu	1,000 µg/mL Sr
10,000 µg/mL Fe	10,000 µg/mL Ti
10,000 µg/mL In *	10,000 µg/mL Tl
10,000 µg/mL K	10,000 ug/mL Y *
1,000 µg/mL Li	10,000 ug/mL Zn
10,000 µg/mL Mg	

Certificates of Analysis are attached for the custom blend standards listed as ICUS-(…) above.

From HIGH PURITY:

1,000 µg/mL Ag	CAL STD #2-R Solution A
1,000 µg/mL Sn	CAL STD #2-R Solution B

From CPI:

1,000 µg/mL V

From Inorganic Ventures

TA-23
TA-21

From JT-BAKER

Concentrated HCl (Trace Metals Grade)
Concentrated HNO_3 (Trace Metals Grade)

Table 17.8 Concentrations of Calibration Standards: (in mg/L)

Element	IC2	IC3	IC4
Al	0.2	25.0	50.0
Sb	0.02	0.5	1.0
As	0.015	0.5	1.0
Ba	0.002	0.5	1.0
Be	0.002	0.5	1.0
Cd	0.002	0.5	1.0
Ca	0.5	25.0	50.0
Cr	0.004	0.5	1.0
Co	0.004	0.5	1.0
Cu	0.01	0.5	1.0
Fe	0.05	25.0	50.0
Li	0.03	0.5	1.0
Mg	0.2	25.0	50.0
Mn	0.003	0.5	1.0
Ni	0.01	0.5	1.0
Ag	0.006	0.5	1.0
Si	0.5	25.0	50.0
Sr	0.005	0.5	1.0
Tl	0.02	0.5	1.0
Zn	0.01	0.5	1.0
V	0.005	0.5	1.0
B	0.02	0.5	1.0
Mo	0.01	0.5	1.0
Ti	0.005	0.5	1.0
Sn	0.1	0.5	1.0
Se	0.025	0.5	1.0
Na	1.0	25.0	50.0
K	0.5	25.0	50.0
Pb	0.01	0.5	1.0
S	0.2	25.0	50.0

Table 17.9 Concentrations for ICSA and ICSAB (in mg/L)

Element	ICSAB	ICSA
Al	500.0	500.0
Ca	500.0	500.0
Fe	100.0	200.0
Mg	500.0	500.0
Ag	0.2	-
As	0.1	-
Ba	0.5	-
Be	0.5	-
Cd	1.0	-
Co	0.5	-
Cr	0.5	-
Cu	0.5	-
Mn	0.5	-
Ni	1.0	-
Pb	0.05	-
Sb	0.6	
Se	0.05	-
Tl	0.1	-
V	0.5	-
Zn	1	-
Li	0.5	-
Si	1.0	-
Sr	0.5	-
S	1.0	-

Table 17.10 Concentrations for CCV and ICV (in mg/L):

Element	CCV	ICV
Al	25.0	18.75
Sb	0.5	0.375
As	0.5	0.375
Ba	0.5	0.375
Be	0.5	0.375
B	0.5	0.375
Cd	0.5	0.375
Ca	25.0	18.75
Cr	0.5	0.375
Co	0.5	0.375
Cu	0.5	0.375
Fe	25.0	18.75
Pb	0.5	0.375
Li	0.5	0.375
Mg	25.0	18.75
Mn	0.5	0.375
Mo	0.5	0.375
Ni	0.5	0.375
K	25.0	18.75
Se	0.5	0.375
Na	25.0	18.75
Ag	0.5	0.375
Si	25.0	50.0
Sr	0.5	0.375
Tl	0.5	0.375
V	0.5	0.375
Zn	0.5	0.375
Sn	0.5	0.375
Ti	0.5	0.375
Mn	0.5	0.375
S	25.0	18.75

Table 17.11 Contract Required Detection Limits (CRDL)

Analyte	CRDL (4.0) (ng/mL)	CRDL (5.0) (ng/mL)
Aluminum	200	200
Antimony	60	5
Arsenic	10	5
Barium	200	20
Beryllium	5	1
Cadmium	5	2
Calcium	5000	5000
Chromium	10	5
Cobalt	50	5
Copper	25	5
Iron	100	100
Lead	3	3
Magnesium	5000	5000
Manganese	15	10
Mercury	0.2	0.1
Nickel	40	20
Potassium	5000	5000
Selenium	5	5
Silver	10	5
Sodium	5000	5000
Thallium	10	5
Vanadium	50	10
Zinc	20	10

17.12 Element Concentrations in the CRI / ICVL/ CCVL Stock and Working Standards

Analyte	CRI	ICVL / CCVL
Aluminum	0.2	0.2
Antimony	0.02	0.02
Arsenic	0.015	0.015
Barium	0.002	0.002
Beryllium	0.002	0.002
Boron	0.02	0.02
Cadmium	0.002	0.002
Calcium	0.5	0.5
Chromium	0.004	0.004
Cobalt	0.004	0.004
Copper	0.01	0.01
Iron	0.05	0.05
Lead	0.01	0.01
Lithium	0.03	0.03
Magnesium	0.2	0.2
Manganese	0.003	0.003
Molybdenum	0.01	0.01
Nickel	0.01	0.01
Potassium	0.5	0.5
Selenium	0.025	0.025
Silver	0.006	0.006
Sodium	1.0	1.0
Silicon	0.5	0.5
Strontium	0.005	0.005
Thallium	0.02	0.02
Tin	0.01	0.01
Titanium	0.005	0.005
Vanadium	0.005	0.005
Zinc	0.01	0.01
Sulfur	0.2	0.2

17.13 Example of a Batch Sheet for Metals

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-9051
Method Code: 480-3005A_TOT-480

Analyst: Marzolf, Michelle

Batch Open: 3/22/2011 9:50:00AM
Batch End:

Preparation, Total Metals

	Input Sample Lab ID (Analytical Method)	SDG	Matrix	Initial Amount	Final Amount	Due Date	Analytical TAT	Div Rank	Comments	Output Sample Lab ID
1	MB-480-9051/1 (6010B)	N/A		50 mL	50 mL	N/A	N/A	N/A		MB 480 9051 1 A
2	LCS-480-9051/2 (6010B)	N/A		50 mL	50 mL	N/A	N/A	N/A		LCS 480 9051 2 A
3	480-27722-A-1 (6010B)	N/A	Water	50 mL	50 mL	3/22/11	2_Days	2		480-27722-A-1-A
4	480-2722-A-2 (6010B)	N/A	Water	50 mL	50 mL	3/22/11	2_Days	2		480-2722-A-2-A
5	480-2722-A-3 (6010B)	N/A	Water	50 mL	50 mL	3/22/11	2_Days	2		480-2722-A-3-A
6	480-2722-A-3-MS (6010B)	N/A	Water	50 mL	50 mL	3/22/11	2_Days	2		480-2722-A-3-A MS
7	480-2722-A-3-MSD (6010B)	N/A	Water	50 mL	50 mL	3/22/11	2_Days	2		480-2722-A-3-A MSD
8	480-2749-G-1 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2		480-2749-G-1-B
9	480-2749-G-2 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2		480-2749-G-2-B
10	480-2749-G-4 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2		480-2749-G-4-B
11	480-2743-D-1 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2		480-2743-D-1-A
12	480-2743-D-2 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2		480-2743-D-2-A
13	480-2743-D-3 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2		480-2743-D-3-A
14	480-2743-D-4 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2		480-2743-D-4-A

Printed : 3/22/2011

Page 1 of 7

TestAmerica Buffalo

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-9051 Analyst: Marzolf, Michelle Batch Open: 3/22/2011 9:50:00AM

Method Code: 480-3005A_TOT-480 Batch End:

15	480-2743-D-5 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2	
16	480-2743-D-6 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2	
17	480-2743-D-7 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2	
18	480-2743-D-8 (6010B)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2	
19	480-2746-E-1 (200.7)	N/A	Water	50 mL	50 mL	3/23/11	8_Days - R	2	
20	480-2724-O-1 (200.7)	2564	Water	50 mL	50 mL	3/23/11	10_Days - R	2	
21	480-2724-O-2 (200.7)	2564	Water	50 mL	50 mL	3/23/11	10_Days - R	2	
22	480-2326-A-11 (6010B)	N/A	Water	50 mL	50 mL	3/14/11	8_Days - R	1	
23	480-2326-A-12 (6010B)	N/A	Water	50 mL	50 mL	3/14/11	8_Days - R	1	

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-9051 Analyst: Marzolf, Michelle Batch Open: 3/22/2011 9:50:00AM

Method Code: 480-3005A_TOT-480 Batch End:

	Input Sample Lab ID (Analytical Method)	(Sub-List)	Analytes
1	MB 480-9051/1 N/A	N/A	N/A B1 CCV+CCB
2	LCS 480-9051/2 N/A	N/A	N/A
3	480-2722-A-1 (6010B)	(Local Method)	Pb
4	480-2722-A-2 (6010B)	(Local Method)	Pb
5	480-2722-A-3 (6010B)	(Local Method)	Pb
6	480-2722-A-3 MS (6010B)	N/A	N/A
7	480-2722-A-3 MSD (6010B)	N/A	N/A
8	480-2749-G-1 (6010B)	(Local Method)	Ag, Al, As, Ba, Ca, Cd, Cr, Fe, K, Mg, Mn, Na, Pb, Se
9	480-2749-G-2 (6010B)	(Local Method)	Ag, Al, As, Ba, Ca, Cd, Cr, Fe, K, Mg, Mn, Na, Pb, Se
10	480-2749-G-4 (6010B)	(Local Method)	Ag, Al, As, Ba, Ca, Cd, Cr, Fe, K, Mg, Mn, Na, Pb, Se
11	480-2743-D-1 (6010B)	(TAL Metals ICP)	Ca, Fe, K, Mg, Mn, Na
12	480-2743-D-2 (6010B)	(TAL Metals ICP)	Ca, Fe, K, Mg, Mn, Na
13	480-2743-D-3 (6010B)	(TAL Metals ICP)	Ca, Fe, K, Mg, Mn, Na
14	480-2743-D-4 (6010B)	(TAL Metals ICP)	Ca, Fe, K, Mg, Mn, Na
15	480-2743-D-5 (6010B)	(TAL Metals ICP)	Ca, Fe, K, Mg, Mn, Na
16	480-2743-D-6 (6010B)	(TAL Metals ICP)	Ca, Fe, K, Mg, Mn, Na

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-9051 Analyst: Marzolf, Michelle Batch Open: 3/22/2011 9:50:00AM

Method Code: 480-3005A_TOT-480 Batch End:

17	480-2743-D-7 (6010B)	(TAL Metals ICP)	Ca, Fe, K, Mg, Mn, Na	
18	480-2743-D-8 (6010B)	(TAL Metals ICP)	Ca, Fe, K, Mg, Mn, Na	
19	480-2746-E-1 (200.7)	(Local Method)	Cu	
20	480-2724-O-1 (200.7)	(Priority Pollutant Metals ICP)	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Sn, Tl, V, Zn	1:5 K, B, Na
21	480-2724-O-2 (200.7)	(Priority Pollutant Metals ICP)	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Sn, Tl, V, Zn	1:5 K+Na CCB ↑ B 10X
22	480-2326-A-11 (6010B)	(TAL Metals ICP)	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sn, Ti, Tl, V, Zn	CCB ↑ B
23	480-2326-A-12 (6010B)	(TAL Metals ICP)	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sn, Ti, Tl, V, Zn	1

Analytes that are not being reported with be displayed in [...] brackets. Analytes that are not being reported but are on the spike list with be displayed in (...) parentheses.

I 20322 11B-4

I 10323 11A -2

MB B
LCS 1
2724-1 1:5 B, K, Na
2724-2 1:5 K, Na
2326-11 B
2326-12 1

17.14 Certificates of Analysis for Custom Blend Standards

ULTRA SCIENTIFIC
Analytical Solutions

Certificate of Analysis

RT00731
RECD: 1/14/10
DAN

Inorganic Custom Standard

Catalog Number: ICUS-575
Lot Number: K00968
Job Number: J00010367
Lot Issue Date: 09/17/2009
Expiration Date: 10/31/2010

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system, and the analyte concentrations were verified by our ISO 17025 accredited laboratory. The certified value and uncertainty value for each analyte is determined gravimetrically.

Analyte	True Value				Analytical Method
antimony	100.0	±	0.5	µg/mL	gravimetric
arsenic	100.0	±	0.5	µg/mL	gravimetric
beryllium	100.0	±	0.5	µg/mL	gravimetric
cadmium	100.0	±	0.5	µg/mL	gravimetric
chromium	100.0	±	0.5	µg/mL	gravimetric
cobalt	100.0	±	0.5	µg/mL	gravimetric
copper	100.0	±	0.5	µg/mL	gravimetric
lead	100.0	±	0.5	µg/mL	gravimetric
manganese	100.0	±	0.5	µg/mL	gravimetric
molybdenum	100.0	±	0.5	µg/mL	gravimetric
nickel	100.0	±	0.5	µg/mL	gravimetric
selenium	100.0	±	0.5	µg/mL	gravimetric
thallium	100.0	±	0.5	µg/mL	gravimetric
titanium	100.0	±	0.5	µg/mL	gravimetric
* vanadium	100.0	±	0.5	µg/mL	gravimetric
zinc	100.0	±	0.5	µg/mL	gravimetric
calcium	5009	±	25	µg/mL	gravimetric
iron	5007	±	25	µg/mL	gravimetric
magnesium	5002	±	25	µg/mL	gravimetric

Matrix: 5% nitric acid, trace hydrofluoric acid, and trace tartaric acid in low TOC water (< 50 ppb)

** light sensitive*

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001

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See Reverse For Additional Information

William J. Leahy
Quality Assurance Manager

RT14762 R: 11/26/10 AMH
E: 9/30/12

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Certificate of Analysis

CLP ICP Interference Check Standard #1

Catalog Number: ICM-441
Lot Number: J00734
Job Number: J00008573
Lot Issue Date: 08/05/2008
Expiration Date: 09/30/2012

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001:2000 registered quality system, and the analyte concentrations were verified by our ISO 17025 accredited laboratory. The true value and uncertainty value at the 95% confidence level for each analyte, determined gravimetrically, is listed below

Analyte	True Value				Analytical Method	NIST SRM
aluminum	5009	±	25	µg/mL	ICP / ICP-MS	3101a
calcium	5005	±	25	µg/mL	ICP / ICP-MS	3109a
iron	2002	±	10	µg/mL	ICP / ICP-MS	3126a
magnesium	5002	±	25	µg/mL	ICP / ICP-MS	3131a

Matrix: 5% nitric acid in low TOC water (< 50 ppb)

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001

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William J. Leary
Quality Assurance Manager

Spike 2

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Certificate of Analysis

Inorganic Custom Standard

family 574

Catalog Number: ICUS-3097
Lot Number: M00419
Job Number: J00013015
Lot Issue Date: 04/21/2011
Expiration Date: 05/31/2012

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system, and the analyte concentrations were verified by our ISO 17025 accredited laboratory. The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Analyte	True Value				Analytical Method
barium	40.00	±	0.20	µg/mL	gravimetric
boron	40.00	±	0.20	µg/mL	gravimetric
aluminum	2001	±	10	µg/mL	gravimetric
potassium	2001	±	10	µg/mL	gravimetric
sodium	2001	±	10	µg/mL	gravimetric
lithium	40.00	±	0.20	µg/mL	gravimetric
strontium	40.00	±	0.20	µg/mL	gravimetric

Matrix: 5% nitric acid in low TOC water (< 50 ppb)

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001

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William J. Leary
Quality Assurance Manager

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Certificate of Analysis

Inorganic Custom Standard

formerly 1392

Catalog Number: ICUS-3099
Lot Number: M00385
Job Number: J00012949
Lot Issue Date: 04/14/2011
Expiration Date: 05/31/2012

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system, and the analyte concentrations were verified by our ISO 17025 accredited laboratory. The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Analyte	True Value			Analytical Method
aluminum	2.000	± 0.010	µg/mL	gravimetric
antimony	0.2000	± 0.0010	µg/mL	gravimetric
arsenic	0.1000	± 0.0005	µg/mL	gravimetric
barium	0.0200	± 0.0001	µg/mL	gravimetric
beryllium	0.0200	± 0.0001	µg/mL	gravimetric
boron	0.2000	± 0.0010	µg/mL	gravimetric
cadmium	0.0100	± 0.00005	µg/mL	gravimetric
calcium	5.000	± 0.025	µg/mL	gravimetric
chromium	0.0400	± 0.0002	µg/mL	gravimetric
cobalt	0.0400	± 0.0002	µg/mL	gravimetric
copper	0.1000	± 0.0005	µg/mL	gravimetric
iron	0.5000	± 0.0025	µg/mL	gravimetric
lead	0.0500	± 0.00025	µg/mL	gravimetric
magnesium	2.000	± 0.010	µg/mL	gravimetric
manganese	0.0300	± 0.00015	µg/mL	gravimetric
molybdenum	0.1000	± 0.0005	µg/mL	gravimetric
nickel	0.1000	± 0.0005	µg/mL	gravimetric
potassium	5.000	± 0.025	µg/mL	gravimetric
selenium	0.1500	± 0.0008	µg/mL	gravimetric
* silver	0.0300	± 0.00015	µg/mL	gravimetric
sodium	10.00	± 0.05	µg/mL	gravimetric
thallium	0.2000	± 0.0010	µg/mL	gravimetric
tin	0.1000	± 0.0005	µg/mL	gravimetric
titanium	0.0500	± 0.00025	µg/mL	gravimetric
* vanadium	0.0500	± 0.00025	µg/mL	gravimetric
zinc	0.1000	± 0.0005	µg/mL	gravimetric
silicon	5.000	± 0.025	µg/mL	gravimetric
lithium	0.3000	± 0.0015	µg/mL	gravimetric
strontium	0.0500	± 0.00025	µg/mL	gravimetric

Matrix: 5% nitric acid, trace tartaric acid in low TOC water (< 50 ppb)

** light sensitive*

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001

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William J. Leary
Quality Assurance Manager

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Certificate of Analysis

Inorganic Custom Standard

formerly 919

Catalog Number: ICUS-3100
Lot Number: M00389
Job Number: J00012950
Lot Issue Date: 04/18/2011
Expiration Date: 05/31/2012

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system, and the analyte concentrations were verified by our ISO 17025 accredited laboratory. The certified value and uncertainty value at the 95% confidence level for each analyte is determined gravimetrically.

Analyte	True Value				Analytical Method
* silver	2.000	±	0.010	mg/L	gravimetric
arsenic	1.000	±	0.005	mg/L	gravimetric
barium	5.000	±	0.025	mg/L	gravimetric
beryllium	5.000	±	0.025	mg/L	gravimetric
cadmium	10.00	±	0.05	mg/L	gravimetric
cobalt	5.000	±	0.025	mg/L	gravimetric
chromium	5.000	±	0.025	mg/L	gravimetric
copper	5.000	±	0.025	mg/L	gravimetric
manganese	5.000	±	0.025	mg/L	gravimetric
nickel	10.00	±	0.05	mg/L	gravimetric
lead	0.5000	±	0.0025	mg/L	gravimetric
antimony	6.000	±	0.030	mg/L	gravimetric
selenium	0.5000	±	0.0025	mg/L	gravimetric
thallium	1.000	±	0.005	mg/L	gravimetric
* vanadium	5.000	±	0.025	mg/L	gravimetric
zinc	10.00	±	0.05	mg/L	gravimetric
aluminum	5005	±	25	mg/L	gravimetric
calcium	5005	±	25	mg/L	gravimetric
iron	1001	±	5	mg/L	gravimetric
magnesium	5002	±	25	mg/L	gravimetric
silicon	10.00	±	0.05	mg/L	gravimetric
lithium	5.000	±	0.025	mg/L	gravimetric
strontium	5.000	±	0.025	mg/L	gravimetric

Matrix: 5% nitric acid, trace hydrofluoric acid, trace tartaric acid in low TOC water (< 50 ppb)

** light sensitive*

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001

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RECD 10/15/10 RT12812

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Fax (843) 767-7906

Certificate of Analysis

SM-606-044 (CAL STD #2RR)
Solution A
Lot # 1027723

Source	Source Purity	Matrix	Standard Concentration
High Purity Metals, Salts, and Oxides	99.98+ %	HNO_3, 5%	µg/mL ± 0.5% See element list on reverse

This spectrometric standard solution has been prepared from high-purity reference materials. Sub-boiling distilled high-purity acid has been used to place the materials in solution and to stabilize the standard. The matrix is as noted above in 18 megaohm deionized water. The reference materials have been assayed by inductively coupled plasma optical emission spectrometry (ICP-OES).

The standard has been prepared gravimetrically by weighing the reference material to 5 significant figures. Volumetric glassware has been calibrated gravimetrically to 5 significant figures. The standard concentration has been verified by ICP-OES against an independent source which is directly traceable to National Institute of Standards and Technology, Standard Reference Material No. 3100 series.

This standard is valid for one year from the shipping date provided the solution is kept tightly capped and stored under normal laboratory conditions.

Theodore C. Rains

Theodore C. Rains, Ph.D.
President

Exp Date: OCT 0 6 2011
MSDS ATTACHED

RECD 10/15/10 RTT2813

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SM-606-044 (CAL STD #2RR)

Solution B

Lot # 1027724

Source	Source Purity	Matrix	Standard Concentration
High Purity Metals, Salts or Oxides	99.96+ %	HNO_3, 5% + Tr HF	100 µg/mL ± 0.5% Antimony Molybdenum Titanium

This spectrometric standard solution has been prepared from high-purity reference materials. Sub-boiling distilled high-purity acid has been used to place the materials in solution and to stabilize the standard. The matrix is as noted above in 18 megaohm deionized water. The reference materials have been assayed by inductively coupled plasma optical emission spectrometry (ICP-OES).

The standard has been prepared gravimetrically by weighing the reference material to 5 significant figures. Volumetric glassware has been calibrated gravimetrically to 5 significant figures. The standard concentration has been verified by ICP-OES against an independent source which is directly traceable to National Institute of Standards and Technology, Standard Reference Material No. 3100 series.

This standard is valid for one year from the shipping date provided the solution is kept tightly capped and stored under normal laboratory conditions.

Theodore C. Rains

Theodore C. Rains, Ph.D.
President

Exp Date: OCT 0 6 2011
MSDS ATTACHED

ULTRA SCIENTIFIC
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Certificate of Analysis

RT10384
RECD: 8/24/10
ATW

Inorganic Custom Standard

Catalog Number: ICUS-1370
Lot Number: L00948
Job Number: J00011904
Lot Issue Date: 08/17/2010
Expiration Date: 09/30/2011

This Certified Reference Material (CRM) was manufactured and verified in accordance with ULTRA's ISO 9001 registered quality system, and the analyte concentrations were verified by our ISO 17025 accredited laboratory. The certified value and uncertainty value for each analyte is determined gravimetrically.

Analyte	True Value				Analytical Method
antimony	40.00	±	0.20	µg/mL	gravimetric
arsenic	40.00	±	0.20	µg/mL	gravimetric
beryllium	40.00	±	0.20	µg/mL	gravimetric
cadmium	40.00	±	0.20	µg/mL	gravimetric
chromium	40.00	±	0.20	µg/mL	gravimetric
cobalt	40.00	±	0.20	µg/mL	gravimetric
copper	40.00	±	0.20	µg/mL	gravimetric
lead	40.00	±	0.20	µg/mL	gravimetric
manganese	40.00	±	0.20	µg/mL	gravimetric
molybdenum	40.00	±	0.20	µg/mL	gravimetric
nickel	40.00	±	0.20	µg/mL	gravimetric
selenium	40.00	±	0.20	µg/mL	gravimetric
thallium	40.00	±	0.20	µg/mL	gravimetric
* vanadium	40.00	±	0.20	µg/mL	gravimetric
zinc	40.00	±	0.20	µg/mL	gravimetric
titanium	40.00	±	0.20	µg/mL	gravimetric
calcium	2000	±	10	µg/mL	gravimetric
iron	2000	±	10	µg/mL	gravimetric
magnesium	2000	±	10	µg/mL	gravimetric

Matrix: 5% nitric acid, trace tartaric acid in low TOC water (< 50 ppb)

** light sensitive*

ULTRA uses purified acids, 18 megohm double deionized water, calibrated Class A glassware & meticulously cleaned bottles in the manufacturing of ULTRAgrade standards. Balances used in the manufacturing of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001

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William J. Leary
Quality Assurance Manager

17.15: Interfering elements on ICAP 1

Interfering Analyte:	Interfered Analyte:
Al	Pb Se
As	Cd
Co	Ni Pb Tl
Cr	As Sb V Zn
Fe	Cd Cr,Pb,V
Mn	V

Interfering Analyte:	Interfered Analyte:
Si	B Ba Cd,Co,Pb,
Ti	Be Co Pb Si Sn,Tl,V
V	Al,Cd,Tl, Be
Mo	B Co Pb

17.16: Interfering elements on ICAP 2

Interfering Analyte:	Interfered Analyte:	Interfering Analyte:	Interfered Analyte:
Al	Pb, Se	Si	B
As	Cd		Ba
Co	Cd		Cd
	Tl		Co
Cr	As		Pb
	Sb	Ti	Ag
	Ti		Be
	V		Co
	Zn		Cu
Fe	Ag		Pb
	Cr		Sn
	Ni		Tl
	Pb		V
	Sb	Tl	Ni
Mn	Tl	V	Al
	V		Ag
Mo	As		Be
	B		Cd
	Co		Cu
	Pb		Tl
	Sb		

Title: Mercury Preparation and Analysis [Methods 245.1, 7470A, 7471A, 7471B]

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):

2/15/18	2/15/18
Jason Kacalski Date	Jennifer Pierce Date
Department Manager	Operations Manager
2/15/18	2/15/18
Mike Mosscrop Date	Kene Kasperek Date
Quality Assurance Manager	Laboratory Director

Facility Distribution No. _____ Distributed
To:_____

1.0 Scope and Application

1.1 This method is used for the determination of Mercury in aqueous and solid environmental samples. This procedure is used to analyze organic and inorganic mercury in drinking water, surface water, waste, and saline waters, both domestic and industrial wastes.

1.2 This method is based upon SW-846, 3rd edition methods 7470A, 7471A, 7471B and also conforms to the EPA Environmental Methods Management Council's "Guidelines and Format for Methods to Be Proposed at 40 CFR, part 136" (Method 245.1).

1.3 This method is for the determination of Hg by cold-vapor atomic absorption (CVAA) in the range of 0.2 μg/L to 10.0 μg/L. The range may be extended to higher levels by selection of a smaller sample size or by dilution of existing samples.

1.4 This method is used only by analysts experienced in the use of the chemical principles outlined in this SOP and who are trained thoroughly in the sample handling and instrumental techniques described in this method.

1.5 This method is "performance based." The laboratory is permitted to modify the method to overcome interferences or lower the cost of measurements provided all performance criteria are met.

1.6 On occasion, clients may request modifications to this SOP. These modifications are addressed following the procedures outlined in the lab Quality Assurance Manual (QAM).

1.7 Analytes, Matrix(s), and Reporting Limits

1.7.1 Total, Total Recoverable, and Dissolved (Soluble) Mercury.

1.7.2 This SOP is used for the preparation and analysis of groundwater, surface water, drinking water, TCLPs, leachates, filtered collection wastes, sand, rock, concrete, soil, sediment, and sludge samples.

1.7.3 Reporting Limits are defined as the lowest concentration of an analyte determined by a given method in a given matrix that the laboratory feels can be reported with acceptable quantitative error, client requirements, values specified by the EPA methods or other project and client requirements. Wherever possible, reporting is limited to values approximately 3–5 times the respective MDL to ensure confidence in the value reported. Client specific requests for reporting to the IDL or MDL are special circumstances not to be confused with the previous statement. The reporting limit for mercury analysis in an aqueous matrix is 0.2 μg/L while the reporting limit for solid samples is typically 0.025 μg/g.

2.0 Summary of Method

2.1 Samples are digested first by oxidation of Hg in the samples to the Hg^{2+} oxidation state under strongly acidic and oxidizing conditions and near boiling temperatures. Potassium permanganate ($KMnO_4$) and potassium persulfate ($K_2S_2O_8$) (aqueous samples only) are added to aid in the oxidation of organic mercury compounds and to eliminate possible interference from sulfides and organic materials. Potassium permanganate is later reduced with hydroxylamine hydrochloride ($NH_2OH \bullet HCl$) prior to the digestate being analyzed.

2.2 Analysis by cold-vapor atomic absorption is based on the absorption of radiation at the 253.7-nm wavelength by Hg vapor. The Hg^{2+} in a digested sample is reduced to the elemental state and aerated from solution in-line. The Hg vapor passes through an optical cell positioned in the light path of an atomic absorption spectrometer. Hg concentration is determined as a function of the measured absorption.

2.3 Quality is assured through the analysis of preparation blanks, laboratory control samples, matrix spikes, duplicates, and reference standards (solids).

3.0 Definitions

3.1 **Total Mercury**: All oxidizable mercury forms and species found in an unfiltered aqueous or solid sample matrix. This includes, but is not limited to, Hg (0), Hg (I), Hg (II), strongly organo-complexed Hg (II) compounds, adsorbed particulate Hg, and several tested covalently bound organo-mercury compounds.

3.2 **Dissolved (Soluble) Mercury**: All oxidizable mercury forms and species found in the filtrate of an aqueous solution that has been filtered through a 0.45 micron filter and then acidified to a pH < 2.

3.3 Any other definitions contained within this document are found in Appendix 2 of the Glossary/Acronym Section of the TestAmerica Buffalo Laboratory Quality Manual.

4.0 Interferences

4.1 Contamination

4.1.1 Contamination Control: Any object or substance that contacts the sample should be mercury free and free from any material that may interfere with the analysis of mercury. Although contamination control is essential, personal health and safety remain the highest priority. Section 5 of this SOP gives suggestions and requirements for personal safety.

4.1.2 Avoiding Contamination**:** The best way to control contamination is to completely avoid exposure of the sample to contamination in the first place. Avoiding exposure means performing operations in an area known to be free of any traces of mercury. Two of the most important factors in avoiding and/or reducing sample contamination are (1) an awareness of potential sources of contamination and (2) strict attention to the work being done

4.1.3 Minimize Exposure: The apparatus and/or glassware that will come into contact with the samples, blanks, or standard solutions are to be opened or exposed only in a clean area of the lab. When any relevant materials, glassware or instruments are not being used, cover with a plastic liner or remove from the area of analysis to avoid accidental exposure.

4.1.4 Clean Work Surfaces: Before a given batch of samples is processed, the analyst makes certain that all work surfaces in the hood, the bench and other areas are clean, thereby minimizing potential for contamination from previous batches.

4.1.5 Wear Gloves: Sampling personnel wear clean, non-talc gloves during all operations involving handling of any instrument, glassware, samples or blanks. Only clean gloves may touch the instruments. If another object or substance is touched, the gloves must be changed before resuming work on the instrument. If it is suspected that gloves have become contaminated, work must be halted, the contaminated gloves removed, and a new pair put on. It is a good practice to change gloves between working on different sample matrices.

4.1.6 Use Mercury-Free Materials: All materials used for the preparation and analysis of mercury at ambient water quality criteria levels must be non-metallic, free of material that may contain metals, or both. Mercury thermometers are not to be used within the mercury preparation or analysis areas.

4.1.7 Containers: Each new container type is tested before use, because Mercury vapors can diffuse in or out of certain types of materials, resulting in results that are biased high or low.

4.1.8 Contamination from Reagents: Contamination can be introduced into samples from the method reagents used during preparation and analysis. Reagents are monitored using method blanks included in each batch. When a reagent is suspected to be impure, it will be analyzed. If the blank is lower than MDL, that reagent can be used.

4.1.9 Contamination from Carryover: Contamination may occur when a sample containing a low concentration of mercury is analyzed immediately after a sample containing a high concentration of mercury. When an unusually concentrated sample (approximately 100+ ppb) is encountered, the cleaning (rinse) time is extended before proceeding with the next sample. To avoid this, samples that are known, or at least suspected of having the lowest mercury content should be analyzed first. As a guideline, samples with results *less than* 10x the RL which immediately follow a sample with a result greater than the LDR, should be reanalyzed to check for carryover.

4.1.10 Contamination from Samples (cross-contamination)**:** Significant laboratory or instrument contamination may result when untreated effluents, in-process waters, landfill leachates and other undiluted samples containing concentrations of mercury greater than 100 ppb are processed and analyzed. Samples known or suspected to contain Hg concentrations greater than 100 ppb should be diluted prior to bringing them into the laboratory whenever possible, or if prior dilution is not possible, the digestate should be diluted prior to analysis. Such samples should be handled with care to avoid contamination of other samples. Change gloves after handling samples known to contain high levels of mercury.

4.2 Chemical Interference

4.2.1 Any material which can absorb radiation at the 253.7-nm wavelength has the potential to cause a positive interference. Materials that inhibit the reduction of Hg^{2+} to Hg^0, or which inhibit the aeration of Hg^0 into the vapor phase have the potential to cause a negative interference. The sample digestion procedure is designed to eliminate common interferences of these types.

4.2.2 The most common interferences come from brine samples and samples containing high levels of sulfides. Use of additional potassium permanganate can remove most of these interferences, however, very high levels can lead to low mercury recoveries. Other interferences include chlorides and iodides (halides), gold, or copper (reported at levels >10 ppm). High levels of organic solvents, such as acetone, hexane, alcohols, and glycols can also interfere.

4.3 Physical Interference

4.3.1 Physical interference can result from a damaged or dirty optical cell (including cracks, smudges, or condensed water vapor), and air bubbles trapped in samples or introduced in-line due to leaks in tubing or junctions.

4.3.2 Inconsistent levels of water vapor within the optical cell can result in instrument drift. Water vapor is regulated through use of a dehydrator; however excessive variations in atmospheric conditions surrounding the dehydrator can result in varying performance. Temperature changes greater than 3-5 °C can also result in instrument drift. For best performance, the sample delivery and detection system should be kept in as stable an operating environment as possible.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001), and in 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 this SOP 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.

5.2 The toxicity or carcinogenicity of each chemical used in this method has not been precisely determined; however, each compound is treated as a potential health hazard. Exposure to these compounds is reduced to the lowest possible level.

5.3 The laboratory is responsible for maintaining a current awareness file of OSHA regulations for the safe handling of the chemicals specified in this procedure. OSHA rules require that a reference file of Safety Data Sheets (SDS) is made available to all personnel involved in these analyses. All SDS may be viewed on the Test America intranet.

5.4 Specific Safety Concerns or Requirements

5.4.1 This SOP uses several highly concentrated mineral acids, as well as strong oxidizers. Analysts must be familiar with proper response procedures for large and small spills, and for physical contact (see reference to CW-E-M-001 in sect 5.1). An acid spill kit is to be stored in a readily accessible location within the laboratory.

5.4.2 All digestion of acidified samples is to be conducted inside of a fume hood. The fume hood is periodically monitored to ensure its proper functioning and airflow requirements. This is especially important during soil digestion in which potassium permanganate can react with hydrochloric acid to produce chlorine gas.

5.4.3 Samples that contain high concentrations of carbonates or organic material, or samples that are at elevated pH may react violently when acids are added. Use extra care and add acids slowly to leachates, colored samples, samples containing bubbles or foam, samples with swollen containers, or sample with strong odors.

5.4.4 Chronic mercury exposure may cause kidney damage, muscle tremors, spasms, personality changes, depression, irritability and nervousness. Organo-mercurials may cause permanent brain damage. Because of the toxicological and physical properties of Hg, only trained personnel familiar with handling mercury standards should handle standards.

5.4.5 As recommended, the laboratory purchases a dilute standard of Hg so that its use won't compromise the health and safety of the analyst. When samples known or suspected of containing high concentrations of mercury are handled, all operations are performed in a controlled area of the laboratory, preferably in a fume hood with adequate airflow and ventilation.

5.4.6 Mercury containing exhaust vapors leaving the instrument are passed through a column of activated carbon, filter trap containing gold or sulfur, or other suitable filter or trap in order to sequester mercury vapors away from the analyst.

5.4.7 While this procedure does call for the trace analysis of mercury at extremely small levels, it is still possible to be exposed to toxic levels of mercury during normal laboratory conditions. Mercury is at it most toxic when it is allowed to enter the bloodstream, therefore, any analyst who has an open wound or other such injury should take special care in avoiding mercury exposure.

5.4.8 The laboratory contains a mercury spill kit in case of serious mercury exposure. The kit is located in an area familiar to all that work in the laboratory, in the cabinet under the sink. Personnel can use mild soap with plenty of scrubbing in order to decontaminate skin. In the case of open wounds, professional help is to be sought immediately. All glassware, tools and surfaces are cleaned with sulfur powder in order to reduce any mercury present to non-volatile mercury sulfide. Washing the surface with reagent water will complete the cleansing process.

5.5 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 Safety Data Sheets (SDS) 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 SDS for each material before using it for the first time or when there are major changes to the SDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Mercury (100 ppm in Reagent)	Oxidizer Corrosive Poison	0.1 Mg/M3 Ceiling (for Hg compounds)	Extremely toxic. Causes irritation to the respiratory tract. Causes irritation. Symptoms include redness and pain. May cause burns. May cause sensitization. Can be absorbed through the skin with symptoms to parallel ingestion. May affect the central nervous system. Causes irritation and burns to eyes. Symptoms include redness, pain, and blurred vision; may cause serious and permanent eye damage.
Sulfuric Acid	Corrosive Oxidizer Dehydrator Poison	1 Mg/M3-TWA	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
Nitric Acid	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
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.

Potassium Permanganate	Oxidizer	5 Mg/M3 Ceiling (for Mn compounds)	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Dry crystals and concentrated solutions are caustic causing redness, pain, severe burns, brown stains in the contact area and possible hardening of outer skin layer. Diluted solutions are only mildly irritating to the skin. Eye contact with crystals (dusts) and concentrated solutions causes severe irritation, redness, and blurred vision and can cause severe damage, possibly permanent.
Potassium Persulfate	Oxidizer	None	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Causes irritation to skin and eyes. Symptoms include redness, itching, and pain. May cause dermatitis, burns, and moderate skin necrosis.
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

6.1 All equipment and supplies will be free of trace mercury, or at least at a level below the MDL of the method. All reusable equipment is cleaned according to the SOP BF-GP-003, Attachment 3, “Cleaning Procedure for Metals Glassware”.

6.2 Supplies and Equipment for Sample Preparation

6.2.1 50 mL graduated Digestion Tubes and Caps, with (at a minimum) marks at 30 mL and 50 mL. If cup volumes are not certified by the manufacturer, the 30 mL and 50 mL marks must be verified on a per lot basis. Verify by filling 5 individual tubes with reagent water to the appropriate (30 mL and/or 50 mL) mark by eye level and weighed. The average weight of water in the five cups must agree to within 1%. The results are logged into a spreadsheet and stored on the network drive.

6.2.2 *Environmental Express* Hot Blocks capable of maintaining a temperature of 95°C (+/- 3°C). Hot Block temperature is verified daily prior to digestion and after digestion is complete. Temperatures are recorded in log book and batch.

6.2.3 Digestion tube racks to store and remove the samples from the hot blocks.

6.2.4 Bottle Repipettors for dispensing acids and reagents to samples.

6.2.5 Nalgene brand Wash Bottles for dispensing reagent water.

6.2.6 Thermometer covering a range of 0-150 °C. Thermometers are calibrated against a NIST certified thermometer in accordance with SOP BF-GP-020.

6.2.7 Analytical Balance accurate to ±0.1 mg (currently a Denver P-214). Calibration to be verified daily. Balances are serviced yearly. (See SOP BF-GP-002)

6.2.8 Weigh boats and spatulas for soil samples and reagent preparation.

6.2.9 50 mL, 100 mL, and 2000 mL volumetric flasks (Class A) for preparation of reagents and standards.

6.2.10 *Eppendorf* Pipettes; varying volumes, preferably one for each volume to be dispensed. Minimally, pipettes in the following ranges are needed: 0.05-0.2 mL, 0.1-1.0 mL, 0.5-2.5 mL, and 2.0-10.0 mL. Pipettes are verified daily and calibrated quarterly in accordance with SOP BF-GP-001.

6.2.11 Time device for monitoring digestion step times.

6.3 Supplies and Instrumentation for Sample Analysis

6.3.1 15 mL test tubes for analyzing samples.

6.3.2 Mercury Adsorbent filter for the instrument exhaust line: currently used -- a mercury adsorbing activated carbon filter from *Perkin-Elmer*.

6.3.3 Pump tubing for delivery of samples and reagents to the instrument:
- **6.3.3.1** Yellow-Blue (0.51 mm) tubing: for $SnCl_2$ introduction.
- **6.3.3.2** Orange-Yellow (1.52 mm) tubing: for Sample introduction
- **6.3.3.3** Green-Green (1.88 mm) tubing: for waste drain

6.3.4 Cold-Vapor Atomic Absorption (CVAA) instrument capable of detecting in the range of 0.2 μg/L to 10.0 μg/L. Currently: (1) Leeman Labs PS200 II Automated Mercury Analyzer, and (1) Leeman Labs Hydra AA Automated Mercury Analyzer. Both instruments are operated using WinHg software version 1.1.

6.3.5 Various consumable and replacement instrument parts available and purchased from the instrument manufacturer.

7.0 Reagents and Standards

7.1 Reagents:

7.1.1 Laboratory Reagent Water: (DI H_2O); Deionized water from a purified source. Water will be monitored for Hg, especially after ion exchange beds are changed.

7.1.2 Silicon (IV) Oxide: (SiO_2); Used as a blank soil matrix substitute. High purity grade (typically 99.995% for metals).

7.2 Stock Acids: ***CAUTION!*** *Concentrated mineral acids are highly corro*sive.

7.2.1 Nitric Acid: (HNO_3): Concentrated, trace metals grade or equivalent.

7.2.2 Sulfuric Acid: (H_2SO_4): Concentrated, trace metals grade or equivalent.

7.2.3 Hydrochloric Acid: (HCl): Concentrated, trace metals grade or equivalent.

7.3 Prepared Reagents:

7.3.1 All prepared reagents are labeled accordingly at the time of preparation. This label must include the reagent name, preparation date, the analyst who prepared it, and the expiration date. Expiration dates must conform to the earliest expiration date of any chemical used in the preparation of the reagent. All information pertinent to the prepared reagents must be recorded in a reagent logbook or directly into the LIMS.

7.3.2 5% (wt/wt) Potassium Permanganate Solution ($KMnO_4$): Prepare by dissolving 100 g of $KMnO_4$ in 2000 mL of reagent water. This solution has a shelf life of six months. ***CAUTION****: strong oxidizer*.

7.3.3 5% (wt/wt) Potassium Persulfate Solution ($K_2S_2O_8$): Prepare by dissolving 100 g of K2S2O8 in 2000 mL of reagent water. This solution has a shelf life of six months. Method 7470 only.

7.3.4 Sodium Chloride / Hydroxylamine Hydrochloride Solution (NaCl / NH_2OH•HCl): (*abbrev. HyHy*); Prepare by dissolving 240 g of NaCl and 240 g of NH_2OH-HCl in 2000 mL of reagent water. This solution has a shelf life of six months.

7.3.5 10% Hydrochloric Acid: (10% concentrated acid by volume.) Prepare by adding 2500 mL of concentrated HCL to a 25L container half-filled with reagent water and bring to the mark with reagent water.

7.3.6 Stannous Chloride Solution ($SnCl_2$ in HCl): Prepare by dissolving 100 g of $SnCl_2$ in 10% HCl. Dilute to the 1000 mL mark. The solution has a shelf life of one month. Store in a tightly closed container so that exposure to air is kept to a minimum. This solution should also be kept away from any mercury standard, reagent used in digestion or field sample.

7.3.7 Blank Matrix Solution (BMS): Fill a 2000 mL flask half way with reagent water. Measure 40 mL of concentrated HNO_3, 80 mL of concentrated H_2SO_4, 200 mL of $KMnO_4$, 80 mL of $K_2S_2O_8$ and 40 mL of Hydroxlyamine Hydrochloride. Swirl until solution is clear and colorless. Allow to cool to room temperature and bring to the 2000 mL mark with reagent water.

7.4 Purchased Standards:

7.4.1 100 µg/mL Hg Stock Standard #1: 100 ppm Hg#1 (SS). Purchased certified standard -- Certificate to be scanned and the original retained in the Mercury laboratory.

7.4.2 100 µg/mL Hg Stock Standard #2: 100 ppm Hg#2 (SS). Purchased certified standard -- Certificate to be scanned and the original retained in the Mercury laboratory. Purchased from a different vendor than #1.

7.4.3 Certified Soil Standard: ERA Soil Standard; "Metals in Soil" from *Environmental Resource Associates* – a standard reference material (SRM) containing a certified quantity of Mercury.

7.5 Prepared Standards:

7.5.1 All prepared standards must be properly labeled and recorded into a standards logbook or directly into the LIMS. For further information refer to SOP BF-GP-019 "Standards Traceability and Storage".

7.5.2 10,000 ng/mL Hg Intermediate Standard #1: 10,000 ppb Hg#1 (IS). Measure 2 mL of concentrated HNO_3 to a 50 mL Class A volumetric flask half-filled with reagent water. Measure 5.0 mL of 100 µg/mL Hg Stock Standard #1, add to the flask and bring to the mark with reagent water. This standard expires in 6 months or when the original purchased stock standard is expired, whichever comes first.

7.5.3 10,000 ng/mL Hg Intermediate Standard #2: 10,000 ppb Hg#2 (IS). Measure 2 mL of concentrated HNO_3 to a 50 mL Class A volumetric flask half-filled with reagent water. Measure 5.0 mL of 100 µg/mL Hg Stock Standard #1, add to the flask and bring to the mark with reagent water. This standard expires in 6 months or when the original purchased stock standard is expired, whichever comes first.

7.5.4 Hg TCLP Spike: Add 5.0 mL of concentrated HNO_3 to a 100 mL Class A volumetric flask half-filled with reagent water. Measure 1.335 mL of 100 µg/mL Hg Stock Standard #1, add to the flask and bring to the mark with reagent water. The final concentration will be 1335 ng/mL. This solution expires in 6 months or when the original purchased stock standard is expired, whichever comes first.

7.5.5 100 ng/mL Hg Working Standard #1: 100 ppb Hg#1 (WS). Measure 2.0 mL of concentrated HNO_3 to a 50 mL Class A volumetric flask half-filled with reagent water. Measure 0.5 mL of 10,000 ng/mL Hg Intermediate Standard #1 to the flask and bring to the mark with reagent water. This standard expires 24 hours from the time of preparation and is to be prepared daily.

This standard is to be used for the preparation of the instrument calibration standards.

7.5.6 100 ng/mL Hg Working Standard #2: 100 ppb Hg#2 (WS). Measure 2.0 mL of concentrated HNO_3 to a 50 mL Class A volumetric flask half-filled with reagent water. Measure 0.5 mL of 10,000 ng/mL Hg Intermediate Standard #2 to the flask and bring to the mark with reagent water. This standard expires 24 hours from the time of preparation and is to be prepared daily.

This standard is to be used for the preparation of the initial calibration verification solution (ICV), the continuing calibration verification solution (CCV), the addition of matrix spikes to samples (MS/MSD), and laboratory control samples (LCS).

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 Aqueous samples are to be collected in plastic containers and preserved with Nitric Acid to pH < 2. Preserved samples can be stored at room temperature. Sample digestion and analysis must be completed within 28 days of sample collection.

8.2 Samples received at the laboratory unpreserved should be kept at 4°C and should be preserved as soon as possible. Allow samples preserved by the laboratory to stand for 24 hours prior to digestion.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time [1]	Reference
Waters	HDPE	50 mL	HNO_3, pH < 2;	28 Days	40 CFR Part 136.3
Soils	Glass	3 g	Cool 4 ± 2°C	28 Days	N/A

[1] Inclusive of digestion and analysis.

9.0 Quality Control

**Refer to the TestAmerica Corporate Quality Assurance Plan 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 QAP or the following criteria. The following criteria are subsequently presented as the minimum criteria of those criteria deemed applicable in the absence of project-specific DQO's.*

9.1 Sample QC

9.1.1 Method Blank (MB): A volume of reagent water (method 7470) or measured amount of silicon oxide (method 7471) which is carried through the sample preparation and analysis procedure along with each batch of samples (not to exceed 20 samples). This blank is useful in monitoring for contamination. May also be referred to as a Preparation Blank (PB).

9.1.1.1 Aqueous Blank (method 7470/245.1): Add 30 mL of reagent water to a digestion cup. Prepare and analyze as a sample with each batch of samples.

9.1.1.2 Soil Blank (method 7471): Add 0.6 g of Silicon (IV) Oxide (used as a soil matrix substitute) to a digestion cup. Prepare and analyze as a sample with each batch of solid samples.

9.1.1.3 TCLP Blank (method 7470): An associated extraction blank will accompany each set of TCLP extracts (EBLK). Add 30 mL of EBLK to a digestion cup (LB). Prepare and analyze with each batch of extracts. This is in addition to the regular aqueous blank (MB).

9.1.2 Laboratory Control Sample (LCS): A volume of reagent water spiked with a known concentration of mercury, which is carried through the preparation and analysis procedure along with each batch of aqueous samples (not to exceed 20 samples). The LCS is employed to determine method accuracy. May also be referred to as a Laboratory Fortified Blank (LFB).

9.1.2.1 Water LCS (method 7470/245.1): Add 30 mL of reagent water to a digestion cup and fortify with a known amount of mercury (spike with 2.0 mL of 100 ppb Hg#2 = 4 ppb Hg at a final volume of 50 mL). Prepare and analyze with each batch of samples.

9.1.2.2 TCLP LCS (method 7470): Add 200 mL of EBLK to a 500 mL bottle and spike with 1.0 mL of Hg TCLP Spike, and preserve to pH <2 with nitric acid. Add 30 mL of the spiked EBLK to a digestion cup (4 ppb Hg at a final volume of 50 mL). Prepare and analyze with each batch of extracts.

9.1.2.3 Solid LCS (for Wipes or project specific): Add 0.6 g of Silicon (IV) Oxide to a digestion cup and spike with 2.0 mL of 100 ppb Hg#2 (4 ppb Hg at a final volume of 50 mL).

9.1.3 Laboratory Control Sample Standard Reference Material (LCSSRM): Method 7471. A solid matrix material containing a known quantity of mercury, which is carried through the preparation and analysis procedure along with each batch of solid samples (not to exceed 20 samples). The LCSSRM serves the same purpose as the LCS. The quantity of laboratory control sample standard reference material used is selected to give a target result of 4 ppb in a final volume of 50 mL. This amount will vary by manufacturer lot.

Example: A lot of ERA Metals in Soil has a certified mercury concentration of 2.170 mg/kg. To obtain a theoretical instrument result of 4 ppb (μg/L) in a 50 mL final volume, use the following target amount of soil LCSSRM:

$$4\ \mu g/L \times 0.050\ L \div 2.170\ \mu g/g = 0.09216\ g$$

9.1.4 Matrix Spikes: For each batch of samples (not to exceed 20 samples), a matrix spike (MS) should be processed on a routine basis. Spiked samples will be used to determine matrix effects on digestion and detection. A representative base sample is selected and a replicate quantity is added to an additional digestion cup. For SW846 and MCAWW this replicate sample is spiked with 2.0 mL of 100 ppb Hg#2 (4 ppb Hg at a final volume of 50 mL).

9.1.5 Duplicates: For each batch of samples (not to exceed 20 samples), replicate samples should be processed on a routine basis. Replicate samples will be used to determine precision, and are either a method duplicate (DU) or matrix spike duplicate (MS or MSD; typical for SW846 and MCAWW, client assigned for MCP/RCP work). A matrix duplicate is just a replicate preparation of a selected representative base sample. A matrix spike duplicate is just a matrix duplicate thatis spiked the same as a matrix spike.

9.1.6 Sample QC frequency and control limits:

Quality Controls	Frequency	Control Limit
Method Blank (MB)	1 in 20 or fewer samples	< Reporting Limit (SW846); < MDL (MCAWW)
Laboratory Control Sample (LCS)[1]	1 in 20 or fewer samples	80-120% recovery (SW846); 85-115% recovery (MCAWW)
Matrix Spike (MS)	1 in 20 or fewer (SW846); 1 in 10 or fewer (MCAWW	75-125% recovery (SW846) 70-130% recovery (MCAWW)
Matrix Spike Duplicate (MSD) or Matrix Duplicate (DU)[2]	1 in 20 or fewer samples	75-125% recovery (MSD); or RPD < 20% (duplicates)
Laboratory Control Sample Standard Ref. Material (LCSSRM)	1 in 20 or fewer samples	Specified by manufacturer on a per lot basis; typically about 70-130%

[1] Alternately referred to as a Laboratory Fortified Blank (LFB).
[2] The base sample for MS/MSD is arbitrarily selected, unless specifically requested by a client.
MCP/RCP requires if the MS/MSD recovery <30%, the samples will be redigested and reanalyzed. Provide narrative upon confirmation. LCSD is also required for MCP/RCP.

9.2 Instrument QC

9.2.1 All instrument QC standards are prepared and digested daily, typically at the same time as the instrument calibration standards (see section 10.2). Add 25-30 mL reagent water to a digestion cup. Spike with the volume of 100 ppb Hg#2 specified for each standard, and digest for a minimum of 30 minutes. The final QC sample volume is 50 mL.

9.2.2 Initial Calibration Verification (ICV): Prepared as described in 9.2.1 and spiked using 1.5 mL of 100 ppb Hg#2 (3 ppb at a final volume of 50 mL). The ICV checks the accuracy of the calibration and must be the first sample analyzed following a new calibration or at the start of a new analytical sequence.

9.2.3 Initial Calibration Blank (ICB): An unspiked blank sample prepared as described in 9.2.1. The ICB must be analyzed directly after the ICV.

9.2.4 Low Level Calibration Verification (CRA/ICVL/CCVL): Prepared as described in 9.2.1 and spiked using 0.1 mL of 100 ppb Hg#2 (0.2 ppb at a final volume of 50 mL). The CRA is at the same concentration as the lowest non-blank calibration point and is at or near the typical laboratory reporting limit (RL). The CRA/ICVL must be analyzed following the ICV and ICB at the beginning of any an analytical sequence. SW846 Update 4 and many client QAPPs require that an additional CRA/CCVL be analyzed at the end of each analytical sequence.

9.2.5 Continuing Calibration Verification (CCV): Prepared as described in 9.2.1 and spiked with 1.0 mL of 100 ppb Hg#2 (2 ppb at a final volume of 50 mL). The CCV is analyzed at the beginning and end of an analytical sequence, and at a frequency of every 10 samples, ensuring the continued accuracy of the calibration.

9.2.6 Continuing Calibration Blank (CCB): An unspiked blank sample identical to the ICB. The CCB must be analyzed directly after each CCV, and verifies that contamination has not accumulated over the analysis of the previous ten samples.

9.2.7 Serial Dilution (SD): For each sample batch, a representative sample is selected (typically the base sample that is used for the MS/MSD). The sample is diluted 5X (1+4 dilution) using blank matrix solution (BMS) and is analyzed along with the base sample to evaluate sample matrix effects.

9.2.8 Instrument QC frequency and control limits:

Quality Check	Conc.	Frequency	Control Limit
ICV	3.0 ppb	Beginning of each analytical sequence	90-110% recovery (SW846); 95-105% recovery (MCAWW)
ICB	Blank	Beginning of each analytical sequence	< Reporting Limit
CRA/ ICVL/CCVL	0.2 ppb	Beginning of each analytical sequence. End of each analytical sequence for SW846 update 4.	50-150% recovery, 70-130% for MCP/RCP 70%-130% recovery – SW846 Update 4
CCV	2.0 ppb	Every 10 samples	80-120% recovery (SW846); 90-110% recovery (MCAWW)
CCB	Blank	Every 10 samples following each CCV	< Reporting Limit
SD	N/A	1 for each sample batch	+/-10% of base sample

10.0 Procedure

10.1 Sample Preparation

10.1.1 Samples to be prepared are selected from a report of available in-house samples separated by sample matrix and/or analysis method, and sorted by due dates (or any of a variety of user selectable sort criteria). Selected samples are added to a Preparation Bench Sheet (or Batch). For additional detail concerning batch creation criteria and procedures, refer to SOP BF-ME-001.

10.1.2 Samples of different matrix types (e.g. water, solid) or preparation/analysis methods (e.g. 7470, CLP) are typically prepared and analyzed separately. Samples assigned 7470 (SW846) and 245.1 (MCAWW) can be batched and analyzed together; but solid samples are separated from water samples, and CLP samples are separated from non-CLP samples. TCLP extracts may be analyzed with aqueous 7470 samples, but typically are not. Although not a method requirement, aqueous total samples are batched and analyzed separately from dissolved samples.

10.1.3 Based on the sample batches to be prepared and analyzed together, a sequential numerical order is established for the preparation and digestion cups are labeled as follows: Starting with '1' for the first client sample in the first batch, begin numbering samples sequentially until the base sample for the batch QC (MS/MSD or MD/MS) is reached. Assign the base sample 2 numbers and skip 1 cup leaving the rack position empty. (This is a placeholder for the serial dilution to be created prior to analysis.) The next two cups are the two batch QC samples. Continue with the next client sample and continue to the last client sample, followed by the batch laboratory control sample (LCS) and method blank (BLK). Continue with additional batches of the same type as necessary (up to 88 labeled sample cups – the number of positions on the Leeman autosampler). It is a good practice to clearly mark the cups to be used for spiked batch QC samples (MS/MSD/LCS).

Note: This assigned sequential order is used throughout both the preparation and analysis procedures.

10.1.4 Obtain the appropriate client samples from the cooler(s) or metals sample storage area. Arrange the samples on a sample cart in the order designated above.

10.1.5 Aqueous Sample Digestion (method 7470, 245.1):

10.1.5.1 Making sure the cap is on securely, shake or invert the container several times to homogenize the sample, and pour 30 mL of the sample into the appropriately labeled digestion cup. (Refer to section 5.5 of SOP BF-GP-005 for further instruction on sample homogenization.) Take care to use the appropriate sample bottle when pouring sample, DU/MS or MS/MSD groups. Some clients provide additional bottles for each of the samples in this group, However, much of the time, a single sample bottle will be used for all three aliquots. Reagent Water (30 mL) is used for the LCS and BLK samples. For TCLP extracts, use the pre-spiked MS/MSD and LCS volumes (typically prepared in the Metals Digestion Lab).

10.1.5.2 Spike all MS, MSD, LCS samples as specified in the Batch QC section.

10.1.5.3 Add the following reagents to all samples in each batch:

- 1.0 mL Nitric Acid (HNO_3): **Caution!** Add slowly to leachates. Acid may react vigorously or violently with some samples. Highly reactive samples may require additional nitric acid.
- 2.0 mL Sulfuric Acid (H_2SO_4): **Caution!** Add slowly to leachates. Acid may react vigorously or violently with some samples.
- 5.0 mL Potassium Permanganate ($KMnO_4$)
- 2.5.mL Potassium Persulfate ($K_2S_2O_8$)

10.1.5.4 Cap the digestion cups loosely enough so that pressure does not build up can be evacuated, but also tight enough so that the caps stay on, and that volume loss due to the heating minimized.

10.1.5.5 All samples should remain a purple color for at least 15 minutes after adding the potassium permanganate. If any sample becomes clear or otherwise loses its purple color, add an additional 5 mL of the potassium permanganate to ALL samples in the batch, including batch QC samples. If the purple color fades once again, re-prepare the affected sample(s) using a reduced initial volume, noting the volume used on the bench sheet, and dilute to 30 mL using reagent water.

10.1.5.6 Put the samples on the hot block (95°C +/- 3°C) for 2 hours. Remove and let cool.

10.1.5.7 Uncap each digestion cup and add 2.0. mL of sodium chloride – hydroxylamine hydrochloride (HyHy) to each sample. Allow bubbling to subside, and top each sample to the 50 mL mark with reagent water.

10.1.5.8 Replace the cap tightly and shake vigorously for two to three seconds or until most of the purple color has faded. Vent the digestion cup. A brown residue of undissolved manganese dioxide (MnO_2) may remain on the bottom or sides of the digestion cup. It is of no concern, and may dissolve over time.

10.1.6 Solid Sample Digestion:

10.1.6.1 Homogenize each sample as described in section 5.6 of SOP BF-GP-005. Add 0.6 g of each sample to the appropriately labeled digestion cup. Take care to use the appropriate sample bottle when weighing sample, DU/MS or MS/MSD groups. Some clients provide additional bottles for each of the samples in this group, However, much of the time, a single sample bottle will be used for all three. For the SRM sample, add the calculated target amount of ERA Standard (see section 9.1.3). For the BLK sample add 0.6g Silicon (IV) Oxide (SiO_2). Add approximately 5 mL reagent water to each cup (enough to cover the sample).

10.1.6.2 Spike all MS, MSD, LCS samples as specified in the Batch QC section.

10.1.6.3 Add the following reagents to all samples in each batch:

- 1.0 mL Nitric Acid (HNO_3). **Caution!** Acid may react vigorously or violently with some samples. Highly reactive samples may require additional nitric acid.
- 3.0 mL Hydrochloric Acid (HCl)

10.1.6.4 Heat the samples uncapped on the hot block at 95°C (+/- 3°C) for 2 minutes. Remove and let cool.

10.1.6.5 Add the following to all samples in each batch:

- 15 mL Reagent Water
- 15 mL Potassium Permanganate ($KMnO_4$): **Caution!** $KMnO_4$ can react with HCl to produce chlorine gas.

10.1.6.6 Cap the digestion cups loosely enough so that pressure does not build up and can be evacuated, but also tight enough so that the caps stay on and that volume loss due to the heating minimized.

10.1.6.7 Put the samples on the hot block at for 30 minutes. Remove and let cool.

10.1.6.8 Uncap each digestion cup and add 6.0 mL of sodium chloride – hydroxylamine hydrochloride (HyHy) to each sample. Allow bubbling to subside, and top each sample to the 50 mL mark with reagent water.

10.1.6.9 Replace the cap tightly and shake vigorously for two to three seconds or until most of the purple color has faded. Vent the digestion cup. A brown residue of undissolved manganese dioxide (MnO_2) may remain on the bottom or sides of the digestion cup. It is of no concern, and may dissolve over time.

10.1.7 Analysis of sample digestates must be performed within 24 hours of digestion or the sample will need to be re-digested.

10.1.8 Some aqueous samples and most solid samples will contain sediments or other solid material that may physically interfere with the analysis by clogging or restricting flow through the instrument sample introduction tubing. These samples may be filtered.

10.2 Calibration

10.2.1 Before any instrument is used as a measurement device, the instrument response to known reference materials must be determined. Instrument calibration for mercury analysis is performed at a minimum of each day the analysis is to be performed. A six point linear calibration is used.

10.2.2 Preparation of Calibration Standards: Six standards of known mercury concentration are prepared by dilution of the 100 ppb Hg#1 working standard. Separate calibration curves are digested for water and soils independently, including instrument QC, to match the matrix of the digested samples.

10.2.2.1 Add 20-30 mL Reagent Water to six digestion cups. Spike each cup with the appropriate volume of 100 ppb Hg#1 (see chart below).

10.2.2.2 Digest each standard using the aqueous or soil digestion procedure from section 10.1.5 or 10.1.6 respectively. This ensures that the instrument calibration is matrix matched to the samples to be analyzed. Final volume for the calibration standards is 50 mL.

10.2.2.3 Allow the calibration standards to fully cool to room temperature before using (minimum 30 minutes). Failure to allow the standards to cool sufficiently will likely result in the need to recalibrate the instrument.

Calibration Standard	Standard Conc. in 50 mL vol. (ppb)	100 ppb Hg#1 Spike vol. (mL)	Final Conc. Aqueous Samples (µg/L)	Final Conc. Solid Samples (mg/kg)	Control Limit
S1	0	0	0	0	SD < 5000
S2	0.2	0.1	0.33	0.017	%RSD < 30
S3	1.0	0.5	1.67	0.083	%RSD < 5
S4	2.0	1.0	3.33	0.17	%RSD < 5
S5	5.0	2.5	8.33	0.42	%RSD < 5
S6	10.0	5.0	16.67	0.83	%RSD < 5

10.2.3 Calibrating the Instrument**:** This procedure outlines the basic steps to calibrating the instrument. For specific details concerning the operation of the Leeman Analyzer and/or instrument software (WinHg), refer to instrument User's Guide and Manual. For the purposes of this SOP it is assumed that the instrument software and settings are configured for the analysis of samples by the methods covered in this SOP and for the generation of data in a format and manner compatible with TestAmerica Buffalo laboratory operations. It is also assumed the analyst is familiar with and properly trained in the use of the instrument and software.

10.2.3.1 Instrument operating parameters have been demonstrated to meet the necessary requirements for the analyses described in this SOP. Instrument parameters may be altered as the need arises, however, significantly altering these parameters may necessitate reevaluation of instrument and method detection limits prior to implementation for sample analysis. Currently used instrument operating parameters are:

- Pump Rate = 7 mL/min
- Gas Flow Rate = 0.7 L/min
- Sample Uptake Time = 10 sec
- Sample Integration Time = 10 sec
- Rinse Time = 40-60 sec

10.2.3.2 Perform any needed instrument maintenance prior to calibration. Note any maintenance performed in the instrument maintenance log. Detailed instructions and manufacturer suggested scheduling for the performance of most routine instrument maintenance is available within the instrument software using the "Perform Maintenance" command under the "Utility" menu.

10.2.3.3 Turn on Lamp, Pump, and Gas. The lamp will require a minimum of 15 minutes to warm up. For best performance, allow the pump to run 15 minutes to flush the tubing and allow it to settle into place. (For new tubing, allow a 30 minute or longer "break-in" time.)

10.2.3.4 Perform a Lamp Adjustment. Record the setting and baseline reading in the maintenance logbook. A large day-to-day change in the lamp setting (without changes to the instrument optical cell or optical bench) may indicate a need for further maintenance.

10.2.3.5 Pour the calibration standards to the appropriate cups on the autosampler. The 6 standards and concentrations are currently set up in the S1-S6 positions.

10.2.3.6 Use 'StdAuto' to analyze 3 replicates of each of the 6 calibration standards (select S1-S6 and Repetitons 1-3) to generate the calibration curve. In addition to the control limits specified above, a correlation coefficient (rho) of at least 0.995 is required; however, for best performance it is strongly recommended that the correlation coefficient be greater than 0.9995. A lower value may indicate a need for instrument maintenance or poorly prepared calibration standards.

10.2.3.7 Calibrations are evaluated in accordance with SOP BF-GP-006, and against the criteria specified in this section. If all criteria are met, accept the calibration. Print a copy of the calibration screen and export the calibration to a data file. Attach a copy of the calibration screen to each data set analyzed using that calibration.

10.3 Sample Analysis

10.3.1 Pre-Run Setup Checklist: Sample analysis is only performed on a properly maintained and calibrated instrument. Prior to beginning an analytical sequence verify or perform the following steps. Note: these items are not necessarily in a specific sequential order.

10.3.1.1 Select analyst initials in the "User Name" on the "Main" tab:

10.3.1.2 Lamp is on and warmed up (at least 15 min); Gas is turned on; Pump is on. Controls for all 3 are on the "Control" tab.

10.3.1.3 Instrument is calibrated and calibration is accepted. "Cal Curve" tab.

10.3.1.4 Stannous Chloride bottle has sufficient volume, and 10% HCl rinse carboy has sufficient volume.

10.3.1.5 Calibration Check Standard cups (Instrument QC) have sufficient volume. Current setup has instrument QC in the following autosampler rack positions: C1 = ICB/CCB; C2 = ICV; C3 = CCV; C4 = CRA/CCVL.

10.3.1.6 Create a data file from the "File" menu, or select an existing file from the "Dataset" field. The file contains information which designates the instrument used, date and sample analysis/batch matrix type using the following convention:

- A single letter instrument identifier (Leeman2 = H; Leeman 3 = J).
- Numeric date: month, day (2 digits each), and year (1 digit); e.g. Jan 15, 2008 = 01159.
- A two character analysis/batch matrix type identifier

- C# = Calibration data file
- D# = Dissolved Hg
- S# = Total Hg - Solids
- TC = TCLP extracts
- W# = Total Hg – Waters

Example: The second analytical sequence (run data file) of aqueous samples for total Hg analyzed on August 12th, 2009 using the Leeman 2 instrument would have a Data File name of H08129W2.

10.3.1.7 For the samples to be analyzed, label test tubes using the same numbering scheme used for the digestion cups.

10.3.1.8 Pour approximately 8-10 mL of each sample from the digestion cups into the test tubes, and place them in a 44 position autosampler rack.

10.3.1.9 Create the serial dilution (SD) samples: Combine 2 mL of the sample to be diluted with 8 mL of Blank Matrix Solution (BMS). The dilution factor for the SD sample is 5 (@5 in the autosampler table).

10.3.1.10 Create Autosampler files (using the Rack Editor) containing all of the batch samples and calibration check standards (instrument QC) to be analyzed. Autosampler table files are named similar to Data Files substituting #1, #2, #3, etc. in place of the 2-character sample type identifier. One file is needed for each rack of up to 44 samples. Auto-sampler table columns are populated as follows:

- cup#: This column is pre-populated from 1-44 (the number of positions per sample rack). The cup number should match up with the digestion cup number and test tube number for the 1st rack of 44 samples. For the 2nd rack (if needed), the cup# will equal the digestion cup number minus 44.
- sample ID: Batch sample IDs (up to 10 characters) may be typed (or scanned from a barcode) into this column..
- extended ID: Batch sample IDs (up to 20 characters) are typed (or scanned from a barcode) into this column. If sample ID is longer than 20 characters, the 3 digit lab code may be removed to provide more space.
- weight and volume: these columns are not used and are pre-populated with 1.0000

- ? A D F P S U SC UI US… (Cup Macro Column): This column uses macro codes to send instructions to the instrument software. All instrument QC samples are analyzed by including the check standard cup position (C1=ICB/CCB; C2=ICV; C3=CCV; C4=CRA/CCVL). The CP macro code tells the instrument to execute the preceding macro codes prior to analyzing the sample in that cup #; otherwise, the macro codes in a given row execute following analysis of the sample in that cup.

- Macro Code Layout: The following macro codes are used for a typical analysis (see example table layout below):

- Cup#1 = C2 C1 C4 C3 C1 CP
- Cup#10,20,30, etc = C3 C1
- .
- Last Cup = C3, C1 or C3, C1, C4 as required)

10.3.1.11 Select the Autosampler file(s) and corresponding cup positions to be analyzed on the "Sample" Tab. Check that the samples/sample racks are in their proper positions on the autosampler.

10.3.1.12 Select "Run Auto" on the "Sample" tab. A full rack of 88 cups including all QC will take about 3.0 - 3.5 hours.

10.3.1.13 Samples with results outside of the calibration range must be diluted to within range and reanalyzed. If sample dilutions are required then add them to the end of the run. Append the autosampler table as needed with the sample ID. The dilution factor is added to the 'extended ID' column preceded by the '@' character. Include any check standard macro codes as appropriate.

10.3.1.14 Perform a preliminary on-screen review of the data for QC failures or other requirement compliances (eg QAPPs). Due to the 24h holding time constraint in analyzing mercury digestates, it is strongly recommended that the analyst perform any needed reanalysis (not requiring sample redigestion) immediately and within the same data file. This will reduce the need for unnecessary sample redigestion and simplify data review and reporting.

Example Autosampler Table for Batch 48552.

cup	sample ID	extended ID	weight	volume	? A D F P S U SC UI C1..C7
1		mb 48048552/1-a	1.0000	1.0000	C2 C1 C4 C3 C1 CP
2		lcs 48048552/2-a	1.0000	1.0000	
3		480-15035-d-1-c	1.0000	1.0000	
4		480-15035-d-2-c	1.0000	1.0000	
5		480-15035-d-3-c	1.0000	1.0000	
6		480-15035-d-4-c	1.0000	1.0000	
7		480-15035-d-5-c	1.0000	1.0000	
8		480-15035-d-6-c	1.0000	1.0000	
9		480-15035-d-7-c	1.0000	1.0000	
10		480-15035-d-8-c	1.0000	1.0000	C3 C1
11		480-15035-d-9-c	1.0000	1.0000	
12		480-15035-d-10-c	1.0000	1.0000	
13		480-15035-d-11-c	1.0000	1.0000	C3 C1 C4
14			1.0000	1.0000	

The above table would result in a run sequence as follows:

ICV
ICB
CRA/ICVL
CCV
CCB
↑
10 samples (with the given ID#s)
↓
CCV
CCB
↑
3 samples
↓
CRA/CCVL
CCV
CCB

10.3.2 Post-Analysis Checklist: Performed once all sample analyses are complete.

10.3.2.1 In the WinHg Database program 'Report' tab, select the appropriate data file to be reported. (Samples to be reported can be selected using a combination of the 'Batch List' and 'Records List' sections.) Select 'Generate Report'. Reports can be generated on-screen ("Report" Format, 'Viewer" Destination -- viewable via the 'Viewer' tab), to the printer ('Report" Format, 'Printer" Destination), or to a file ('PRN File" Format, "Disk File' Destination). The current report format setting is 'HgRpt'.

10.3.2.2 Generate a printed report of the raw data, and a PRN disk file (used to import data to the LIMS). The file should be named the same as the instrument data file that the samples were run in. Save the file directly to the H-Drive (Lab Data) in the folder *H:\Mercury\Lims*. Click 'Generate' after creating the file to write the data to the file. Raw instrument files are backed up to a network drive in accordance with SOP BF-IS-010.

10.3.2.3 Record solution ID#s for the ICV, ICB, CRA/CCVL, CCV, and CCB directly onto the raw data report.

10.3.2.4 Attach a hard copy (screen–shot) of the Calibration Curve screen to the printed raw data report. Record the following information on the Calibration page:

- Analysis Date
- Analyst Initials
- Instrument Name

- Solution ID#s for the Calibration Standards
- Calibration File Name (eg H08129C1)
- Data File Name the calibration was used for (eg H08129CW)
- Batch ID#s for the analyzed batches

11.0 Calculations / Data Reduction

11.1 Accuracy

$$\text{ICV / CCV / CRA / LCS \%Recovery} = \frac{\text{observed concentration}}{\text{known concentration}} \times 100$$

$$\text{MS / MSD \% Recovery} = \frac{\text{(spiked sample) - (unspiked sample)}}{\text{spiked concentration}} \times 100$$

11.2 Precision (RPD)

$$\text{Matrix Duplicate (MD)} = \frac{|\text{orig. sample value - dup. sample value}|}{[(\text{orig. sample value + dup. sample value})/2]} \times 100$$

11.3 Wet-Weight Basis

Sample Concentration (mg/kg) = $C \times V/W$

Where: C = concentration in extract (mg/L)
V = Volume of the digestate (L, 50 mL = 0.05 L)
W = Weight of sample aliquot (not dried) extracted (g $\times$ 0.001 = kg)

11.4 Percent Solids

To report percent solids in solid samples, calculate as follows:

% Solid (S) = $DW / WW \times 100$

Where: DW = Sample weight (g) dried (dry weight)
WW = Sample weight (g) before drying (wet weight)

11.5 Dry-Weight Basis

Sample Concentration (mg/kg) = $(C \times V) / (W \times S)$, *or*
Sample Concentration (mg/kg) = $C \times V / WW$

11.6 Calculation of extract concentrations are automatically done by the system's software.

11.7 Calculation of sample concentrations from measured extract concentration are done by the LIMS system.

11.8 Contingencies for Handling Out-of Control or Unacceptable Data

11.8.1 Data is to be evaluated in accordance with SOPs BF-GP-012 and BF-ME-013.

11.8.2 If an ICV, ICB, or opening CRA/ICVL falls out of acceptance limits, discontinue the analysis to correct the problem, and then restart the analysis. Note: Instrument re-calibration may be required.

11.8.3 If any CCV or CCB falls out of acceptance limits, the preceding and following 10 samples must be evaluated. If a LCS or BLK fails, the entire batch of samples must be evaluated.

- For high CCVs and LCSs, non-detect samples may be accepted. All other affected samples must be reanalyzed.
- For low CCVs, all affected samples must be reanalyzed. For low LCSs, the batch must be re-prepared and reanalyzed.
- For High CCBs and BLKs, non-detect samples may be accepted. Samples greater than 10x the CCB or BLK result may also be accepted. All other affected samples need to be reanalyzed or re-prepared and reanalyzed.

11.8.4 A Job Exception Report form or Non-Conformance Memo (NCM) may need to be filed if extensive problems are noted within any one sample or analysis. The analyst performing the run completes these forms. A Job Exception Report form should 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-digestion
- Re-digestion required due to sample batch QC failure
- Unusual sample matrix or sample reactivity which requires deviation from this SOP.

11.8.5 In the event of unknown positives or sample matrix which presents 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.

11.8.6 When an out of control situation occurs, the analyst must use his/her best judgment and use any available resources to determine the corrective action to be taken. The analyst may need to seek immediate assistance from the supervisor, laboratory director, project manager, QA personnel or other experienced members of the staff if he/she is uncertain of the proper course of action. The test may need to be stopped until the problem is corrected since the problem may be instrumental and not chemical. Out of control data will never be released without the approval of the Supervisor, QA Manager, or Laboratory Director.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

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 SOP BF-QA-001. 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. MDLs are verified on each instrument to which they will apply via annual MDLV studies. Instrument detection limits (IDL) are determined for each instrument on a quarterly basis.

12.2 Training Requirements

12.2.1 Analyst training will adhere to requirements specified in SOP BF-QA-004

12.2.2 The department supervisor has the responsibility to ensure that this procedure is performed by analysts with the required experience and properly trained in its use.

12.2.3 The analyst must complete laboratory safety orientation training that includes, but is not limited to, PPE requirements, chemical handling, and electrical safety.

12.2.4 The analyst must read the SDS for all chemicals used in this method.

12.2.5 The analyst must read and understand the contents of this SOP and the Method used as a reference for this SOP.

12.2.6 The analyst must successfully complete a Demonstration of Capability (DOC) before training in this method is deemed to be complete.

12.3 Demonstration of Capability (DOC)

12.3.1 Initial Demonstration of Capability is performed upon completion all other aspects of training. A completed IDOC is the final step of analyst training and allows the analyst to perform the method without trainer supervision.

12.3.2 Continuing Demonstration of Capability is performed annually. This ensures that the analyst has remained proficient in performing the method and no retraining is necessary.

12.3.3 DOC will be performed as described in SOP BF-QA-004 section 5.8.

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

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 section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention".

14.2 The following waste streams are produced when this method is carried out:

- Acidic waste from samples and sample digests. Waste generated will contain Nitric Acid and will therefore be disposed of as "AN" waste in accordance with SOP BF-WM-001.

15.0 References / Cross-References

15.1 EPA Method 7470A – Mercury in Liquid Waste

15.2 EPA Method 7471A – Mercury in Solid Waste

15.3 EPA Method 7471B – Mercury in Solid Waste

15.4 40 CFR Part 136 (MCAWW) (Revision B), "Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act" U.S. Environmental Protection Agency.

15.5 EPA 600/4-79-020 Methods 245.1, Revision B; SW-846, 3rd Edition, Method 7470A

15.6 "Method 1631, Revision B: Mercury in Water by Oxidation" (40 CFR 136, Revision B) U.S. Environmental Protection Agency, May 1999.

15.7 The following SOPs have been referenced, or are relevant to, procedures described in this document, and should be referred to for more detailed information on the indicated topics:

- BF-ME-001 Metals Department Batching Procedure
- BF-ME-013 Metals Data Review
- BF-GP-001 Autopipets (Eppendorfs), Syringes, Repipettor Calibration

- BF-GP-002 Balances, Reagent Water, Temperature Control Devices
- BF-GP-003 Glassware Cleaning
- BF-GP-004 Dry Weights
- BF-GP-005 Sample homogenization and sub-sampling
- BF-GP-006 Initial Calibration Evaluation
- BF-GP-011 Sample Storage and Handling
- BF-GP-012 Data Review Requirements
- BF-GP-019 Standard Storage and Traceability
- BF-GP-020 Thermometer Calibration
- BF-IS-010 Instrument Data File Backup
- BF-WM-001 Waste Management
- BF-QA-001 Determination of MDLs
- BF-QA-004 Personnel Training (for DOC's)

16.0 Method Modifications:

Item	Method xx	Modification
01	7470/7471/ 245.1	The volumes have been minimized for preparation of all methods listed, although the chemistry remains unchanged. This change fits our preparation equipment and minimizes waste.
02	7470/7471/ 245.1	*Environmental Express* Hot Blocks and plastic digestion cups replace Hot Plates and BOD bottles for sample preparation.

17.0 Attachments

17.1 Attachment 1: Manufacturer recommended positioning of the computer/analyzer/ autosampler system.

17.2 Attachment 2: Sample Water Digestion Batch Bench Sheet

17.3 Attachment 3: Sample Soil Digestion Batch Bench Sheet

17.4 Attachment 4: Example Instrument Calibration Page

18.0 Revision History

- Revision 11, dated February 15, 2018
  - Quality Manager Change, signature added
  - Department Manager Changed, signature added
- Revision 10, dated October 14, 2016
  - Quality Manager Change, signature added.

- Revision 9, dated October 1, 2015
  - Section 9.1.2.2: Changed volume of EBLK used to 200 mls.
  - Section 9.1.2.2: Changed spike volume used to 1.0 ml.
  - Lab Director Change, signature added.
- Revision 8, dated September 23, 2014
  - Approval Section updated, signatures added
  - Throughout document: changed CRA to either CRA/ICVL or CRA/CCVL to include nomenclature change for SW846 Update 4 methods.
  - Section 10.1.5 Changed preparation reagent volumes to better match relative quantites in reference methods. Potassium persulfate changed from 2mL to 2.5mL. Hydroxylamine hydrochloride solution changed from 2.5mL to 2mL.
  - Section 10.1.6 Changed preparation reagent volumes to better match relative quantities in reference methods. Potassium permanganate changed from 10-15mL to 15mL. Hydroxylamine hydrochloride solution changed from 2.5mL to 6mL. Changed the two additions of reagent water from 5-10mL each to 5mL and 15mL.
- Revision 7, dated April 25, 2013
  - Section 6.2.2 added reference to include both beginning and ending temperature measurements.
  - Section 10.3.1.10 changed sample ID to include use for sample ID's less than 10 characters.
  - Section 10.3.1.10 removed reference to S and P macro Code combination for determination of spike recoveries (no longer used).
  - Section 12.1 removed reference to yearly MDL determination
  - Section 9.1.5 addition of MCP/RCP assignment of MS/MSD
  - Section 9.1.6 added MCP/RCP to LCSD and MS/MSD criteria
  - Table 9.2.8 added CRA criteria of 70-130% for MCP/RCP
  - Quality Manager updated, signature added
- Revision 6, dated March 28, 2012
  - Section 10.2.2 added reference to include soil digestion to match the matrix of the digested samples.
  - Section 10.2.2.2 addition of 10.1.6 to reference the soil digestion procedure.
- Revision 5, dated January 19, 2012
  - Changed Standard Reference Material (SRM) to Laboratory Control Sample Standard Reference Material (LCSSRM). Throughout.
  - Changed LCV to CRA throughout.
  - Changed Method Blank (BLK) to Method Blank (MB) throughout.
  - Changed Matrix Duplicate (MD) to Matrix Duplicate (DU) throughout.
  - Changed Serial Dilution (SRD) to Serial Dilution (SD).
  - 9.1.1.3 Changed TCLP extraction blank TALS ID from BLK to LB.
  - 6.2.7 Changed scale model from Mettler AE200 to Denver P-214.
  - 10.2.3.3, 10.3.1.4 removed references to the rinse bath.
  - 10.3.1.10 Due to character limitations batch sample IDs are entered into extended ID instead of sample ID.
  - Updated Example Autosampler Table to reflect changes in section 10.3.1.10.

- Deleted S P out of Example Autosampler Table.
- 10.3.2.2 H-Drive folder changed from Ward/Sdgs/Instdata/Mercury to H:\Mercury\Lims.

- Revision 4, dated 15 February 2011
  - Replaces previous SOP BF-ME-011, revision 3
  - Added reference to Method 7471B in Section 1.2 and Section 15.0
  - Replaced all references to Blank Spikes (BS) to Laboratory Control Samples (LCS).
  - Added hot block temperature range of +/-3°C to Section 6.2, 10.1.5 and 10.1.6.
- Revision 3, dated 25 January 2010
  - Replaces previous SOP BF-ME-011, revision 2
  - Spelling, Grammar, & Formatting corrections
  - Section 4.1.9 Added specific guideline for sample reanalysis to check for carryover from high level samples
  - Section 4.2 & 4.3 Additional detail provided concerning various chemical vs. physical interferences
  - Section 9.1.2.3 Removed references to AFCEE and USACE
  - Sections 6.26, 6.27, 6.2.10, 10.2.3.7 Added missing cross-references to other relevant SOPs
  - Attachment 4 - Title renamed for clarity

- Revision 2, dated 02 September 2009
  - Replaces previous SOP BF-ME-011, revision 1
  - Section format changes from STL to TestAmerica Standard format completed. Several section numbers have changed, and several new tables have been included. References to outdated SOP reference numbers updated.
  - Incorporated contents of interim change from July 07, 2008 concerning concentration of purchased mercury stock standards (1000 ppm → 100 ppm) and concentrations of prepared intermediate standards (20,000 ppb → 10,000 ppb, and elimination of 2000 ppb).
  - Changed spike amount for the blank spike for aqueous total mercury batches from 2.0 ppb to 4.0 ppb so that the blank spike and matrix spike levels are now the same, which is in better accordance with SW-846. The 2.0 ppb blank spike had been implemented to accommodate AFCEE/USACE. A 2.0 ppb blank spike will still be used for AFCEE/USACE at which point that becomes necessary.
  - Corrected Table 9.1.6 Sample QC control limits to agree with EPA methods:
    1. MS/MSD %recoveries from 20% to 25% (SW846) and 30% (MCAWW)
    2. MD/MSD %RSD from 30% to 20%
  - Changes to several sections reflecting differences in operation between AIMS and ELEMENT LIMS systems; including the following abbreviation changes:
    1. CRA → LCV
    2. SD → MSD
    3. LCS and LFB → BS or SRM
    4. MBLK → BLK
  - Added details concerning data file and autosampler file naming conventions

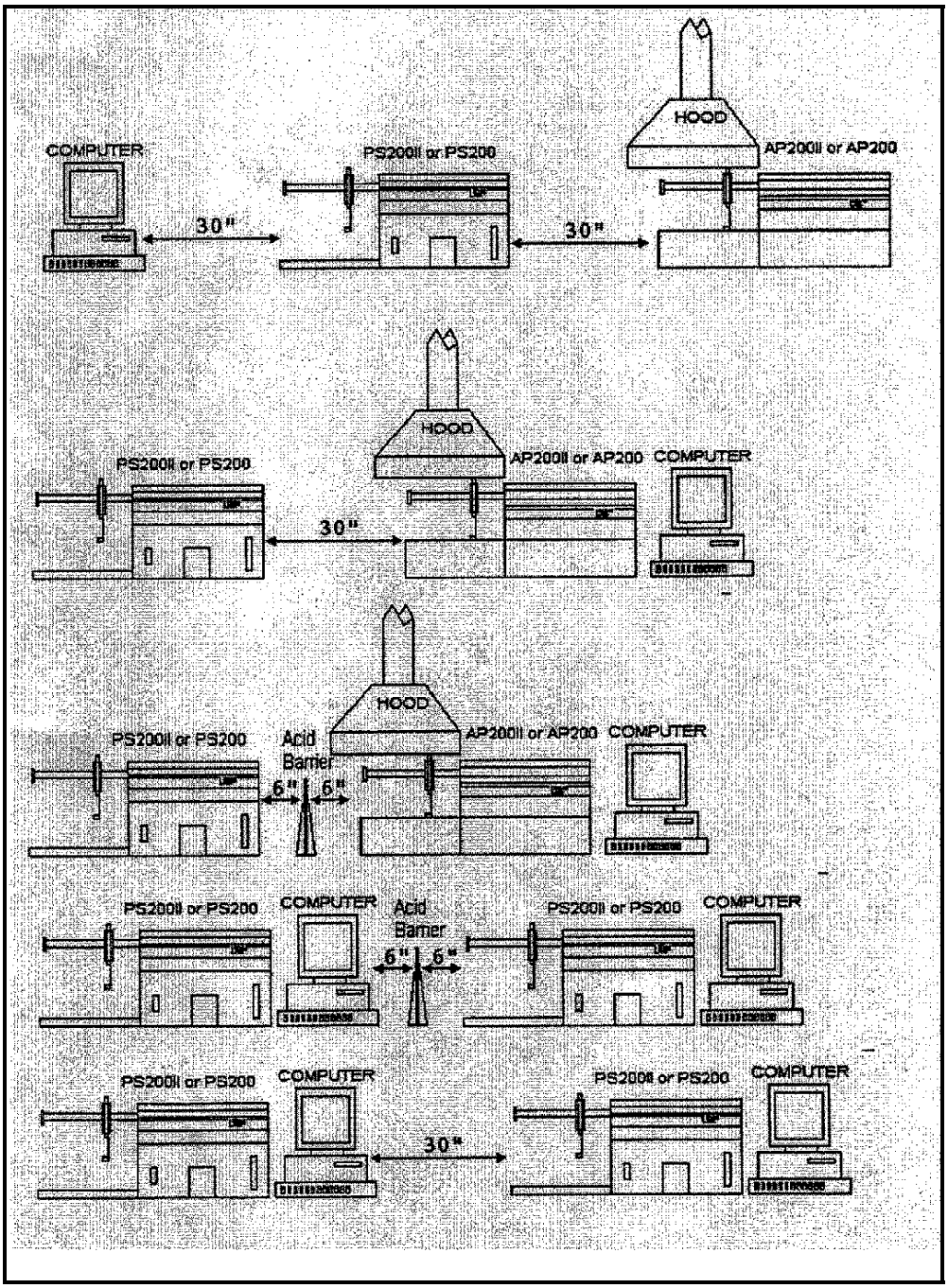
- Added details concerning sample preparation cup and analysis test tube numbering system
- Added an example autosampler table for demonstration of use of extended ID field for sample IDs longer than 10 characters, and for improved clarity in demonstrating the use of macro codes for execution of instrument QC.
- Reformatted sample preparation section to separate Aqueous from Solid digestion steps
- Rewrote calibration and sample analysis sections to better depict current use of instrument software in setting up, calibrating, and sample analysis. Added section on instrument operating parameters
- Added Sample Calibration Page Attachment
- Updated Example batch attachments from AIMS to ELEMENT batches
- Changed potassium permanganate added to soil samples from 10 mL to 10-15mL.

- Revision 1, dated 15 April 2008
  - Replaces previous SOP BF-ME-011, revision 0
  - Sections 10.3.7, 10.3.8, 10.3.9 and 10.4. Edited for improved clarity regarding stock standard, intermediate standard, and working standard preparation; and to correct copying errors introduced in transitioning SOP formats from AME-MERCURY-50, rev.7 to BF-ME-011, rev.0.
  - Section 12.7 and 12.8. Correct 100 ppb to Hg#2 instead of Hg#1
  - Sections 10.4.3 and 10.4.4. Moved reference to preparation of MS/SD, LCS, and LFB from Section 10.4.3 to Section 10.4.4.
  - Section 12.1.2. Changed quantity of water added to soil MBLK to 10 mLs and removed "Carry the MBLK through the entire digestion process" (redundant with 12.1)
  - Section 14.4. Added addition of approximately 10 mLs reagent water to cover soil samples

- Revision 0, dated 30 November 2007
  - Replaces previous SOP AME-MERCURY-50, revision 7
  - Section 9.2.5 correct to weekly to daily for pipette verification
  - Sections 12.2.2, 12.2.3, 12.3, and 12.6 correct 100ppb to Hg#2 instead of Hg#1
  - Section 12.4 correct from 1:3 to 1:5 serial dilution
  - Section 14.26 replace 40CFR with MCAWW
  - Section 14.31 deleted turn off argon gas valve

Attachment 1

Manufacturer recommended positioning of the computer/analyzer/autosampler setup.



Attachment 2

Sample Water Digestion Batch Bench Sheet (Page 1 of 5)

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-5412
Method Code: 480-7470A_Prep-480

Analyst: Kacalski, Jason

Batch Open: 2/14/2011 9:25:00AM
Batch End: 2/14/2011 11:25:00AM

Preparation, Mercury

	Input Sample Lab ID (Analytical Method)	SDG	Matrix	Initial Amount	Final Amount	Due Date	Analytical TAT	Dlv Rank	Comments	Output Sample Lab ID
1	MB~480-4850/17-A N/A	N/A		30 mL	50 mL	N/A	N/A	N/A		
2	LCS~480-4850/18-A N/A	N/A		30 mL	50 mL	N/A	N/A	N/A		
3	480-1514-D-1 (7470A)	N/A	Filtrate	30 mL	50 mL	2/15/11	10_Days - R	2		
4	480-1514-D-1~SD (7470A)	N/A	Filtrate	30 mL	50 mL	2/15/11	10_Days - R	2		
5	480-1514-D-1~MS (7470A)	N/A	Filtrate	30 mL	50 mL	2/15/11	10_Days - R	2		
6	480-1514-D-1~MSD (7470A)	N/A	Filtrate	30 mL	50 mL	2/15/11	10_Days - R	2		
7	480-1514-D-2 (7470A)	N/A	Filtrate	30 mL	50 mL	2/15/11	10_Days - R	2		
8	480-1514-D-3 (7470A)	N/A	Filtrate	30 mL	50 mL	2/15/11	10_Days - R	2		
9	480-1514-D-4 (7470A)	N/A	Filtrate	30 mL	50 mL	2/15/11	10_Days - R	2		
10	480-1516-G-1 (7470A)	N/A	Filtrate	30 mL	50 mL	2/16/11	10_Days - R	2		
11	480-1516-G-2 (7470A)	N/A	Filtrate	30 mL	50 mL	2/16/11	10_Days - R	2		
12	480-1516-G-3 (7470A)	N/A	Filtrate	30 mL	50 mL	2/16/11	10_Days - R	2		
13	480-1569-F-1 (7470A)	N/A	Filtrate	30 mL	50 mL	2/16/11	10_Days - R	2		
14	480-1569-F-2 (7470A)	N/A	Filtrate	30 mL	50 mL	2/16/11	10_Days - R	2		

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TestAmerica Buffalo

Attachment 2

Sample Water Digestion Batch Bench Sheet (Page 2 of 5)

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-5412 Analyst: Kacalski, Jason Batch Open: 2/14/2011 9:25:00AM

Method Code: 480-7470A_Prep-480 Batch End: 2/14/2011 11:25:00AM

15	480-1569-F-3 (7470A)	N/A	Filtrate	30 mL	50 mL	2/16/11	10_Days - R	2	
16	480-1569-F-4 (7470A)	N/A	Filtrate	30 mL	50 mL	2/16/11	10_Days - R	2	
17	480-1569-F-5 (7470A)	N/A	Filtrate	30 mL	50 mL	2/16/11	10_Days - R	2	
18	N/A	N/A				N/A	N/A	N/A	
19	N/A	N/A				N/A	N/A	N/A	
20	N/A	N/A				N/A	N/A	N/A	

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Attachment 2

Sample Water Digestion Batch Bench Sheet (Page 3 of 5)

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-5412
Method Code: 480-7470A_Prep-480

Analyst: Kacalski, Jason

Batch Open: 2/14/2011 9:25:00AM
Batch End: 2/14/2011 11:25:00AM

Batch Notes

Uncorrected Temperature	95.0
Oven, Bath or Block Temperature 1	95.0
Uncorrected Temperature 2	
Oven, Bath or Block Temperature 2	
Digestion Tube/Cup Lot #	1010192-0328
Hood ID or number	
Hot Block ID number	A
ID number of the thermometer	A-02-24-10
Temperature	
Lot # of Nitric Acid	-RT12894-
Lot # of hydrochloric acid	
Sulfuric Acid Lot Number	RT13092
Potassium Permanganate Lot Number	027468
Potassium Persulfate Lot Number	20419
Hydroxylamine Sulfate Lot Number	
Stannous Chloride Lot Number	039576
Hydroxylamine Hydrochloride Lot	039590
NaCL Lot #	
Repittetor Volume Check	
SOP Number	

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Attachment 2

Sample Water Digestion Batch Bench Sheet (Page 4of 5)

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-5412
Method Code: 480-7470A_Prep-480

Analyst: Kacalski, Jason

Batch Open: 2/14/2011 9:25:00AM
Batch End: 2/14/2011 11:25:00AM

Reagent Additions Worksheet

Lab ID	Reagent Code	Amount Added	Final Amount	By	Witness
LCS 480-4850/18-A	MEH_HG2_WKG_00002	2.0 mL	50 mL		
480-1514-D-1 MS	MEH_HG2_WKG_00002	2.0 mL	50 mL		
480-1514-D-1 MSD	MEH_HG2_WKG_00002	2.0 mL	50 mL		

Other Reagents:

Reagent	Amount/Units	Lot#:

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Attachment 3

Sample Soil Digestion Batch Bench Sheet (Page 1 of 4)

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-5415 Analyst: Kacalski, Jason Batch Open: 2/14/2011 10:30:00AM

Method Code: 480-7471A_Prep-480 Batch End: 2/14/2011 11:00:00AM

Preparation, Mercury

	Input Sample Lab ID (Analytical Method)	SDG	Matrix	Initial Amount	Final Amount	Due Date	Analytical TAT	Div Rank	Comments	Output Sample Lab ID
1	MB-480-5415/1 N/A	N/A		+0.6250 g	50 mL	N/A	N/A	N/A		
2	LCSSRM-480-5415/2 N/A	N/A		+0.0677 g	50 mL	N/A	N/A	N/A		
3	480-1409-B-5 (7471A)	1342	Solid	+0.6609 g	50 mL	2/11/11	8_Days - R	4		
4	480-1553-C-1 (7471A)	N/A	Solid	+0.6374 g	50 mL	2/16/11	8_Days - R	2		
5	480-1553-C-1~SD (7471A)	N/A	Soli					2		
6	480-1553-C-1~MS (7471A)	N/A	Soli					2		
7	480-1553-C-1~MSD (7471A)	N/A	Solid	+0.6230 g	50 mL	2/16/11	8_Days - R	2		
8	480-1553-B-2 (7471A)	N/A	Solid	+0.6139 g	50 mL	2/16/11	8_Days - R	2		
9	N/A	N/A				N/A	N/A	N/A		
10	N/A	N/A				N/A	N/A	N/A		

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Attachment 3

Sample Soil Digestion Batch Bench Sheet (Page 2 of 4)

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-5415 Analyst: Kacalski, Jason Batch Open: 2/14/2011 10:30:00AM

Method Code: 480-7471A_Prep-480 Batch End: 2/14/2011 11:00:00AM

Batch Notes

Acid used for pH adjustment	
Perform Calculation (0=No, 1=Yes)	
Nominal Amount Used	
SOP Number	
Digestion Tube/Cup Lot #	1010192-0328
Hot Block ID number	B
Hood ID or number	
Balance ID	25850472
Blank Soil Lot Number	RT05542
Lot # of Nitric Acid	-RT12894-
ID number of the thermometer	A-02-24-10
Lot # of hydrochloric acid	026990
Potassium Permanganate Lot Number	027468
Sulfuric Acid Lot Number	
Hydroxylamine Sulfate Lot Number	
Potassium Persulfate Lot Number	
Stannous Chloride Lot Number	039576
Uncorrected Temperature	95.0
Oven, Bath or Block Temperature 1	95.0
Uncorrected Temperature 2	

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Attachment 3

Sample Soil Digestion Batch Bench Sheet (Page 3 of 4)

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-5415 Analyst: Kacalski, Jason Batch Open: 2/14/2011 10:30:00AM

Method Code: 480-7471A_Prep-480 Batch End: 2/14/2011 11:00:00AM

Oven, Bath or Block Temperature 2	
NaCL Lot #	
Repittetor Volume Check	
Aqua Regia Lot Number	
Hydroxylamine Hydrochloride Lot	039590
Batch Comment	Eppie: HGL-5

Comments

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Attachment 3

Sample Soil Digestion Batch Bench Sheet (Page 4 of 4)

Metals/Inorganics Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 480-5415
Method Code: 480-7471A_Prep-480

Analyst: Kacalski, Jason

Batch Open: 2/14/2011 10:30:00AM
Batch End: 2/14/2011 11:00:00AM

Reagent Additions Worksheet

Lab ID	Reagent Code	Amount Added	Final Amount	By	Witness
LCSSRM 480-5415/2	MED_SRM_D066_00001	0.0677 g	50 mL		
480-1553-C-1 MS	MEH_HG2_WKG_00002	2.0 mL	50 mL		
480-1553-C-1 MSD	MEH_HG2_WKG_00002	2.0 mL	50 mL		

Other Reagents:

Reagent	Amount/Units	Lot#:

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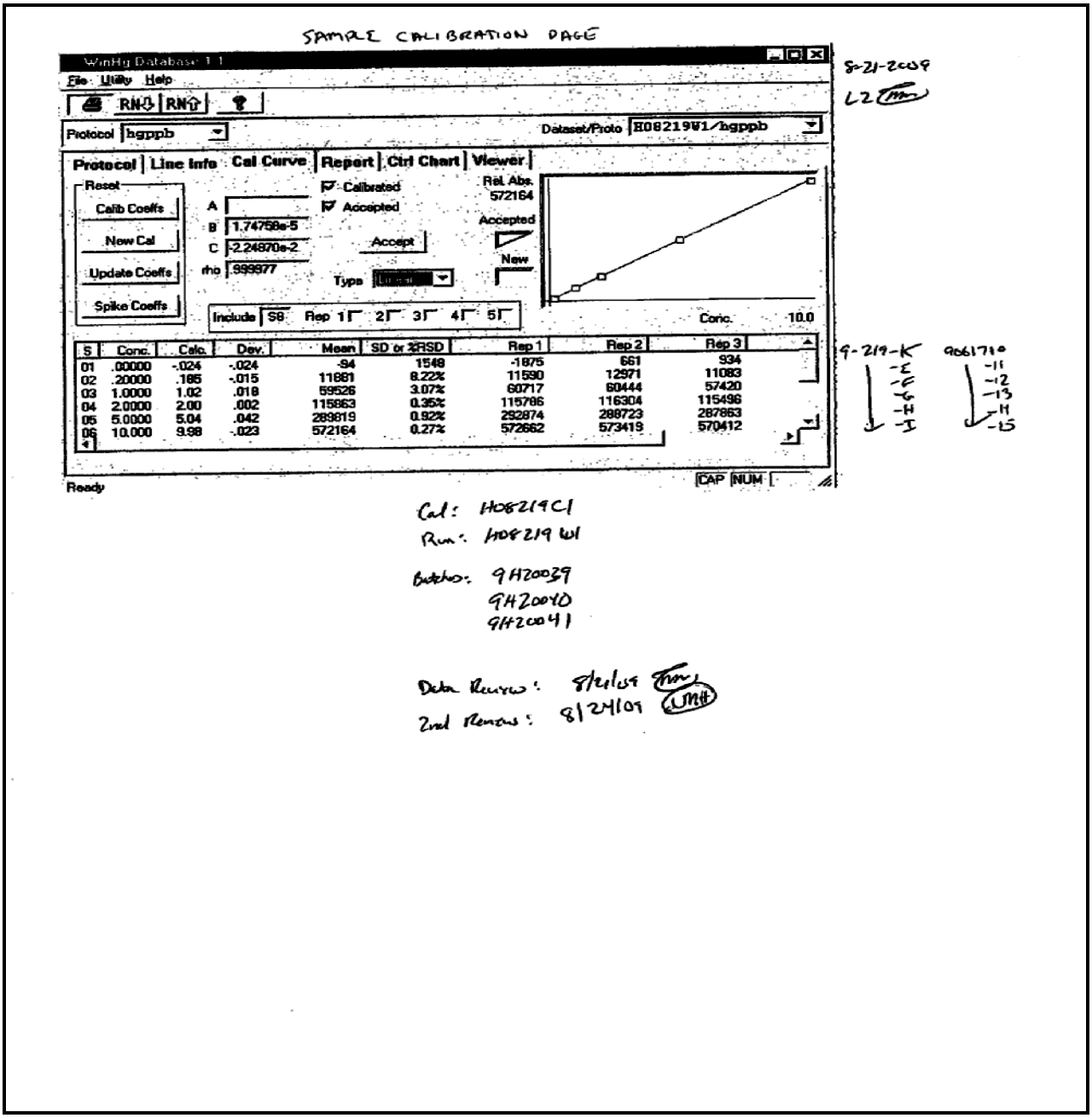
Attachment 4

Example Instrument Calibration Page



Title: Analytical Methods for the Analysis of GC/MS Volatiles

[SW-846 Method 8260C]

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):

Leah Hill 3/1/19
Leah Hill Date
Department Manager

Kenneth Kasperek 3/1/19
Kenneth Kasperek Date
Laboratory Director

3/1/19
Michael Mosscrop Date
Quality Assurance Manager

Facility Distribution No. _____ **Distributed To:_____**

1.0 Scope and Application

This SOP contains the procedures for the determination of volatile organic compounds (VOC) by gas chromatography/mass spectrometry (GC/MS).

Technical acceptance criteria and corrective actions for MCP and RCP analysis are also included in this SOP.

The routine matrices performed by this procedure are waters and soils. Other matrices which may be performed include wipes, leachates, and wastes.

A complete target analyte list, the reporting limits (RL), the method detection limits (MDL), and the accuracy and precision criteria associated with this procedure are provided in the LIMS Method Limit Groups (MLGs).

2.0 Summary of Method

Volatile compounds are extracted from sample matrix by the purge and trap method. Qualitative identification of the target compounds is based on the retention time and the relative abundance of the characteristic masses as compared to component reference spectra determined from standards analyzed on the same GC/MS under the same conditions. Quantitative analysis of the target compounds is performed by the internal standard technique using a single characteristic ion.

3.0 Definitions

MCP – Massachusetts Contingency Plan
RCP – Connecticut Reasonable Confidence Protocols
Additional definitions can be found in the TAL Buffalo Laboratory Quality Manual (QAM)

4.0 Interferences

Some of the possible interferences that arise during GCMS Volatile analysis include, but are not limited to:

1. Glassware contamination
2. Matrix interference
3. System air leaks
4. Injection port/liner contamination
5. Warped filament, and/or dirty source

Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Determine if the source of interference is in the preparation and/or cleanup of the samples and take corrective action to eliminate the problem.

All non-disposable labware must be scrupulously cleaned in accordance with TestAmerica Buffalo SOP BF-GP-003, current revision, to ensure it is free from contaminants and does not contribute artifacts.

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 needs to 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.
- The following analytes covered under this SOP have been tentatively classified as known or suspected human or mammalian carcinogens:
  - Benzene
  - Carbon tetrachloride
  - Chloroform
  - Vinyl chloride
- Exposure to chemicals must be maintained as low as reasonable achievable; therefore, unless they are known to be non-hazardous, all samples should be opened, transferred and prepared in a fume hood, or under other means of mechanical ventilation. Solvent and waste containers should be kept closed unless transfers are being made.
- Analysts are expected to use caution and common sense while working in a laboratory environment. Each employee is required to read the company's Corporate Safety Manual. All of the samples to be analyzed have the potential to contain hazardous substances. Most standards also contain hazardous chemicals and many do contain known carcinogens. Employees must use protective equipment when handling standards, samples and extracts including gloves, lab coats and safety glasses.
- It is the analyst's responsibility to read and familiarize themselves with the Safety Data Sheets (SDS) of each chemical and/or reagent involved in this method.
- Samples, standards and/or extracts should never be opened or transferred outside of a fume hood.
- Spills should be cleaned up promptly and waste should be disposed of as per the Chemical Hygiene Plan.

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 Safety data Sheets (SDS) 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 SDS for each material before using it for the first time or when there are major changes to the SDS.

Material	Hazards	Exposure Limit (1)	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.
1 – Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Micro syringes 5, 10, 25, 50, 100, 500, 1000 microliter.

6.2 Vials and caps -20mL disposable, 40mL disposable

6.3 pH paper - wide range - Baxter Diagnostics Inc.

6.4 Analytical Balance Mettler - Toledo Inc. Mettler AE160

6.5 Volumetric flasks.

6.6 Instrumentation
Gas Chromatograph/Mass Spectrometer (GC/MS) System

6.6.1 Gas Chromatograph -
- Hewlett Packard 6890/7890
- Carrier gas Helium UPC grade or equivalent

6.6.2 Gas Chromatography Column
- Zebron ZB-624
- Internal diameter: 0.53mm, 0.25mm, 0.18mm
- Coating: Cyanopropylphenyl Methyl Silicone
- Film thickness: 3.0,um 1.4um, 1.0um

6.6.3 Mass Spectrometer
- HP5973, HP5975 and HP5977
- Tuning compound PFTBA
- Scan Range 35-350 AMU

6.6.4 Autosampler
- Archon
- OI Model 4551

6.6.5 Purge and trap device
- OI Eclipse Concentrator 4660
- Trap Packing
    - #10 Trap
        - -Tenax
        - -Silica Gel
        - - CMS

6.6.6 Data System
- HP Chemstation
- Chrom chromatography analysis system
- TALS data analysis system

7.0 Reagents and Standards

7.1 Purge and Trap grade Methanol

7.2 Stock Standards

7.2.1 Corporate approved Primary and Second Source Restek mixtures:

8260 List1/Std #1	8260 List1/Std #5	8260 List2/Std #5
8260 List1/Std #2	8260 List1/Std #6	8260 List2/Std #6
8260 List1/Std #3	8260 List2/Std #3	8260 List2/Std #7
8260 List1/Std #4	8260 List2/Std #4	8260 List3/Std #1
Buff ADD 2A	Buff ADD 2B	

7.2.2 Equivalent vendor mixtures:

p-BFB (Supelco)
3MCP (Absolute)
2-Methylthiophene (Absolute)
3-Methylthiophene (Absolute)

All Certificates of Analysis received from the manufacturer are maintained in the laboratory's TALS data system.

Volatile free water for making sample dilutions, standards, and volatile blanks.

7.3 Working Standards

7.3.1 Surrogate Standard Spiking Solution

Surrogate Standard spiking solution contains 1,2-Dichloroethane-d4, 4-Bromofluorobenzene, Dibromofluoromethane and Toluene-d8 at a concentration of 125ug/mL for 8260C waters

and Medium Level soil and at a concentration of 250ug/mL for 8260C Low Level soil. Surrogate standards are added to all QC and client samples.

8260C Water and Medium Level soil

8260 Working Surrogate Standard Mix	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
4 Comp Surrogate (SURR_STK)	Methanol	2500	1000	20	125

8260C Low Level soil

8260 Working Surrogate Standard Mix	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
4 Comp Surrogate (SURR_STK)	Methanol	2500	500	5	250

7.3.2 Internal Standard Solution

Internal Standard solution contains 1,4-Dichlorobenzene-d4, Chlorobenzene-d5 and Flurorbenzene.

8260C Water and Medium Level soil

8260 Working Internal Standard Mix	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
Corp IS Stock (IS_STK)	Methanol	2500	1000	20	125

8260C Low Level soil

8260 Working Internal Standard Mix	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
Corp IS Stock (IS_STK)	Methanol	2500	500	5	250

7.3.3 Instrument Performance Check Solution (BFB)

A solution of Bromofluorobenzene (BFB) is prepared at a concentration of 50ug/mL.

BFB_WRK	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
MV_BFB_STK	Methanol	25000	20	10	50

7.3.4 Initial and Continuing Calibration Solutions

Calibration standards are prepared at a minimum of six concentration levels from a working intermediate mix. For the main list of compounds, List 1, each calibration standard shall contain each compound of interest and each surrogate. A seventh and eighth level may be added.

8260 Working Intermediate Standards List 1

8260 Corp mix (8260 CORP mix)	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
2-CEVE	MeOH	2500	800	20	100
Acrolein Mix	MeOH	20000	500	20	500
Ketones	MeOH	12500	800	20	500
MegaMix	MeOH	2500	800	20	100
Vinyl Acetate	MeOH	5000	800	20	200

8260 Working Intermediate Standards List 1

Gas Mix (GAS CORP mix)	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
8260/624-Gas	MeOH	2500	800	20	100

8260 Calibration Levels List 1- Water and Medium Level soil

Calibration Level	Reagents Added	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/L)
0.5	8260 Corp	0.5		
	Gas Corp	0.5	100	0.5
1	8260 Corp	1		
	Gas Corp	1	100	1
5	8260 Corp	5		
	Gas Corp	5	100	5
10	8260 Corp	5		
	Gas Corp	5	50	10
25	8260 Corp	12.5		
	Gas Corp	12.5	50	25
50	8260 Corp	25		
	Gas Corp	25	50	50
100	8260 Corp	50		
	Gas Corp	50	50	100

8260 Calibration Levels List 1- Low Level soil

Calibration Level	**Reagents Added**	**Initial Vol. (uL)**	**Final Vol. (mL)**	**Final Conc. (ug/L)**
2.5	8260 Corp	2.5		
	Gas Corp	2.5	100	2.5
5	8260 Corp	5		
	Gas Corp	5	100	5
10	8260 Corp	10		
	Gas Corp	10	100	10
20	8260 Corp	10		
	Gas Corp	10	50	20
50	8260 Corp	25		
	Gas Corp	25	50	50
100	8260 Corp	50		
	Gas Corp	50	50	100
200	8260 Corp	100		
	Gas Corp	100	50	200

Additional calibration standards may be analyzed to include compounds not in the main list (List 1). Surrogate analytes are not added to additional calibration mixes and are only calibrated from List 1. Additional routine calibrations are List2.

8260 Working Intermediate Standards List 2

ADD Corp mix (ADD CORP mix)	Solvent	Stock Conc. (µg/ml)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
1,4-Difluorob	MeOH	2500	800	20	100
ADD STD 4	MeOH	2500	800	20	100
ADD STD 5	MeOH	2500	800	20	100
ADD STD 6	MeOH	2500-62500	800	20	100-2500
ADD STD 7	MeOH	2500-5000	800	20	100-200
Badd-2A	MeOH	2000-10000	1000	20	100-500
Badd-2B	MeOH	10000-20000	1000	20	500-1000
Cyclohexanone	MeOH	25000	800	20	1000
Ethanol	MeOH	100000	800	20	4000
Polar Adds	MeOH	2500-25000	800	20	100-1000

8260 Working Intermediate Standards List 2

2-Methylthiophene (2-MTP_WK)	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
2-Methylthiophene	MeOH	1000	1000	10	100

8260 Working Intermediate Standards List 2

3-Methylthiophene (3-MTP_WK)	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
3-Methylthiophene	MeOH	1000	1000	10	100

8260 Working Intermediate Standards List 2

3 MCP (3_MCP_Add_WK)	Solvent	Stock Conc. (ug/mL)	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/mL)
3 MCP	MeOH	100	1000	1	100

8260 Calibration Levels List 2- Water and Medium Level soil

Calibration Level	Reagents Added	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/L)
0.5	Add Corp	0.5	100	0.5
	2-MTP	0.5		
	3-MTP	0.5		
	3 MCP	0.5		
1	Add Corp	1	100	1
	2-MTP	1		
	3-MTP	1		
	3 MCP	1		
5	Add Corp	5	100	5
	2-MTP	5		
	3-MTP	5		
	3 MCP	5		
10	Add Corp	5	50	10
	2-MTP	5		
	3-MTP	5		
	3 MCP	5		
25	Add Corp	12.5	50	25
	2-MTP	12.5		
	3-MTP	12.5		
	3 MCP	12.5		
50	Add Corp	25	50	50
	2-MTP	25		
	3-MTP	25		
	3 MCP	25		
100	Add Corp	50	50	100
	2-MTP	50		
	3-MTP	50		
	3 MCP	50		

8260 Calibration Levels List 2- Low Level soil

Calibration Level	Reagents Added	Initial Vol. (uL)	Final Vol. (mL)	Final Conc. (ug/L)
2.5	Add Corp	2.5	100	2.5
	2-MTP	2.5		
	3-MTP	2.5		
	3 MCP	2.5		
5	Add Corp	5	100	5
	2-MTP	5		
	3-MTP	5		
	3 MCP	5		
10	Add Corp	10	100	10
	2-MTP	10		
	3-MTP	10		
	3 MCP	10		
20	Add Corp	10	50	20
	2-MTP	10		
	3-MTP	10		
	3 MCP	10		
50	Add Corp	25	50	50
	2-MTP	25		
	3-MTP	25		
	3 MCP	25		
100	Add Corp	50	50	100
	2-MTP	50		
	3-MTP	50		
	3 MCP	50		
200	Add Corp	100	50	200
	2-MTP	100		
	3-MTP	100		
	3 MCP	100		

7.4 Storage of Standards

Stock, intermediates and working standards are stored at 4ºC ± 2ºC or less in Teflon-lined crimp-cap amber bottles or vials. Standards are stored separately from sample extracts.

Preparation of standards is done in accordance with the TestAmerica Buffalo SOP BF-GP-019. Working calibration standards are prepared every two months or sooner, if the expiration date of any parent precedes. Gas mix is made weekly.

8.0 Sample Collection, Preservation, Shipment and Storage

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[1]	Reference
Waters	Glass	40 mLs	HCL, pH < 2; Cool 4 ± 2°C	14 Days	40 CFR Part 136.3
Waters	Glass	40 mLs	Cool 4 ± 2°C	7 Days	40 CFR Part 136.3

[1] Inclusive of preparation and analysis.

- Sample holding time is 14 days from sample date when samples are collected in 40 ml vials and preserved 1:1 HCl to pH<2.
- If the samples are unpreserved, the expiration is shortened to 7 days or 3 days from sample date (determined by requested analytes. It may be necessary to consult specific Protocol, QAPP, or method modifications specified by the client for additional requirements.

9.0 Quality Control

9.1 Sample QC - The following quality control samples are prepared with each batch of samples.

Quality Controls	Frequency	Control Limit
Method Blank (MB)	1 in 20 or fewer samples	<ReportingLimit (RL)
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] Limits of analytes not method assigned are derived from statistical data. Statistical control limits are updated annually and are entered into TALs

9.1.1 Method Blanks

A method blank is a volume of a clean reference matrix (reagent water). The purpose of a method blank is to determine the levels of contamination associated with the processing and analysis of samples.

A method blank must be prepared for each analytical batch.

9.1.1.1 Preparation of the Method Blank

A method blank is prepared by filling a vial with Volatile Free water.

9.1.1.2 Technical Acceptance Criteria for Method Blank Analysis

All technical acceptance criteria for retention time, surrogate and IS recovery must be met for blank analysis. In addition, the following acceptance criterion applies.

For all target analytes, the method blank must contain less than the reporting limit (RL) of any single target compound.

If any single target compound is detected in the method blank with a concentration above the RL, samples that contain detections below the RL or samples containing detections that are 10X greater than the detection found in the blank will be flagged, noted in the job narrative and reported. Final concentrations in the LIMS system are to be utilized when making this determination.

Unless specified by the project, the Method Blank is determined and reported down to the method detection limit (MDL). If a detection exists between the method detection limit and reporting limit (RL), a J-flag is applied to the result. Corrective action is not taken for J-flag detections.

9.1.1.3 Corrective Actions for Method Blank Analyses

If the acceptance criteria for method blank analysis are not met, the analytical system may be assumed to be out of control.

Any contamination in the method must be investigated. Samples associated with the contaminated blank must be reanalyzed.

If surrogate recoveries in the method blank do not meet the acceptance criteria, first reanalyze the method blank. If the surrogate recoveries do not meet the acceptance criteria after reanalysis, instrument maintenance is required OR the samples may be reported as estimated, and noted in the case narrative.

If the method blank does not meet internal standard response requirements, check calculations, the internal standard spiking solutions, and the instrument operation. If the calculations were incorrect, correct the calculations and verify that the internal standard responses meet their acceptance criteria. If the internal standard compound spiking solution was improperly prepared, concentrated, or degraded, re-prepare solutions and

reanalyze samples. If the instrument malfunctioned, correct the instrument problem and reanalyze the method blank. If the instrument malfunction affected the calibration, recalibrate the instrument before reanalyzing the blank.

9.1.2 Laboratory Control Sample/Matrix Spike/Matrix Spike Duplicate (LCS/MS/MSD)

A Laboratory Control Sample (LCS), matrix spike (MS) and matrix spike duplicate (MSD) are analyzed to evaluate the analytical system and the effects of sample matrix.

A LCS, matrix spike and matrix spike duplicate are analyzed for every batch of 20 samples of a similar matrix. Matrix spike and matrix spike duplicates are not performed for field QC samples such as rinsates or field/trip blanks.

If insufficient sample volume is received to perform matrix spike and matrix spike duplicate analysis, a Laboratory Control Sample Duplicate (LCSD) may be analyzed.

9.1.2.1 Preparation of LCS/MS/MSD Samples

LCS preparation:

Water analysis: 50mL of reagent water is spiked with 12.5uL of 8260 Corp mix and Gas Corp mix. Pour into 40mL vial.
Low Level soil analysis: 50mL of reagent water is spiked with 25uL of 8260 Corp mix and Gas Corp mix. Pour 5mLs into a 40mL vial.
Medium Level soil analysis: 50mL of reagent water is spiked with 125uL of 8260 Corp mix and Gas Corp mix. Take 1mL of this spike into 50mLs reagent water. Pour into 40mL vial.

MS/MSD preparation:

Water analysis: 50mL of sample is spiked with 12.5uL of 8260 Corp mix and Gas Corp mix.
Low Level soil analysis: 5g of sample is spiked with 2.5uL of 8260 Corp mix and Gas Corp mix.
Medium Level soil analysis: 10mL of sample is spiked with 125uL of 8260 Corp mix and Gas Corp mix.

For non-diluted samples the spike amount should be adjusted based on the sample volume. Standard procedure for undiluted samples is to assume a 44mL final volume. 11uL of 8260 Corp mix and Gas Corp mix are added to 44mL.

9.1.2.2 Technical Acceptance Criteria for LCS

The acceptance criteria for retention time, surrogate and IS recovery must be met for the LCS analysis. Any failures in the LCS are flagged automatically in the laboratories TALS LIMS system.

The Laboratory Control Sample recovery and RPD limits for 8260C are based on historical data and are updated annually.

Analytes that have been identified as a Poor Performing Compounds (Table 5) will be

considered compliant as long as their percent recovery exceeds 10%.

Recovery limits for MCP and RCP are 70-130%.

MCP RPD limits are ≤20%.

RCP RPD limits are ≤30%.

MCP allows the following “difficult” analytes to be outside of criteria, provided the recovery is within 40-160%: Acetone, Methyl ethyl ketone (2-Butanone), 4-Methyl-2-pentanone,2-Hexanone, Dichlorodifluoromethane, Bromomethane, Chloromethane and 1,4-Dioxane.

For MCP, ≤10% of the target analytes may be outside acceptance limits, provided the recovery is ≥10%.

For RCP, ≤10% of the target analytes may be outside acceptance limits, provided the recovery is 40-160%.

Any single target compound that recovers above the upper control limit for is to be considered high bias in all samples associated to that LCS (and/or LCSD). If the detection of that analyte in associated samples is either not detected or detected at a concentration below the reporting limit (RL), the deficiency will be noted in the job narrative and the sample(s) will be reported.

If a surrogate exceeds the upper control limit, associated samples may be reported if all target compounds are not detected or detected at a concentration below the reporting limit (RL). The deficiency will be noted in the job narrative and the sample(s) will be reported.

9.1.2.3 Technical Acceptance Criteria for MS/MSD

The acceptance criteria for retention time and IS recovery must be met for matrix spike and matrix spike duplicate analysis.

The matrix spike recovery limits are advisory. If the recovery limits are not met, no further corrective action will be necessary. However, frequent occurrences of this nature should be investigated.

Re-analysis of the matrix spike and matrix spike duplicate may be necessary if, in the technical judgment of the analyst and/or supervisors, an error was made during the preparation of the matrix spike and matrix spike duplicate.

Exceedances of 150% or less than 10% and/or RPD of >50% should be narrated for potential matrix interference, especially when an associated LCS meets acceptance criteria.

9.1.2.4 Corrective Actions for Laboratory Control Sample Analysis

If the acceptance criteria for the laboratory control sample/laboratory control sample duplicate analysis are not met, the analytical system may be assumed to be out of control. The following corrective actions may be taken.

If the recovery of any target analyte is above the upper control limit, all associated samples with positive detections of the analyte greater than the reporting limit must be re-analyzed. Associated samples without positive detections, or detections below the reporting limit do not require reanalysis.

If the recovery of any target analyte is below the lower control limit, re-analyze the laboratory control sample and/or laboratory control sample duplicate to ensure an issue with the injection did not occur. If the LCS/LCSD fails in the reanalysis, all samples associated to the LCS/LCSD that require the non-compliant compound must be re-analyzed.

If surrogate recoveries in the LCS/LCSD do not meet the acceptance criteria, first reanalyze the LCS/LCSD. If the surrogate recoveries do not meet the acceptance criteria after re-analysis, instrument maintenance is required OR the samples may be reported as estimated, and noted in the job narrative.

If the LCS/LCSD does not meet internal standard response requirements, check the calculations, the internal standard spiking solutions, and the instrument operation. If the calculations were incorrect, correct the calculations and verify that the internal standard responses meet their acceptance criteria. If the internal standard spiking solution was improperly prepared, concentrated, or degraded, re-prepare solutions and re-analyze the LCS and associated samples. If the instrument malfunctions affected the calibration, recalibrate the instrument before reanalyzing the LCS.

An exception to corrective action for LCSD-only failures may be allowed on a case by case basis, depending on client requirements.

9.2 Surrogate Recoveries

Surrogates are added to the QC and samples at the instrument level.

9.2.1 Technical Acceptance Criteria for Surrogate Recovery

Surrogate recovery limits for 8260C are based on historical data. All limits are entered into TALS. Historical limits are evaluated and updated annually.

One or multiple surrogates may recover above the upper control limits as long as sample detections are below the reporting limit.

Surrogates failing to meet acceptance criteria related to significant and obvious matrix interference may be reported, or a dilution may be performed to reduce the amount of interference.

Any surrogate recovery outside the acceptance limits will be qualified and noted in the job narrative.

9.2.2 Corrective Actions for Surrogate Recovery

Calculations, injection volumes and preparation volumes should be checked to ensure an error was not made. If all calculations, volumes, etc., were correct the analyst will proceed to the next step in the corrective action process.

The sample is re-analyzed to verify an error was not made during the original analysis. If after re-analysis surrogate recoveries are outside of the acceptance criteria, the analyst will proceed to the next step in the corrective action process.

If after re-analysis the surrogate recoveries are within criteria limits, this analysis will be reported. If the re-analysis is outside holding time and surrogate recoveries are within acceptance limits, both sets of data shall be reported. If after re-analysis surrogate recoveries are not within criteria limits, a matrix effect may be assumed. If this should occur, the original or re-analysis may be reported. The instance will be documented in the job narrative.

9.3 Internal Standard Recoveries

Internal standards are added to all initial calibration standards, initial calibrations verification (ICV) and continuing calibration verification (CCV) standards, batch QC (MB/LCS/MS/MSD) and client samples. For the ICV and CCV, the internal standard responses are compared to the mid-level calibration standard. For batch QC and samples, internal standards are compared to the daily CCV.

9.3.1 Technical Acceptance Criteria for Internal Standard Recoveries

Internal standard recovery for instrument QC must be within 50-200% of the mid-range calibration level.

Internal standard recovery for batch QC and samples must be within 50-200% of the daily continuing calibration verification (CCV).

Retention time shifts for each Internal Standard must be within ±0.5min between the continuing calibration verification and the mid-level standard of the most recent initial calibration.

Retention time shifts for each Internal Standard must be within ±0.5min between the sample and the most recent continuing calibration verification.

9.3.2 Corrective Actions for Internal Standard Recoveries

Calculations, internal standard solution volumes and injected volumes are checked to ensure that an error was not made. If all calculations and volumes are correct the analyst will proceed to the next step in the corrective action process.

The samples is re-analyzed to ensure that the instrument was working properly. If after re-analysis, the internal standard recoveries are within criteria limits, the second analysis will be reported. If after re-analysis the internal standard recoveries are outside of criteria limits, the following steps will be taken:

If an instrument QC standard fails internal standard recover, the electron multiplier (EM) voltage can be adjusted accordingly and the BFB and standards must be re-analyzed. Failure again and the reagent will be re-prepared and re-analyzed. Repeat IS failures require initial calibration and/or instrument maintenance.

If a client sample fails internal standard recovery, the sample will be re-analyzed. Exception: If internal standard recoveries of a sample, MS/MSD agree (i.e., recoveries are outside of criteria limits for all three samples), it may be assumed that a matrix effect is involved and no corrective action is necessary. The instance will be documented in the job narrative.

10.0 Procedure

10.1 Instrument Performance Check

The GC/MS system is tuned using Perfluorotributylamine (PFTBA) such that an injection of 50ng of BFB will meet the abundance criteria listed in Table 2.

Prior to the analysis of standards or samples, the mass calibration and resolution of the GC/MS system is verified by the analysis of BFB. This analysis will verify the proper tuning of the system for 12 hours. After 12 hours, the instrument performance must be verified before standard and sample analysis may continue.

The average of the apex of the BFB peak, the scan before and the scan after the peak is used to assess ion abundances. If the criteria is not met, a single scan of the apex may be evaluated. This is performed automatically in the Chrom system.

The mass spectrum of BFB may be background subtracted to eliminate column bleed or instrument background ions. The background spectrum is selected as one scan before the start of the BFB peak.

All subsequent standards and samples must be acquired under the same GC/MS tuning conditions that were used for the analysis of the instrument performance check solution.

10.1.1 Technical Acceptance Criteria for the GC/MS Instrument Performance Check

BFB criteria is listed in Table 2

10.1.2 Corrective Actions for the GC/MS Instrument Performance Check

If any of the technical acceptance criteria are not met, the BFB should be re-injected to insure that the injection made was not a cause for failure. If, after re-injection, acceptance criteria have not been met, one or more of the following corrective actions may be taken:

1. Replace the septum in the injector
2. Replace the injector liner
3. Cut the column at the injector end
4. Re-prepare the BFB working standard and re-analyze
5. Clean injection port with MeOH

6. Change injection port seal
7. Retune the GC/MS
8. Replace the column
9. Clean the source; replace parts, etc.
10. An instrument service call may be placed.

10.2 Initial Calibration

After the instrument performance check criteria has been met and prior to the analysis of samples, the GC/MS system is calibrated with a minimum of five concentration levels in order to establish instrument sensitivity and linearity.

The initial calibration should be performed when major instrument maintenance has been performed or if continuing calibration criteria cannot be met.

Major instrument maintenance may consist of source cleaning, column changing, re-tuning of the MS, injection port replacement or quadrupole rod adjustment. Preventative maintenance such as septum changes, injector liner changes or column cutting may not require an initial calibration to be performed.

10.2.1 Procedure for Initial Calibration

Calibration standards for common target volatile compounds are prepared to contain all target, Internal Standard and surrogate compounds. Additional calibration mixes may be prepared that contains an extra list of target compounds and internal standards only. Refer to Section 7.3.4 for preparation of calibration mixes, Section 7.3.1 for preparation of Surrogate working mix and Section 7.3.2 for preparation of Internal Standard working mix.

10.2.2 Technical Acceptance Criteria for Initial Calibration

The relative standard deviation (%RSD) should be ≤20% for each target analyte and surrogate compound for 8260C. The relative standard deviation (%RSD) should be ≤15% for each target analyte and surrogate compound for MCP and RCP. If relative standard deviation is greater than 20% or 15%, a linear calibration fit may be used. The acceptance criterion for this is a correlation coefficient (r^2) value greater than or equal to 0.990.

Less than 10% of the calibrated compounds can fail to meet the above criteria for 8260C given the following conditions:

A standard with a concentration at or below the reporting limit for compounds failing to meet the RSD or correlation coefficient must be analyzed with each analytical sequence, preceding the analysis of samples. Acceptance criterion for this is detection only.

Any non-detection in sample analysis associated to compounds failing to meet RSD or correlation coefficient criteria may be reported without flagging, only with the successful detection of the analyte in the reporting limit standard.

Any detection associated to compounds failing to meet RSD or correlation coefficient criteria must be must be flagged as estimated. Every effort should be made to reanalyze the sample on an instrument with a passing calibration.

Less than 10% of the compounds for MCP can fail to meet the above criteria, as long as the %RSD <40%.

Less than 20% of the compounds for RCP can fail to meet the above criteria as long as the %RSD <30%.

The relative response factor (RRF) for the most common volatile compounds must be greater than or equal to the minimum response factors listed in Table 6.

If a compound fails to meet the minimum response factor defined in Table 6, a standard with a concentration at or below the reporting limit (RL) must be analyzed in each analytical batch, preceding sample analysis. Acceptance criterion for this is detection only.

Samples containing non-detections for these compounds may be reported without flagging only with a passing RL check.

Samples with positive detections must be flagged as estimated. Every effort should be made to reanalyze the sample on an instrument with passing minimum response factors in the initial calibration.

Identification of analytes in all calibration levels can be made only if there are at least 5-10 scans of the quantitation ion across the peak. All minor ions, where the expected abundance set from the mid-level standard is greater than 10%, must also be present.

Analytes fitted with a linear calibration model must have a readback concentration of 30% of the true value at the low level of the calibration, for 8260C, MCP and RCP. Any non-detection in samples associated to a compound that fails to meet this criterion in the calibration may be reported without flagging. Detections must be flagged as estimated and noted in the job narrative.

Internal Standard responses of each calibration level should be within 50-200% of the mid-level standard.

Relative retention times of Internal Standards, surrogates and compounds must be within ±0.06min of the RT set in the mid-level point of the calibration.

Additional Initial Calibration requirements are described in TestAmerica Buffalo SOP BF-GP-012 (current revision), beginning with Section 5.5: Initial Calibration Review

10.2.3 Corrective Actions for Initial Calibration

If any of the acceptance criteria for initial calibration are not met, it may be necessary to re-analyze one or more of the calibration standards. If after re-analysis the acceptance criteria have not been met, it may be necessary to take further corrective actions.

The following corrective actions may be taken if the acceptance criteria of initial calibration cannot be met.

1. Replace the septum on the injector
2. Replace the liner
3. Cut column at the injector end
4. Prepare fresh standards and re-analyze the initial calibration
5. Re-tune the GC/MS system and re-analyze the instrument performance check
6. Replace the analytical column
7. Clean the source
8. An instrument service call may be placed

The acceptance criteria must be met before sample analysis may proceed.

10.2.4 Initial Calibration Verification

To verify the accuracy of the initial calibration, a standard is obtained from a source difference from the calibration standards. Alternatively, if a different source is not available, a differing lot number of the standards used in the initial calibration may substitute as the second source.

Immediately following the analysis of an acceptable initial calibration curve, an aliquot of the second source standard with a concentration approximating the mid-point of the curve is injected.

An acceptable ICV must be achieved before sample analysis can begin.

10.2.5 Technical Acceptance Criteria for Initial Calibration Verification

Acceptance limits for the ICV for method 8260C are ±30%D or up to 50% for defined poor performing compounds (Table 5).

If any analyte recovery exceeds the upper control limit, data analysis may continue. Non-detections in sample analysis associated to a failing analyte may be reported without flagging. Any detection in sample analysis must be re-analyzed on an instrument with a passing initial calibration and initial calibration verification.

If any analyte recovery exceeds the lower control limit, the calibration is deemed to be out of control and corrective action must be taken prior to sample analysis.

Internal Standard retention times and responses are evaluated after acquisition of the initial calibration verification. If the retention time of any internal standard shifts by more than 30 seconds from that in the mid-point standard level of the initial calibration or the response of any internal standard is outside of the 50-200% range compared to the mid-point standard level of the initial calibration, the system shall be inspected and corrected as needed. The ICV will be re-analyzed after inspection. If the problem is not resolved, a new initial calibration must be performed.

10.2.6 Corrective Actions for Initial Calibration Verification

If the Technical Acceptance Criteria for Initial Calibration Verification is not met, the following corrective action steps should be taken.

Re-analyze the ICV to verify there was not an error made during the original analysis.

Perform instrument maintenance and re-calibrate.

Re-prepare initial calibration standards and re-calibrate.

Prepare the ICV and/or initial calibration reagents from different lots numbers to verify degradation hasn't occurred. Ensure that all ICV lot numbers are different from the initial calibration.

Re-order either initial calibrations or ICV reagents

10.2.7 Continuing Calibration Verification

The continuing calibration check must be analyzed once every 12 hour time period of operation. This check must be analyzed prior to the analysis of samples for a given 12 hour time period.

10.2.8 Procedure for Continuing Calibration Verification

A mid-level calibration standard is used for the continuing calibration verification (CCV).

8260C Waters and Medium Level soil analysis:
25ug/L standard containing 8260 Corp and Gas Corp is used for the continuing calibration verification (CCV) and a 25ug/L standard containing Add Corp, 2-MTP, 3-MTP and 3-MCP is used for the additional analyte continuing calibration verification (CCV).

8260C Low Level soil analysis:
50ug/L standard containing 8260 Corp and Gas Corp is used for the continuing calibration verification (CCV) and a 50ug/L standard containing Add Corp, 2-MTP, 3-MTP and 3-MCP is used for the additional analyte continuing calibration verification (CCV).

10.2.9 Acceptance Criteria for Continuing Calibration Verification

The relative response factor (RRF) for the most common volatile compounds must be greater than or equal to the minimum response factors listed in Table 6.

The percent difference or percent drift (%D) should be less than or equal to ±20% for all compounds, for 8260C, MCP and RCP.

For 8260C, up to 20% of the total compounds analyzed between CCVs in a batch are allowed to be outside of the ±20%D criterion. The total number allowed is based on the laboratory's main list of calibrated analytes. Additional analytes/CCVs may be analyzed and the total number may be adjusted accordingly.

For 8260C, if a compound fails to meet the %D criteria or minimum response factor criteria, a standard at or below the reporting limit must be analyzed following the CCV and prior to sample analysis. Acceptance criteria for this is detection only.

Any non-detection for analytes failing to meet the %D or minimum response factor criteria in samples and only with a passing reporting limit check may be reported with notation in the job narrative only.

Any detection for analytes failing to meet the %D or minimum response factor criteria in samples must be flagged as estimated. Every effort should be made to reanalyze the sample on an instrument with a passing CCV.

For MCP, 20% of the total compound list is allowed to exceed criteria, as long as the %D is <40%.

For RCP, 10% of the total compound list is allowed to exceed criteria, as long as the %D is <30%.

Internal Standard retention times and responses are evaluated after acquisition of the continuing calibration check. If the retention time of any internal standard shifts by more than 30 seconds from that in the mid-point standard level of the most recent initial calibration or the response of any internal standard is outside of the 50-200% range compared to the mid-point standard level of the most recent initial calibration, the system shall be inspected and corrected as needed. The CCV will be re-analyzed after inspection. If the problem is not resolved, a new initial calibration must be performed.

10.2.10 Corrective Actions for Continuing Calibration Verification

If any of the Technical Acceptance Criteria for continuing calibration verification are not met, it may be necessary to re-analyze the continuing calibration standard. If after re-analysis the acceptance criteria cannot be met, further corrective actions may be required.

The following corrective actions may be taken if the acceptance criteria for continuing calibration cannot be met.

1. Check purge flow
2. Replace the septum on the injector
3. Replace the injector liner
4. Cut column at the injector end
5. Re-tune the GC/MS system and re-analyze the instrument performance check
6. Prepare fresh standards
7. Re-analyze the initial calibration

11.0 Sample Analysis

11.1 Procedure

Sample shall be analyzed only after the GC/MS system has met the instrument performance check, initial calibration, second source calibration verification and continuing calibration

requirements. The same instrument conditions must be employed for the analysis of samples as were used for calibration.

8260C Water analysis:
12.5ul of target compound mixture is added to a 50ml
volumetric flask. Invert 3 times. A 5ml aliquot is analyzed. Internal standards and system monitoring compounds are added by the auto sampler prior to analysis.
The sample is transferred into a 40ml VOA vial.
The sample is then loaded onto the auto sampler where it is in turn transferred to the purge chamber.

The sample is purged for 11.0 minutes
Purge flow (high purity Helium) = 30-60 ml/min.
The analytes are desorbed from the trap (backflushed) to the GC for 1 minute at 250°C.
The trap is then baked for an additional 6-8 minutes at 260°C to remove any remaining analytes and prevent carryover into the next sample.
The baking process flushes these analytes out of a vent on the Purge & Trap concentrator.
The purge vessel is rinsed with volatile free water between samples to prevent carryover into the next sample.

8260C Low Level soil analysis:
25ul of target compound mixture is added to a 50ml volumetric
flask. Invert 3 times. Internal standards and system monitoring compounds are added by the auto sampler prior to analysis
A 5ml aliquot is transferred to a 40mL vial.
The sample is then loaded onto the auto sampler.

Reagent water is added to the soil/sediment sample and is heated to 40°C
The sample is purged for 11.0 minutes
Purge flow (high purity Helium) = 30-60 ml/min.
The analytes are desorbed from the trap (backflushed) to the GC for 1 minute at 250°C.
The trap is then baked for an additional 6-8 minutes at 260°C to remove any remaining analytes and prevent carryover into the next sample.
The baking process flushes these analytes out of a vent on the Purge & Trap concentrator.
The purge vessel is rinsed with volatile free water between samples to prevent carryover into the next sample.

8260C Medium Level soil analysis:
12.5ul of target compound mixture is added to a 50ml
volumetric flask. Invert 3 times. A 5ml aliquot is analyzed. Internal standards and system monitoring compounds are added by the auto sampler prior to analysis.
A pre-determined amount of the methanol extract is added to a 50ml
volumetric flask, brought to volume with reagent water and inverted 3 times.
The sample is transferred into a 40ml VOA vial.
The sample is then loaded onto the auto sampler where it is in turn transferred to the purge chamber.

The sample is purged for 11.0 minutes
Purge flow (high purity Helium) = 30-60 ml/min.
The analytes are desorbed from the trap (backflushed) to the GC for 1 minute at 250°C.

The trap is then baked for an additional 6-8 minutes at 260°C to remove any remaining analytes and prevent carryover into the next sample.
The baking process flushes these analytes out of a vent on the Purge & Trap concentrator.
The purge vessel is rinsed with volatile free water between samples to prevent carryover into the next sample.

An instrument blank is analyzed to condition the trap for at least 10minutes prior to the start of the clock daily.

After the 8260C Water sample aliquots are taken from the VOA vials, the pH of the sample is determined using wide range pH paper. The pH is recorded.

11.2 Dilutions

Dilutions of samples are required if any target compounds exceeds the initial calibration range.

The dilution chosen should keep the response of the largest target compound within the upper portion of the calibration range.

Analytes should be reported from the lowest dilution possible, where the peak area is within the calibration range. The higher diluted sample may report the analyte(s) previously over-range. Reporting requirements for multiple sample analyses are found in TestAmerica Buffalo SOP BF-QA-007, current revision.

Dilutions of samples may be performed due to the matrix of the sample. Any coating of the vial by the sample will be diluted appropriately to the level of viscosity or color observed. Dilutions may also be performed based off historical data and previous dilutions performed.

For routine dilutions, see Table 8 for volumes utilized in performing these dilutions

11.3 Qualitative Identification

11.3.1 Target Compounds

Target compound identification is done by comparing the sample mass spectrum to that of the standard. The following criteria must be satisfied in order to verify identifications.

Elution of the sample analyte within GC relative retention time (RRT) unit window established from the 12 hour BFB injection.

To establish correspondence of the GC relative retention time (RRT), the sample component RRT must compare within ±0.06 RRT units of the mid-level calibration.

Correspondence of the sample analyte and calibration standard component mass spectra.

To establish correspondence of the sample component mass spectra to that of the standard, the following criteria must be met:

All ions present in the standard mass spectrum at a relative intensity greater than 10.0 percent (most abundant ion in the spectrum equals 100 percent) must be present in the sample spectrum.

The relative intensities of ions specified in the paragraph above must agree within ±20 percent between the standard and sample spectrum. (Example: For an ion with an abundance of 50.0 percent in the standard spectrum, the corresponding sample ion abundance must be between 30.0 and 70.0 percent).

Ions greater than 10.0 percent in the sample spectrum but not present in the standard spectrum must be considered and accounted for by the analyst making the comparison. The verification process should favor false positives. All compounds meeting the identification criteria must be reported with their spectra. When target compounds are above the method detection limit (MDL) but are below the reporting limit (RL) but the spectrum meets the identification criteria, report the concentration with a “J”.

11.3.2 Non-Target Compounds

A library search may be executed for non-target sample components for the purpose of tentative identification. For this purpose, the NIST/EPA/NIH mass spectral library is used to identify non-target compounds of greatest apparent concentration by a forward search of the library. A background subtraction method may be employed to better match a peak’s spectrum to the library. TIC processing is performed only on client requested samples and the Method Blank (MB) associated to those samples.

11.3.3 Guidelines For Making Tentative Identifications

After samples have been process for Target compounds, any unidentified peak in a sample which has an area count of 10% of greater of the closest Internal Standard will be eligible for TIC identification.

A start and end retention time should be set to 0, which allows the entire chromatogram to be searched.

Note, if the solvent delay is not set appropriately during sample acquisition, the solvent may be collected. This should not be reported as a TIC.

Major ions in the reference spectrum (ions greater than 10 percent of the most abundant ion) should be present in the sample spectrum.

The relative intensities of the major ions should agree within ±20 percent. Molecular ions present in reference spectrum should be present in sample spectrum.

Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting compounds.

Ion present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination of co-eluting compounds.

Sample spectra are compared to the NIST/EPA>NIH library for tentative identification. A criterion of 85% or greater confidence is used in determining IDs.

These settings are entered into the data processing software (Chrom). For routine work, these settings perform the bulk of TIC identification. Manual review of all TIC matches are not part of the standard review, except in the following situations:

CO_2 should be removed as a TIC.

Internal Standard/surrogates not required by the client should be removed as a TIC.

Siloxanes should be reported as “Column Bleed”.

Multiple peaks may result in the same ID from the library. In this case, every effort should be made to identify the peak with the greatest confidence for that ID. The other shall be re-identified with the next ID listed or re-identified as unknown.

If, in the technical judgement of the mas spectral interpretation specialist, no tentative identification can be made, the compound will be reported as unknown. Further identification may be possible, such as molecular weights or classifications (i.e., unknown hydrocarbon, unknown acid, etc.).

Further information on TICs is documented in TestAmerica Corporate Quality Policy Memorandum No. CA-Q-QM-001.

11.3.4 Targeted TICs

Targeted Tentatively Identified Compounds may be requested and reported on occasion. Unlike TICs, Targeted TICs are searched and reported even if they are not detected.

These are included in the client requested compound list, but are not calibrated.

Identification is made using the NIST/EPA/NIH spectral library to compare all peaks in a chromatogram that are not identified as part of the client target analyte list.

An Internal Standard is pre-determined based on the proximity of a detected peak to the closest Internal Standard.

A match threshold of 50% is used for identification of the sample spectrum versus the reference spectrum assigned for that compound.

A response factor of 1 is assumed for quantitation.

Any detection of a Targeted TIC is flagged as estimated in the data system (TALS).

11.4 Quantitative Identification

11.4.1 Target Compounds

Target compounds identified shall be quantitated by the internal standard method.

In instances where manual integration is necessary due to co-elution, baseline noise or matrix interferences, all instances will be initialed and dated by the analyst. The quantitation report is documented as such by a “m” next to the compound that has been edited. In all instances of manual integration, a hardcopy of the EICP for that compound will be supplied with the raw data. This applies to all target compounds, internal standards and surrogate compounds. Manual Integrations are completed in accordance with TestAmerica Buffalo SOP BF-GP-013, current revision.

11.5 Technical Acceptance Criteria for Sample Analysis

The samples must be analyzed on a GC/MS system meeting the BFB, initial calibration and continuing calibration criteria.

The sample must be analyzed within specified holding times.

The sample must have an associated method blank meeting the technical acceptance criteria for a MB, defined in Section 9.1.1.2.

The sample must have an associated laboratory control sample meeting the technical acceptance criteria for a LCS, defined in Section 9.1.2.2.

A matrix spike/matrix spike duplicate should be prepared with samples. If insufficient volume for a MS/SD, a laboratory control sample duplicate must be analyzed and meet the technical acceptance criteria for a LCS, defined in Section 9.1.2.3.

All surrogates must meet the technical acceptance criteria for Surrogate Recoveries, defined in Section 9.2.1.

The relative retention time of each compound must be within ±0.06 RRT units of its relative retention time in the continuing calibration standard.

The instrumental response (EICP area) for each of the internal standards must meet the technical acceptance criteria for Internal Standard recoveries, defined in Section 9.3.1.

Excluding those ions in the solvent front, no ion may saturate the detector. No target compound concentration may exceed the upper limit of the initial calibration range unless a more dilute aliquot of the sample is also analyzed.

11.6 Corrective Actions for Sample Analysis

The technical acceptance criteria must be met before data are reported. If any of the criteria listed above are not met, either re-analyze the sample on an instrument meeting all technical criteria, refer to corrective actions defined throughout Sections 9.0 and 10.0, or re-analyze the sample.

Refer to TestAmerica Buffalo SOP BF-QA-007, current revision for reporting multiple sample analyses.

If the technical acceptance criteria for the relative retentions times of the internal standard, surrogate or target compounds are not met, the following corrective actions are taken in the given order:

Carrier gas, zone temperatures and instrument temperature programs are checked to ensure that an error was not made or that the gas tank was not dry or clogged. If no errors are found, the analyst will proceed to the next step in the corrective action process.

The sample is re-analyzed to ensure that an error was not made during the first injection. If, after re-analysis, the relative retention times are not within the technical acceptance criteria, it may be assumed that a matrix effect was involved. Both analyses will be reported and the instance will be documented in the job narrative. If, after re-analysis, the relative retention times are within the technical acceptance criteria, the second analysis will be reported only.

Exception: If the relative retention times of a sample, MS/MSD agree (i.e., relative retention times are outside of criteria limits for the sample, MS and MSD), it may be assumed that a matrix effect was involved and further corrective action is not necessary.

11.7 Calculations

11.7.1 Calculations For MS/MSD Samples

The percent recovery of the matrix spiking compounds is determined using equation:

$$\text{Matrix Spike Recovery} = \frac{SSR - SR}{SA} \times 100$$

Where: SSR = Spiked sample result
SR = Sample results
SA = Spike added

The relative percent difference (RPD) of the recoveries of each compound between the matrix spike and matrix spike duplicate is determined using equation:

$$RPD = \frac{|MSR - MSDR|}{\frac{1}{2}(MSR + MSDR)} \times 100$$

Where: MSR = Matrix spike recovery
MSDR = Matrix spike duplicate recovery

11.7.2 Calculations For Initial Calibration

The relative response factor (RRF) for each target compound and each system monitoring compound is calculated using equation.

$$RRF = \frac{Ax}{Ais} \times \frac{Cis}{Cx}$$

Where,
Ax = Area of the characteristic ion (EICP) for the compound to be measured (see Table 4)
Ais = Area of the characteristic ion (EICP for the specific internal standard (see Table 4)
Cis = Concentration of the internal standard
Cx = Concentration of the compound to be measured

The relative response factor of the Xylenes requires the use of the area response and the concentration of the peak that represents the single isomer.

The relative response factor of 1,2-dichloroethene is calculated using the sum of the areas of both isomers and the sum of the concentrations.

The average response factor (RRF) is calculated for all compounds of interest.

The relative standard deviation (% RSD) is calculated over the working range of the curve for all compounds using equation:

$$\%RSD = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

$$\text{Standard Deviation} = \sqrt{\frac{\sum_{i=1}^{n}(\chi i - \overline{\chi})2}{n-1}}$$

Where,
Xi = each individual value used to calculate the mean
X = the mean of n values
n = the total number of values

11.7.3 Calculations For Continuing Calibration

The relative response factor (RRF) for all target compounds and system monitoring compounds is calculated using equation 11.7.2.

The percent difference between the initial calibration and the continuing calibration is

determined for all target compounds and system monitoring compound using equation:

$$\%\text{Difference} = \frac{RRFc - RRFi}{RRFi} \times 100$$

Where,
RRFc = Relative response factor from continuing calibration standard
RRFi = Mean relative response factor from the most recent initial calibration meeting technical acceptance criteria

Quantitation of volatile target compounds is done using the internal standard method. The Internal Standard RRF of the continuing calibration is used in the quantitation calculation.

Water Samples: The following equation is used to calculate water samples:

$$\text{Concentration ug/L} = \frac{(Ax)\,(Is)\,(DF)}{(Ais)\,(RRF)\,(Vo)}$$

Where,
Ax = Area of the characteristic ion (EICP) for the compound to be measured (see Table 4)
Ais = Area of the characteristic ion (EICP) for the specific internal standard (see Table 4)
Is = Amount of internal standard added in nanograms (ng)
RRF= Relative response factor from the ambient temperature purge of the calibration standard.
Vo = Volume of water purged in milliliters (mL)
Df = Dilution factor. The dilution factor for analysis of water samples for volatiles by this method is defined as the ratio of the number of milliliters (mL) of water purged (i.e., Vo above) to the number of mL of the original water sample used for purging. For example, if 2.0 mL of sample is diluted to 5 mL with reagent water and purged, Df = 5 mL/2.0 mL = 2.5. If no dilution is performed, Df = 1.

Low Level Soil/Sediment Samples - The following equation is used for low level soil/sediment samples:

$$\text{Concentration ug/Kg (dry weight basis)} = \frac{(Ax)\,(Is)}{(Ais)\,(RRF)\,(Ws)\,(D)}$$

Where,
Ax, Is, Ais are as given for water.
RRF = Relative response factor form the heated purge of the calibration standard.
$D = \frac{100 - \%\ \text{moisture}}{100}$
Ws = Weight of sample added to the purge tube, in grams (g).

Medium Level Soil/Sediment Samples

The following equation is used for quantitation of medium level soil/sediment samples:

$$\text{Concentration ug/Kg (Dry weight basis)} = \frac{(Ax)\,(Is)\,(Vt)\,(1000)\,(Df)}{(Ais)\,(RRF)\,(Va)\,(Ws)\,(D)}$$

Where,
Ax, Is, Ais are as given for water.
RRF = Relative response factor from the ambient temperature purge of the calibration standard.
Vt = Total volume of the methanol extract in milliliters (mL).

NOTE: This volume is typically 10 mL, even though only 1 mL is transferred to the vial.

Va = Volume of the aliquot of the sample methanol extract (i.e., sample extract not including the methanol added to equal 100 uL) in micro liters (ul) added to reagent water for purging.
Ws = Weight of soil/sediment extracted, in grams (g).
D = $\frac{100 - \%\ \text{moisture}}{100}$
Df = Dilution factor. The dilution factor for analysis of soil/sediment samples for volatiles by the medium level method is defined as:

$$\frac{\text{ul most conc. extract used to make dilution + ul clean solvent}}{\text{ul most conc. extract used to make dilution}}$$

(The dilution factor is equal to 1.0 in all cases other than those requiring dilution of the sample methanol extract (Vt). The factor of 1,000 in the numerator converts the value of Vt from mL to ul.)

When quantitating the sample concentration of Xylenes (total), the areas of both the m & p Xylene peak and the o-Xylene peak are summed and the RRF determined using equation 11.2.1 are used. The concentration of each peak may be determined separately and then summed to determine the concentration of Xylene (total).

When quantitating the concentration of 1,2-Dichloroethene (total), the concentrations of the two isomers (cis and trans) are summed.

Secondary ion quantitation may be used if interferences (such as matrix effects) may cause a bias in quantitation.

If manual integration of any compound (including internal standards, system monitoring compounds, target or tentatively identified compounds) is required, the EICP of that compound will be provided. All manual integrations will be identified with an "m" and

initialed and dated by the GC/MS analyst.

11.7.4 Percent Moisture Determinations

Immediately after weighing the sample for analysis, a 5-10g portion is weighed into a tarred weigh pan. The sample is then dried at 105^0C. The sample is allowed to cool. The final weight is recorded. Using the equation for % moisture, concentrations relative to the dry weight of the soil/sediment samples, may be determined.

$$\%\text{moisture} = \frac{\text{g of wet sample - g of dry sample}}{\text{g of wet sample}} \times 100$$

11.7.5 System Monitoring Compounds

The recovery of all system monitoring compounds in samples, blanks matrix spikes and matrix spike duplicates, is calculated using equation:

$$\%\ \text{Recovery} = \frac{\text{Concentration (amount) found}}{\text{Concentration (amount) spiked}} \times 100$$

12.0 Documentation

12.1 Instrument Logbook

A logbook must be maintained to track major maintenance as well as daily maintenance to an instrument. The logbook must contain the date and time of the maintenance, the initials of the analyst performing the work, the reason why maintenance was performed and the maintenance completed. If any parts are replaced, catalog and lot numbers must be recorded. If maintenance either resolves the issue or further maintenance is required, this should be notated as well.

12.2 Reagents

All standards must be entered into LIMS. Each ampule will receive a LIMS ID# for traceability.

The certificate of analysis (COA) for each standard is initialized, dated and given the corresponding LIMS ID#. It is then scanned and attached to the reagent in LIMS.

When intermediates or working mixes are created, they are to be logged into LIMS and will be assigned a unique LIMS reference number.

12.3 Sample Logbook

Prior to the start of analysis, QC and samples are logged into a unique Chrom worklist which serves as an electronic run log. This is accomplished with either a barcode scanner or the prep batch import function in Chrom, which uses the unique sample ID supplied directly from TALS via the prep batch.

Run logs must contain the following information:

Date, time and analyst initials
File number, sample ID, vial # and job #
Injection volume, final volume, initial volume and dilution factor
References for the standards, tune mix and IS mix

All samples injected must be added to a Chrom worklist. If injections are not used, they are labelled accordingly in the worklist. Files must never remain in the Missing Samples list in Chrom and must not be deleted from this list. These must be entered into the worklist, properly linked and processed.

12.4 Checklists

Calibration checklist BF-MV-ICAL-009 (current revision) is to be completed by first and second level reviewers. This is scanned and attached to the batch in LIMS.

Data Review checklist CA-Q-WI-039 (current revision) is to be completed by first and second level reviewers. This is scanned and attached to the batch in LIMS.

An electronic checklist for an initial calibration as well as sample batch is also complete by first and second level reviewers in LIMS.

13.0 Data Review

Technical data review of initial calibrations, instrument/batch QC and client data criteria is listed in TestAmerica Buffalo SOP BF-GP-012 (current revision).

13.1 Method Detection Limit Study (MDL)

A valid method detection limit for each analyte of interest must be generated. The MDL must be below the reporting limit for each analyte. The MDL is defined as the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the spiked analyte is present and distinguishable from method blank results. This value is calculated as the MDL_s. Method Blanks are also used to calculate a MDL (MDL_b), which calculates the 99% confidence level that the MDL is derived from the sample and not from contamination or noise. The laboratory's working MDL is then the higher of the two values (MDL_s vs MDL_b).

An initial study is performed, consisting of at least 7 spiked replicates analyzed over at least 3 days on all instruments that perform the analysis. Replicates analyzed on two or more instruments should not be analyzed on the same day.

After completion of the MDL study, the continuing MDL study is performed. Two spiked replicates are analyzed on all instrumentation performing the analysis. This is performed each quarter. At the end of the 1-year (4 quarters) mark, a new MDL should be calculated using the data acquired throughout the year.

At least 7 method blanks (or 20 if extending over 3 or more months) should be used to calculate the MDL_b.

The MDL procedure can be found in TestAmerica Buffalo SOP BF-QA-001, current revision.

13.2 Demonstration of Capabilities

Initial Demonstration of Capabilities (IDOC): The initial demonstration with each sample preparation technique and analytical method combination utilized must be performed by generated data of acceptable accuracy and precision for target analytes in a clean matrix. This is also done for new staff or when significant changes in instrumentation are made. Demonstration of Capabilities (DOC) will be performed annually for those analyst whom have passing IDOCs.

14.0 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, current revision) for "Waste Management and Pollution Prevention".

15.0 Waste Management

Waste management practices are conducted consistently 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 Section 13 of the Corporate Safety Manual. The following waste streams are produced when this method is carried out.

There are two types of aqueous waste generated in the lab:

A-Waste: All non-nitric acid and alkaline aqueous waste.
AN-Waste: A;; aqueous waste containing nitric acid.

These types of waste are to be disposed of into appropriately marked plastic containers.

The following list other types of non-aqueous lab waste and where to dispose of:

C-Waste: All solvent waste gets dumped into appropriately marked metal cans. These cans need to be grounded whenever they are emptied to reduce explosion hazards. Discarded standard (except PCBs) will also be dumped into C-Waste cans.

Solid Waste: all contaminated paper, solid sample waste, sodium sulfate and all other non-glass material that has been contaminated is to be wrapped in foil and gathered to be dumped into 55 gallon drums.

Glass: contaminated glass needs to be rinsed off with methylene chloride and disposed of with all other glass in glass-specific containers with special extra thick polypropylene liners. These containers are for glass only.

Extract Vials: extract vials are to be archived and stored at 4ºC ± 2ºC or less in Teflon-lined crimp-cap amber bottles (and separately from standards and current samples) for 6 months after they have been analyzed. After the archival period, vials are to be crushed into a 55 gallon drum.

16.0 References / Cross-References

- Method 8260C, "Test Methods for Evaluating Solid Waste"; SW846, Fourth Edition, August 2006.

17.0 Attachments

Table 1. Compounds Determined by Method 8260C
Table 2. BFB Key Ions and Ion Abundance Criteria
Table 3. Volume of Medium Level Extracts for Dilution
Table 4. Characteristic Masses (m/z) for Purgeable Organic Compounds
Table 5. Poor Performing Compounds
Table 5a. Defined CCV Poor performing compounds
Table 6. Minimum Response Factors
Table 7.Job Summary Check List (Pages 1 - 5)
Table 8 TestAmerica Buffalo GCMS VOA Dilution Calculation

18.0 Revision History

Revision 03, dated -01 March, 2019
- Changed Initial Calibration Charts.
- Added new Instrument (HP5977).
- Restructured the entire format to have better flow and usability.

Revision 02, dated -02 February, 2017
- Changed Department Manager, Laboratory Director, and Quality Manager, signatures added.
- Section 7.3 – Updated mixes to reflect new standards and removed concentrations.
- Removed outdated COA's from tables section.

Revision 01, dated -13 January, 2015
- Section 1.1.1: Removed reference to 25mL purge analysis – no longer perform.
- Section 2.2: Removed reference to 25mL purge analysis.
- Section 3.6 Change batch to 18 field samples.
- Section 9.4.1.4 Added the read back of the low level standard for linear fit analytes.
- Section 7.3.1.2: Changed the standards to incorporate the new corporate formulations.

- Section 7.3.1.3: Changed the standards to incorporate the new add corporate formulations.
- Section 7.3.2.1&2: Changed the second source standards to incorporate the new corporate formulations.
- Section 7.3.3: Removed 1,4-difluorobenzene and added Fluorobenzene – new corporate mixes.
- Section 7.3.4: Added Dibromofluoromethane – new corporate mixes.
- Section 7.3.5: Removed Stock Matrix Spike Solution – do not use.
- Section 7.4(old): Removed whole section as it is not needed (secondary IS and Surrogate dilution standards.
- Section 7.4.1.2: Removed the 54 component reference and changed to the 8260 Mega mix reference.
- Section 7.4.1.2: Change the number of stocks from four to five.
- Section 7.4.2: Removed the 17 compound spike references and removed the verification in standard.
- Section 7.4.2.2: Changed the 200uL to 1000uL of the 8260 Mega mixes; four mixes to five.
- Section 7.4.5: Removed the 25mL purge curve reference. Reduced curves to 6 point calibrations for both waters and soils.
- Section 7.4.5.1.1: Changed 5mL water initial curve to 6 points. Removed the surrogate multipoint references.
- Section 7.4.5.1.2: Removed the multipoint surrogate calibration.
- Section 7.4.5.2.1: Changed 5mL soil initial curve to 6 points. Removed the surrogate multipoint references.
- Section 7.4.5.2.2: Removed the multipoint surrogate calibration.
- Section 7.4.6: Removed the 25mL continuing calibration standards.
- Section 8.5.1: Removed the 8uL of 50 ng/uL or 4ul of 100 ng/ul matrix spike standard for 25mL and 22ul of 50ng/ul. Also removed the concentrations related to 25mL purge.
- Section 8.5.2: Removed 5ul of 50ng/ul standard.
- Section 9.2.1: Removed 10ug/L for 25mL analysis.
- Section 9.2.2: Removed 10ug/L for 25mL analysis.
- Section 9.2.5: Removed the 17 compound spike references and removed the when required from the full spike.
- Section 9.4.1.2: Added the alternate quant ion statement.
- Section 9.4.1.4.2: Added ICV allowed at 50% for poor performing compounds.
- Section 9.4.2.2: Added CCV failure corrective actions.
- Section 9.5.5.1: Removed the 17 compound spike reference as we use full spike.
- Section 10.1.3: Removed the chart for 25mL Purge analysis and * for optional 6th point.
- Section 10.2.1: Removed 25mL purge amount.
- Section 10.2.4.2: Removed 25mL purge reference.
- Section 10.4.1: Removed 25mL purge reference.
- Section 10.6.3: Added the correct procedure for medium level soil prep for method 5035.
- Section 11.10.2: Added the Chrome setting for the 85% Q value and naming convention.
- Table 1: Added compounds to additional analytes amenable to 8260 analysis.
- Table 3: Change volume of extract header.
- Table 4: Removed 1,4-difluorobenzene and added Fluorobenzene and the correct primary and secondary ions.
- Table 5: Removed add compounds as we do not spike with adds and added Bromoform, Isobutyl alcohol and 2-methyl-2-propanol.
- Table 5a: Defined CCV poor performers.
- Table 8: Replaced gas mix certification.
- Table 9: Changed the 54 compound mix to 8260 Mega Mix and put in new certification.

- Table 10: Changed the title of table and the certifications.
- Table 11: Changed the title of table and the certifications.
- Table 12: Changed the title of table and the certifications.
- Table 13: Changed the certifications.
- Table 15: Changed the certifications.
- Table 16: Changed the certifications.

Revision 01, dated -30 July, 2013

- Initial Version

Table 1: Compounds Determined by Method 8260C

Compound	CAS No.[b]	Appropriate Technique					
		5030/5035	5031	5032	5021	5041	Direct Injection
Acetone	67-64-1	pp	c	c	nd	c	c
Acetonitrile	75-05-8	pp	c	nd	nd	nd	c
Acrolein	107-02-8	pp	c	c	nd	nd	c
Acrylonitrile	107-13-1	pp	c	c	nd	c	c
Allyl alcohol	107-18-6	ht	c	nd	nd	nd	c
Allyl chloride	107-05-1	c	nd	nd	nd	nd	c
Benzene	71-43-2	c	nd	c	c	c	c
Benzyl chloride	100-44-7	c	nd	nd	nd	nd	c
Bis(2-chloroethyl)sulfide	505-60-2	pp	nd	nd	nd	nd	c
Bromoacetone	598-31-2	pp	nd	nd	nd	nd	c
Bromochloromethane	74-97-5	c	nd	c	c	c	c
Bromodichloromethane	75-27-4	c	nd	c	c	c	c
4-Bromofluorobenzene (surr)	460-00-4	c	nd	c	c	c	c
Bromoform	75-25-2	c	nd	c	c	c	c
Bromomethane	74-83-9	c	nd	c	c	c	c
n-Butanol	71-36-3	ht	c	nd	nd	nd	c
2-Butanone (MEK)	78-93-3	pp	c	c	nd	nd	c
t-Butyl alcohol	75-65-0	pp	c	nd	nd	nd	c
Carbon disulfide	75-15-0	pp	nd	c	nd	c	c
Carbon tetrachloride	56-23-5	c	nd	c	c	c	c
Chloral hydrate	302-17-0	pp	nd	nd	nd	nd	c
Chlorobenzene	108-90-7	c	nd	c	c	c	c
Chlorobenzene-d5 (IS)		c	nd	c	c	c	c
Chlorodibromomethane	124-48-1	c	nd	c	nd	c	c
Chloroethane	75-00-3	c	nd	c	c	c	c
2-Chloroethanol	107-03-3	pp	nd	nd	nd	nd	c
2-Chloroethyl vinyl ether	110-75-8	c	nd	c	nd	nd	c

Compound	CAS No.[b]	Appropriate Technique					
		5030/5035	5031	5032	5021	5041	Direct Injection
Chloroform	67-66-3	c	nd	c	c	c	c
Chloromethane	74-87-3	c	nd	c	c	c	c
Chloroprene	126-99-8	c	nd	nd	nd	nd	c
3-Chloropropionitrile	542-76-7	l	nd	nd	nd	nd	pc
Crotonaldehyde	4170-30-3	pp	c	nd	nd	nd	c
1,2-Dibromo-3-chloropropane	96-12-8	pp	nd	nd	c	nd	c
1,2-Dibromoethane	106-93-4	c	nd	nd	c	nd	c
Dibromomethane	74-95-3	c	nd	c	c	c	c
1,2-Dichlorobenzene	95-50-1	c	nd	nd	c	nd	c
1,3-Dichlorobenzene	541-73-1	c	nd	nd	c	nd	c
1,4-Dichlorobenzene	106-46-7	c	nd	nd	c	nd	c
1,4-Dichlorobenzene-d4 (IS)		c	nd	nd	c	nd	c
cis-1,4-Dichloro-2-butene	1476-11-5	c	nd	c	nd	nd	c
trans-1,4-Dichloro-2-butene	110-57-6	pp	nd	c	nd	nd	c
Dichlorodifluoromethane	75-71-8	c	nd	c	c	nd	c
1,1-Dichloroethane	75-34-3	c	nd	c	c	c	c
1,2-Dichloroethane	107-06-2	c	nd	c	c	c	c
1,2-Dichloroethane-d4 (surr)		c	nd	c	c	c	c
1,1-Dichloroethene	75-35-4	c	nd	c	c	c	c
trans-1,2-Dichloroethene	156-60-5	c	nd	c	c	c	c
1,2-Dichloropropane	78-87-5	c	nd	c	c	c	c
1,3-Dichloro-2-propanol	96-23-1	pp	nd	nd	nd	nd	c
cis-1,3-Dichloropropene	10061-01-5	c	nd	c	nd	c	c
trans-1,3-Dichloropropene	10061-02-6	c	nd	c	nd	c	c
1,2,3,4-Diepoxybutane	1464-53-5	c	nd	nd	nd	nd	c
Diethyl ether	60-29-7	c	nd	nd	nd	nd	c

Compound	CAS No.[b]	Appropriate Technique					
		5030/5035	5031	5032	5021	5041	Direct Injection
1,4-Difluorobenzene (I.S.)	540-36-3	nd	nd	nd	nd	c	c
1,4-Dioxane	123-91-1	pp	c	c	nd	nd	c
Epichlorohydrin	106-89-8	l	nd	nd	nd	nd	c
Ethanol	64-17-5	l	c	c	nd	nd	c
Ethyl acetate	141-78-6	l	c	nd	nd	nd	c
Ethylbenzene	100-41-4	c	nd	c	c	c	c
Ethylene oxide	75-21-8	pp	c	nd	nd	nd	c
Ethyl methacrylate	97-63-2	c	nd	c	nd	nd	c
Fluorobenzene (IS)	462-06-6	c	nd	nd	nd	nd	nd
Hexachlorobutadiene	87-68-3	c	nd	nd	c	nd	c
Hexachloroethane	67-72-1	l	nd	nd	nd	nd	c
2-Hexanone	591-78-6	pp	nd	c	nd	nd	c
2-Hydroxypropionitrile	78-97-7	l	nd	nd	nd	nd	pc
Iodomethane	74-88-4	c	nd	c	nd	c	c
Isobutyl alcohol	78-83-1	pp	c	nd	nd	nd	c
Isopropylbenzene	98-82-8	c	nd	nd	c	nd	c
Malononitrile	109-77-3	pp	nd	nd	nd	nd	c
Methacrylonitrile	126-98-7	pp	l	nd	nd	nd	c
Methanol	67-56-1	l	c	nd	nd	nd	c
Methylene chloride	75-09-2	c	nd	c	c	c	c
Methyl methacrylate	80-62-6	c	nd	nd	nd	nd	c
4-Methyl-2-pentanone (MIBK)	108-10-1	pp	c	c	nd	nd	c
Naphthalene	91-20-3	c	nd	nd	c	nd	c
Nitrobenzene	98-95-3	c	nd	nd	nd	nd	c
2-Nitropropane	79-46-9	c	nd	nd	nd	nd	c
N-Nitroso-di-n-butylamine	924-16-3	pp	c	nd	nd	nd	c
Paraldehyde	123-63-7	pp	c	nd	nd	nd	c
Pentachloroethane	76-01-7	l	nd	nd	nd	nd	c

Compound	CAS No.[b]	Appropriate Technique					
		5030/5035	5031	5032	5021	5041	Direct Injection
2-Pentanone	107-87-9	pp	c	nd	nd	nd	c
2-Picoline	109-06-8	pp	c	nd	nd	nd	c
1-Propanol	71-23-8	pp	c	nd	nd	nd	c
2-Propanol	67-63-0	pp	c	nd	nd	nd	c
Propargyl alcohol	107-19-7	pp	l	nd	nd	nd	c
B-Propiolactone	57-57-8	pp	nd	nd	nd	nd	c
Propionitrile (ethyl cyanide)	107-12-0	ht	c	nd	nd	nd	c
n-Propylamine	107-10-8	c	nd	nd	nd	nd	c
Pyridine	110-86-1	l	c	nd	nd	nd	c
Styrene	100-42-5	c	nd	c	c	c	c
1,1,1,2-Tetrachloroethane	630-20-6	c	nd	nd	c	c	c
1,1,2,2-Tetrachloroethane	79-34-5	c	nd	c	c	c	c
Tetrachloroethene	127-18-4	c	nd	c	c	c	c
Toluene	108-88-33	c	nd	c	c	c	c
Toluene-d8 (surr)	2037-26-5	c	nd	c	c	c	c
o-Toluene	95-53-4	pp	c	nd	nd	nd	c
1,2,4-Trichlorobenzene	120-82-1	c	nd	nd	c	nd	c
1,1,1-Trichloroethane	71-55-6	c	nd	c	c	c	c
1,1,2-Trichloroethane	79-00-5	c	nd	c	c	c	c
Trichloroethane	79-01-6	c	nd	c	c	c	c
Trichlorofluoromethane	75-69-4	c	nd	c	c	c	c
1,2,3-Trichloropropane	96-18-4	c	nd	c	c	c	c
Vinyl acetate	108-05-4	c	nd	c	nd	nd	c
Vinyl chloride	75-01-4	c	nd	c	c	c	c
Xylene (Total)	1330-20-7	c	nd	c	c	c	c

c= Adequate response by this technique
b= Chemical Abstract Services Registry Number
pp= Poor purging efficiency resulting in high EQLs
l= Inappropriate technique for this analyte
nd= Not determined
surr= Surrogate
IS= Internal Standard
ht= Method analyte only when purged at 80 C

pc= Poor chromatographic behavior

The following compounds are also amenable to analysis by Method 8260:

Bromombenzene
n-Butylbenzene
sec-Butlybenzene
tert-Butylbenzene
Chloroacetonitrile
1-Chlorobutane
1-Chlorohexane
2-Chlorotoluene
4-Chlorotoluene
Dibromofluoromethane
cis-1,2-Dichloroethene
Di-isopropyl ether
tert-amyl methyl ether
isooctane
2-methylnaphthalene
t-amyl alcohol
1,3-Dichloropropane
2,2-Dichloropropane
1,1-Dichloropropene
p-Isopropyltoluene
Methyl acrylate
Methyl-t-butyl ether
Pentafluorobenzene
n-Propylbenzene
1,2,3-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
tert-butyl ethyl ether
benzyl chloride
n-butyl acetate
ethanol

Table 2. BFB Key Ions and Ion Abundance Criteria

mz	Required Intensity (relative abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

*Alternate tuning criteria may be used, (e.g. CLP, Method 524.2, or manufacturers' instructions), provided that method performance is not adversely affected.

Table 4. Characteristic Masses (m/z) for Purgeable Organic Compounds

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Acetone	58	43
Acetonitrile	41	40,39
Acrolein	56	55,58
Acrylonitrile	53	52,51
Allyl alcohol	57	58,39
Allyl chloride	76	41,39,78
Benzene	78	-
Benzyl chloride	91	126,65,128
Bromoacetone	136	43,138,93,95
Bromobenzene	156	77,158
Bromochloromethane	128	49,130
Bromodichloromethane	83	85,127
Bromoform	173	175,254
Bromomethane	94	96
iso-Butanol	74	43
n-Butanol	56	41
2-Butanone	72	43
n-Butylbenzene	91	92,134
sec-Butylbenzene	105	134
tert-Butylbenzene	119	91,134
Carbon disulfide	76	78
Carbon tetrachloride	117	119
Chloral hydrate	82	44,84,86,111
Chloroacetonitrile	48	75
Chlorobenzene	112	77,114
1-Chlorobutane	56	49
Chlorodibromomethane	129	208,206
Chloroethane	64 (49*)	66 (51*)
2-Chloroethanol	49	44,43,51,80
bis-(2-Chloroethyl) sulfide	109	111,158,160
2-Chloroethyl vinyl ether	63	65,106
Chloroform	83	85
Chloromethane	50 (49*)	52 (51*)
Chloroprene	53	88,90,51
3-Chloropropionitrile	54	49,89,91
3-Chlorotoluene	91	126
4-Chlorotoluene	91	126
1,2-Dibromo-3-chloropropane	75	155,157
Dibromochloromethane	129	127
1,2-Dibromoethane	107	109,188
Dibromomethane	93	95,174
1,2-Dichlorobenzene	146	111,148
1,2-Dichlorobenzene-d_4	152	115,150
1,3-Dichlorobenzene	146	111,148
1,4-Dichlorobenzene	146	111,148
cis-1,4-Dichloro-2-butene	75	53,77,124,89

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
trans-1,4-Dichloro-2-butene	53	88,75
Dichlorodifluoromethane	85	87
1,1-Dichlorothane	63	65,83
1,2-Dichloroethane	62	98
1,1-Dichlorothene	96	61,63
cis-1,2-Dichloroethene	96	61,98
trans-1,2-Dichloroethene	96	61,98
1,2-Dichloropropane	63	112
1,3-Dichloropropane	76	78
2,2-Dichloropropane	77	97
1,3-Dichloro-2-propanol	79	43,81,49
1,1-Dichloropropene	75	110,77
cis-1,3-Dichloropropene	75	77,39
trans-1,3-Dichloropropene	75	77,39
1,2,3,4-Diepoxybutane	55	57,56
Diethyl ether	74	45,59
1,4-Dioxane	88	58,43,57
Epichlorohydrin	57	49,62,51
Ethanol	31	45,27,46
Ethyl acetate	88	43,45,61
Ethylbenzene	91	106
Ethylene oxide	44	43,42
Ethyl methacrylate	69	41,99,86,114
Hexachlorobutadiene	225	223,227
Hexachloroethane	201	166,199,203
2-Hexanone	43	58,57,100
2-Hydroxypropionitrile	44	43,42,53
Iodomethane	142	127,141
Isobutyl alcohol	43	41,42,74
Isopropylbenzene	105	120
p-Isopropyl toluene	119	134,91
Malonitrile	66	39,65,38
Methacrylonitrile	41	67,39,52,66
Methyl acrylate	55	85
Methyl-t-butyl ether	73	57
Methylene chloride	84	86,49
Methyl ethyl ketone	72	43
Methyl iodide	142	127,141
Methyl methacrylate	69	41,100,39
4-Methyl-2-pentanone	100	43,58,85
Naphthalene	128	-
Nitrobenzene	123	51,77
2-Nitropropane	46	-
2-Picoline	93	66,92,78
Pentachloroethane	167	130,132,165,169
Propargyl alcohol	55	39,38,53
B-Propiolactone	42	43,44
Propionitrile (ethyl cyanide)	54	52,55,40
n-Propylamine	59	41,39

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
n-Propylbenzene	91	120
Pyridine	79	52
Styrene	104	78
1,2,3-Trichlorobenzene	180	182,145
1,2,4-Trichlorobenzene	180	182,145
1,1,1,2-Tetrachloroethane	131	133,119
1,1,2,2-Tetrachloroethane	83	131,85
Tetrachloroethene	164	129,131,166
Toluene	92	91
1,1,1-Trichloroethane	97	99,61
1,1,2-Trichloroethane	83	97,85
Trichloroethene	95	97,130,132
Trichlorofluoromethane	151	101,153
1,2,3-Trichloropropane	75	77
1,2,4-Trimethylbenzene	105	120
1,3,5-Trimethylbenzene	105	120
Vinyl acetate	43	86
Vinyl chloride	62	64
o-Xylene	106	91
m-Xylene	106	91
p-Xylene	106	91
INTERNAL STANDARDS/SURROGATES		
Benzene-d6	84	83
Bromobenzene-d5	82	162
Bromochloromethane-d2	51	131
Fluorobenzene	96	77
Chlorobenzene-d5	117	
1,4-Dichlorobenzene-d4	152	115,150
1,1,2-Trichloroethane-d3	100	
4-Bromofluorobenzene	95	174,176
Chloroform-d1	84	
Dibromofluoromethane	113	

Table 5. Poor Performing Compounds

Bromoform	Bromomethane
1,2-Dibromo-3-chloropropane (DBCP)	Carbon Disulfide
1,4-Dioxane	Chloroethane
2-Butanone (MEK)	Isobutyl Alcohol
2-Chloroethylvinyl ether	Dichlorodifluoromethane
2-Methyl-2-propanol	Iodomethane
4-Methyl-2-pentanone (MIBK)	Methyl Acetate
Acetone	trans-1,4-Dichloro-2-butene
Acrolein	

Table 6. Minimum Relative Response Factors

RECOMMENDED MINIMUM RELATIVE RESPONSE FACTOR CRITERIA FOR INITIAL AND CONTINUING CALIBRATION VERIFICATION

Volatile Compounds	Minimum Response Factor (RF)[a]	Typical Response Factor (RF)[b]
Dichlorodifluoromethane	0.100	0.327
Chloromethane	0.100	0.537
Vinyl chloride	0.100	0.451
Bromomethane	0.100	0.255
Chloroethane	0.100	0.254
Trichlorofluoromethane	0.100	0.426
1,1-Dichloroethene	0.100	0.313
1,1,2-Trichloro-1,2,2-trifluoroethane	0.100	0.302
Acetone	0.100	0.151
Carbon disulfide	0.100	1.163
Methyl Acetate	0.100	0.302
Methylene chloride	0.100	0.380
trans-1,2-Dichloroethene	0.100	0.351
cis-1,2-Dichloroethene	0.100	0.376
Methyl tert-Butyl Ether	0.100	0.847
1,1-Dichloroethane	0.200	0.655
2-Butanone	0.100	0.216
Chloroform	0.200	0.557
1,1,1-Trichloroethane	0.100	0.442
Cyclohexane	0.100	0.579
Carbon tetrachloride	0.100	0.353
Benzene	0.500	1.368
1,2-Dichloroethane	0.100	0.443
Trichloroethene	0.200	0.338
Methylcyclohexane	0.100	0.501
1,2-Dichloropropane	0.100	0.382

Table 6. Minimum Relative Response Factors continued…

Volatile Compounds	Minimum Response Factor (RF)[a]	Typical Response Factor (RF)[b]
Bromodichloromethane	0.200	0.424
cis-1,3-Dichloropropene	0.200	0.537
trans-1,3-Dichloropropene	0.100	0.515
4-Methyl-2-pentanone	0.100	0.363
Toluene	0.400	1.577
1,1,2-Trichloroethane	0.100	0.518
Tetrachloroethene	0.200	0.606
2-Hexanone	0.100	0.536
Dibromochloromethane	0.100	0.652
1,2-Dibromoethane	0.100	0.634
Chlorobenzene	0.500	1.733
Ethylbenzene	0.100	2.827
meta-/para-Xylene	0.100	1.080
ortho-Xylene	0.300	1.073
Styrene	0.300	1.916
Bromoform	0.100	0.413
Isopropylbenzene	0.100	2.271
1,1,2,2-Tetrachloroethane	0.300	0.782
1,3-Dichlorobenzene	0.600	1.408
1,4-Dichlorobenzene	0.500	1.427
1,2-Dichlorobenzene	0.400	1.332
1,2-Dibromo-3-chloropropane	0.050	0.129
1,2,4-Trichlorobenzene	0.200	0.806

[a] The project-specific response factors obtained may be affected by the quantitation ion selected and when using possible alternate ions the actual response factors may be lower than those listed. In addition, lower than the recommended minimum response factors may be acceptable for those compounds that are not considered critical target analytes and the associated data may be used for screening purposes.
[b] Data provided by EPA Region III laboratory.

Table 7.Job Summary Check List (Pages 1 of 5)

TestAmerica *[lab name]*

GCMS Volatile CCV & Batch Data Review Checklist

LIMS Batch Number:	**Worklist #:**	**Instrument ID:**
Analyst/1st Reviewer:	**Prep Method (circle):** 5030 5035-L 5035-H	**Analytical Method (circle):** 524.2 624 8260B 8260C SOM__ Other___
QC Type (circle): Standard QAPP Other-Explain_____		
Matrix (circle one): Drinking Water Non-potable Water Solid Waste		**Circle:** 5-ml 20-ml Meth Ext TCLP/SPLP

Review Items	NA	Yes	No	2nd Rev	If No, why is data reportable?
A. Tune & Continuing Calibration					
1. Did BFB meet tune criteria?					Time of injection:_____
2. Was the correct ICAL used for quantitation? Date and instrument ID of ICAL verified? (Check in both Chrom/Target and TALS)					
3. Do RFs meet minimum criteria? (524.2 & 624 – not method defined) (8260B-SPCCs = Chloromethane, 1,1-Dichloroethane, Bromoform ≥0.1; Chlorobenzene, 1,1,2,2-Tetrachloroethane ≥0.3) (8260C- all cmpds have min RFs defined in method/SOP)					If no, list details: _____
4. Does %Difference/%Drift meet criteria? (524.2: ≤30% all cmpds/surrogates) (624: cmpd specific-Table 5 Q value) (8260B: ≤20% for CCCs; ≤20% for all cmpds/surrogates if CCCs not on list) (8260C: ≤20% for all cmpds/surrogates)					If no, list details: _____ (8260B: %D high, samples ND?) (8260C: <20% of cmpds fail criteria & for failed cmpds RL standard verifies sensitivity for NDs?)
5. Are the Internal Standard area responses within method limits? (524.2, -30% of most recent CCV or -50% of ICAL mid pt) (624 – not method defined) (8260B & 8260C, 50% - 200% of ICAL mid pt)					If no, list details: _____
6. Are the internal standard retention times within method limits? (524.2, 3SD of RT in ICAL; 624, ±30 sec of ICAL mid pt) (8260B, ±30 sec of ICAL mid pt; 8260C, ±10 sec of ICAL mid pt)					If no, list details: _____
7. Isomeric pairs checked for elution order and correct peak assignment? • Vinyl Acetate / Isopropyl Ether • 1,2- & 1,3-& 1,4-Dichlorobenzene • Ethylbenzene / Xylenes • 1,3,5- & 1,2,4-Trimethylbenzene / Isopropylbenzene / sec-butylbenzene • 2- & 4-Chlorotoluene / n-Propylbenzene • MIBK / 2-Hexanone • Methyl Methacrylate / Ethyl Methacrylate • 1,1-Dichloroethene / cis-1,2- & trans-1,2-Dichloroethene • 1,2,3- & 1,2,4-Trichlorobenzene					

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Table 7.Job Summary Check List (Pages 2 of 5)

TestAmerica *[lab name]*

• 1,1-Dichloropropene / cis-1,3- & trans-1,3-Dichloropropene / 1,2,3-Trichloropropane • Chlorobenzene-d5 / 1,1,1,2-Tetrachloroethane • Trichlorofluoromethane / Freon 113 • Hexane / Vinyl Acetate (Chrom: View/Documents/Methods/Isomers)					
& Were manual integrations performed correctly and properly documented? (dated, initialed and reason given; 2nd review of all MIs required)					

2nd Reviewer: _____ **Review Date:** _____

Comments: _____

Table 7.Job Summary Check List (Pages 3 of 5)

TestAmerica *[lab name]*

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

LIMS Batch Number:	Worklist #:	Instrument ID:
Analyst/1st Reviewer:	Prep Method (circle): 5030 5035-L 5035-H	Analytical Method (circle): 524.2 624 8260B 8260C SOM__ Other___
QC Type (circle): Standard QAPP Other-Explain_____		
Matrix (circle one): Drinking Water Non-potable Water Solid Waste		Circle: 5-ml 20-ml Meth Ext TCLP/SPLP
Job #(s):		Batch #(s):

A. Batch - Sample & QC Review					
1. All samples & QC injected within 12 hours of BFB? (or 24 hrs for 624?)					Time of last injection:_____
2. LCS (LFB) %recovery within limits? (524.2= 70-130%, 624=cmpd specific – Table 5 'P' value) (8260B & 8260C=lab statistical limits)					
3. MS/MSD (LFM/LFMD) %recoveries within limits? (524.2= SOP defined; 624=cmpd specific-Table 5 'P' value) (8260B & 8260C=lab statistical limits)					
4. MS/MSD (LFM/LFMD) RPD within limits? (624=cmpd specific-Table 6 or SOP defined)					
5. Do all spiked samples (LCS, MS, MSD) yield positive detections? (Concentrations of ND require evaluation, correction or explanation.)					
6. Are all duplicate or spiked duplicate sample RPDs <75%? (Excessive RPDs (>75%) require evaluation, correction or explanation.)					
7. Target cmpds in Method Blank are below method required conc? (524.2<RL; 624<RL; 8260B & 8260C<MDL or SOP defined)					e.g.; Conc in blk<5% of sample conc
8. Surrogates within %Recovery acceptance limits for all samples and QC?					□ Samples reanalyzed □ Confirmed by reanalysis □ Insufficient sample for reanalysis □ Surrogates high, samples ND □ Visual Matrix interference-Client notified- Explain_____
9. Area of Internal Standards in all samples and QC within method limits? (524.2, -30% of CCV or -50% of ICAL mid pt) (624 – not method defined) (8260B & 8260C, 50% - 200% of ICAL mid pt)					□ High IS response. Sample(s) rerun to confirm, or at dilution. □ Low IS response. Sample(s) reanalyzed. Explain_____

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Table 7.Job Summary Check List (Pages 4 of 5)

TestAmerica *[lab name]*

					_____
10. Are internal standards <0.5 min of IS in last CCV? (524.2, 3SD of RT in ICAL; 624, ±30 sec of ICAL mid pt) (8260B, ±30 sec of ICAL mid pt; 8260C, ±10 sec of ICAL mid pt)					
11. Was pH of all aqueous samples (except TCLP/SPLP) measured and documented?					
12. Were preparation & analysis Holding Times met for all samples in the batch? (524.2, pH>2=24 hr, pH<2=14 d) (624, pH<2=14 d , A&A, pH7= 3 days, 2-CEVE, pH7=14d) (8260B&C water pH<2=14d, pH>2=7d, 2-CEVE, pH7=14d) (8260B&C soil: 48 hr to preserve; 14 d to analysis) (TCLP/SPLP: 14d to leach; 14d from leach to analysis)					
13. Were acid sensitive compounds analyzed from unpreserved sample vials? (624 – Acrolein, Acrylonitrile , 2-CEVE) (8260B&C – 2-CEVE) (See CA-T-TM-001)					e.g.; not cmpd of concern for project
14. Were spectra for all detections evaluated for correct identification?					
15. Was a review performed of all chromatographic peaks that were deleted to verify removal was appropriate? (perform review in Chrom – not TALS)					
16. Were unidentified peaks reviewed for missed target compounds?					
17. Were manual integrations performed correctly and properly documented? (dated, initialed and reason given; 2nd review of all MIs required)					Reasons: 1)Split Peak; 2)Undetected peak; 3)Tailing; 4)RT shift; 5)Wrong peak selected; 6)Baseline Correction; 7)Other-explain
18. Were Isomeric pairs checked for correct assignment? (verify against ICAL & CCV)					
19. Are weights, volumes and dilution factors correct?					
20. Were results from diluted & undiluted runs comparable?					
21. Dilution: Is highest target analyte >20% of calibration range?					
B. Other – Final Report Data Review					
22. Were all project requirements met?					
23. Samples checked to ensure all requested targets uploaded and reported correctly?					
24. Results for Samples/LCS/MS/MSD calculated/reported correctly in TALS and in final report? Are recovery & RPD limits present in final report?					(Reagents associated correctly?) (Limits in reference data?)
25. NCMs reviewed for applicability, correct references to batches/analytes, grammatical/typographical errors?					
26. Raw Data					
a. Unused data is clearly identified with reason not used					
b. All crossed out data is initialed and dated					
c. Out of control QC is clearly identified					
d. Any data that has a qualifier tick is commented on with appropriate action taken					

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Table 7.Job Summary Check List (Pages 5 of 5)

TestAmerica *[lab name]*

e. The first page of the run includes the filename, instrument, and analyst initials/signature					
30. Run Log					If Chrom worklist is used for runlog, all runs upload to Worklist
a. Unused data is clearly identified					
b. All crossed out data is initialed and dated					
c. Analyst initials/signature provided					
31.TALS Samples Tab					
a. LIMS Sample IDs / Containers are correct					
b. Method and matrix are correct					
c. Date and time match raw data					
d. Dilutions are correct					
e. Correct suffix designated (where applicable)					
32.TALS Worksheet Tab is complete and correct					
33.TALS Reagent Tab is complete and correct					
34.TALS QC Links Tab is correct					Missing QC? □ Check QC links, to samples and duplicates □ Check cross batch links □QC at second level review? Missing limits? □ Check QC links □ Check spike (reagents) associated with appropriate analytes □ check limits in ref. data-QA
35.TALS Sample Results Tab					
a. All unused data are marked Rejected or Accepted					
b. All reported analytes are marked Primary or Secondary					
c. Flags are correctly applied (no flags missing)					□ Apply manually □ Failing condition not propogated to samples- Re-calc
36.TALS Batch Information Screen documentation is complete					
37.Historical Data Checker: Check historical data. Print charts for outliners. Take corrective action as appropriate.					
38.TALS Status set to appropriate review level					□ Check for "yellow calculator"

2nd Reviewer: _____ **Review Date:** _____

Comments: _____

_____

_____

_____

_____

_____

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TestAmerica Buffalo GCMS VOA Dilution Calculation

Table 8:

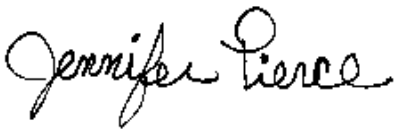
5mL and 25mL Water	2	(25mL/50mL)/5mL P&T
	4	(12.5mL/50mL)/5mL P&T
	5	(10mL/50mL)/5mL P&T
	8	(6.25mL/50mL)/5mL P&T
	10	(5mL/50mL)/5mL P&T
	20	(2.5mL/50mL)/5mL P&T
	25	(2mL/50mL)/5mL P&T
	40	(1.25mL/50mL)/5mL P&T
	50	(1mL/50mL)/5mL P&T
	80	(625uL/50mL)/5mL P&T
	100	(500uL/50mL)/5mL P&T
	125	(400uL/50mL)/5mL P&T
	200	(250uL/50mL)/5mL P&T
	400	(125uL/50mL)/5mL P&T
	500	(100uL/50mL)/5mL P&T
	800	(62.5uL/50mL)/5mL P&T
	1,000	(50uL/50mL)/5mL P&T
	2,000	(25uL/50mL)/5mL P&T
	4,000	(12.5uL/50mL)/5mL P&T
	5,000	(10uL/50mL)/5mL P&T
	8,000	(6.25uL/50mL)/5mL P&T

NOTE: **1. Primary dilutions are contained within the innermost parentheses. Any dilutions above 8000x are serial dilutions. The 50mL volumes are transferred into a 40mL Voa vial and contain zero headspace.**
2. If the analyst does not see the dilution listed on the work instruction; the dilution performed must be indicated on the raw data, including the dilution factor, in the "sample Info": filed of the quantitation report.

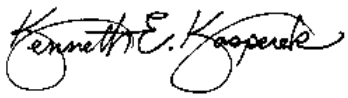
Title: Total and Amenable Cyanide Via Microdistillation Methods 335.4, 9012A / 9012B, SM4500-Cn E, Lachat 10-204-00-1-X

Once printed, this is considered an uncontrolled document.

Approvals (Signature/Date):



2/4/19
Jennifer Pierce Date
Inorganics Operation Manager



2/4/19
Kenneth Kasperek Date
Laboratory Director

2/4/19
Michael Mosscrop Date
Quality Assurance Manager

Facility Distribution No. _____ **Distributed To:_____**

1.0 Scope and Application

1.1 Analytes, Matrices, and Reporting Limits

Applicable matrices are drinking water, surface water, saline water and aqueous leachates. The laboratory standard reporting limit is 0.01 mg/L.

2.0 Summary of Method

2.1 Cyanide as hydrocyanic acid (HCN) is released from cyanide complexes by means of micro-distillation (SimpleDist®) and then absorbed in a scrubber containing sodium hydroxide solution. The cyanide ion in the absorbing solution is then analyzed colorimetrically.

2.2 Cyanide amenable to chlorination (CATC) can be determined by pretreatment of the sample (see section 10.2).

2.3 In the colorimetric measurement the cyanide is converted to cyanogen chloride, CNCl, by reaction with chloramine-T at a pH less than 8 without hydrolyzing to the cyanate. After the reaction is complete, color is formed upon the addition of pyridine-barbituric acid reagent. The absorbance is read at 570 nm.

3.0 Definitions

3.1 Cyanide is defined as cyanide ion and complex cyanides converted to hydrocyanic acid (HCN) by reaction in a reflux system of a mineral acid in the presence of magnesium ion.

4.0 Interferences

4.1 High results may be obtained for samples that contain nitrate and/or nitrite. During the distillation nitrate and nitrite will form nitrous acid which will react with some organic compounds to form oximes. These compounds formed will decompose under test conditions to generate HCN. The interference of nitrate and nitrite is eliminated by pretreatment of all samples and standards with sulfamic acid.

4.2 Sulfides adversely affect the colorimetric procedure. Samples that contain hydrogen sulfide, metal sulfides, or other compounds that may produce hydrogen sulfide during the distillation should be eliminated.

4.3 The presence of surfactants may cause samples to foam during refluxing. If this occurs, the addition of an agent such as DOW CORNING 544 antifoam agent will help prevent foaming.

4.4 Oxidizing agents, such as chlorine, decompose most cyanide containing samples. Therefore, each sample is tested for chlorine using potassium iodide starch test papers.

4.5 Thiocyanate is reported to be an interference when present at very high levels.

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

Potassium Cyanide will give off Hydrogen Cyanide (HCN) gas if combined with strong acids. Inhalation of CN gas can cause irritation, dizziness, nausea, unconsciousness and potentially death.

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 Safety Data Sheet (SDS) 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 SDS for each material before using it for the first time or when there are major changes to the SDS.

Material [1]	Hazards	Exposure Limit [2]	Signs and symptoms of exposure
Sulfuric Acid	Corrosive Oxidizer Dehydrator	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.
Chloramine-T Hydrate	Poison		May be harmful by inhalation, ingestion, or skin absorption. This material is irritating to mucous membranes and upper respiratory tract. Avoid contact and inhalation.

Pyridine	Flammable Irritant	5 ppm-TWA	Inhalation causes severe irritation to the respiratory tract. Symptoms of overexposure include headache, dizziness, nausea, and shortness of breath. Causes severe irritation possibly burns, to the skin. Symptoms include redness and severe pain. Absorption through the skin may occur, resulting in toxic effects similar to inhalation. May act as a photosensitizer. Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.
Potassium Cyanide	Poison Corrosive	5 Mg/M3 TWA as CN	**This material will form Hydrogen Cyanide (HCN) gas when combined with strong acids. Breathing HCN gas may result in death.** Corrosive to the respiratory tract. May cause headache, weakness, dizziness, labored breathing nausea and vomiting, which can be followed by weak and irregular heart beat, unconsciousness, convulsions, coma and death. Solutions are corrosive to the skin and eyes, and may cause deep ulcers, which heal slowly. May be absorbed through the skin, with symptoms similar to those noted for inhalation. Symptoms may include redness, pain, blurred vision, and eye damage.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

5.3 Many of the reagents used in these test methods are highly toxic. These reagents and their solutions must be disposed of properly.

5.4 Wear hand and eye protection suitable for use with caustic and corrosive materials.

5.5 Hot surfaces during operation – do not touch.

5.5.1 Heat blocks operate at up to 120°C.

5.6 Do not move unit while hot; sudden movement may result in bumping and sample loss.

5.7 Avoid breathing vapors, may be harmful or fatal. Review all safety data sheets for all materials utilized or generated in this operation.

5.8 Unplug unit prior to cleaning exterior surfaces of distilling units (SHOCK HAZARD). Wipe with damp sponge or towel first after each use..

5.9 THIS LIST CONTAINS SOME BASIC RECOMMENDED SAFETY PRECAUTIONS. IT SHOULD NOT BE CONSIDERED AS A COMPLETE OR EXHAUSTIVE LIST. MORE RIGOROUS OR ENHANCED PRECAUTIONS MAY BE NECESSARY WHILE USING THIS EQUIPMENT. PLEASE CONSULT YOUR SAFETY COORDINATOR AND SDS PRIOR TO USING THIS EQUIPMENT.

6.0 Equipment and Supplies

6.1 Instrumentation

- Environmental Express SimpleDist® Micro Distillation apparatus: The SimpleDist® Micro heating block is made from PTFE-coated graphite enclosed in a durable Kydex® housing with a built-in controller. Designed for use with disposable polypropylene tubes with hydrophobic membranes. Sample tubes are available from multiple vendors including Hach and Environmental Express.

- Analytical balance

- Lachat Quikchem 8000: flow injection analysis equipment designed to deliver and react sample and reagents in the required order and ratios.

    - Sampler
    - Multi-channel proportioning pump
    - Reaction unit or manifold
    - Colorimetric detector (570nm) (similar to a spectrophotometer)
    - Data system

6.2 Supplies

- Polypropylene disposable distillation micro tubes with caps and hydrophobic membranes
- Sample Assembly Press
- Heat Resistant Gloves
- Culture tube racks
- 125 mL Erlenmeyer flasks
- Filter pump
- Miscellaneous laboratory glassware (volumetric flasks, graduated cylinders, etc.).
- Eppendorf pipettes
- Lead acetate test paper
- Potassium iodide – starch test paper

7.0 Reagents and Standards

7.1 0.25N and 1.0 N Sodium Hydroxide (NaOH) solutions

7.2 Deionized Water (DI H_2O)

7.3 7.11M H_2SO_4 / 0.79M $MgCl_2$ Releasing Agent: In a hood, combine 110.8 g of reagent water and 32.2.g of magnesium chloride hexahydrate ($MgCL_2$•6H20) in a 500 mL beaker while stirring. Dissolve completely. Slowly add 139g (approximately 80 mL) of concentrated sulfuric acid (H_2SO_4) in small increments while stirring. **CAUTION:** Solution is highly exothermic and fumes will be released after adding sulfuric acid. Allow to cool. Expires after one year.

7.4 Sulfamic Acid: Dissolve 50.0 g of Sulfamic Acid (H_2NSO_3H) in 500 ml DI H_2O.

7.5 Lead Acetate (Powder)

7.6 Ascorbic acid

7.7 Stock cyanide solution 1mL = 1 mg CN; Purchased pre-made, two separate sources (Complex and Free)

NOTE: Stock cyanide solutions and intermediate cyanide solutions have limited stability. All cyanide solutions must be stored refrigerated and in the dark at all times. When an aliquot is needed to prepare other solutions, pour off a portion, protect from light, and immediately return the stock to the refrigerator. Prevent the stock from coming to room temperature for more time than needed. Used the poured off portion as quickly as possible once it is to room temperature to prepare the working standards and then discard the rest.

7.8 Phosphate Buffer, 0.71M: Dissolve 97.0g potassium phosphate, monobasic, anhydrous into 1L of DI H_2O. Store in dark bottle. Prepare biannually.

7.9 Chloramine-T solution: Dissolve 2.0g Chloramine-T into 250 mL of DI H_2O. Prepare daily.

7.10 Pyridine-Barbituric acid reagent: In a fume hood place 15g of Barbituric acid into a 1L volumetric flask, and add just enough DI H_2O to wash the sides of the flask and wet the barbituric acid. Add 75 mL of pyridine while stirring until barbituric acid dissolves. Add 15 mL of concentrated HCl, mix, and cool to room temperature. Dilute to 1L with DI H_2O and mix. Store in dark bottle. Prepare weekly.

7.11 Intermediate Cyanide STD: **50** ppm, Complex; used to prepare **LCS** (7.14.1 and 7.14.2) for distillation: **2.5 mL** of the 1000ppm **Complex** Cyanide Standard is added to 50mL DI H_2O. Expires within one week. Must be stored refrigerated and in the dark. When an aliquot is needed to prepare other solutions, pour off a portion, protect from light, and immediately return the stock to the refrigerator. Prevent the stock from coming to room temperature for more time than needed. Used the poured off portion as quickly as possible once it is to room temperature to prepare the working standards and then discard the rest.

7.11.1 Intermediate Cyanide STD **50** ppm, Free; used to prepare the **Instrument CCV** (7.13) and the **CCVL** (7.14.3) : **2.5 mL** of the 1000ppm **Free** Cyanide standard is added to 50mL DI H_2O. Expires within one week. Must be stored refrigerated and in the dark. When an aliquot is needed to prepare other solutions, pour off a portion, protect from light, and immediately return the stock to the refrigerator. Prevent the stock from coming to room temperature for more time than needed. Used the poured off portion as quickly as possible once it is to room temperature to prepare the working standards and then discard the rest.

7.12 Instrument Continuing Calibration Verification (**CCV**) **0.250** ppm: **0.250 mL** of the 50ppm Intermediate **Free** Cyanide Standard (**7.12**) is added to 50mL of 0.25N Sodium Hydroxide. This working standard must be prepared daily.

7.13 Laboratory Control Standard (LCS): The first distilled batch of the day requires a high-range LCS (0.400 mg/L), and a mid-range LCS (0.250 mg/L), as well as a low-range check CCVL (0.100 mg/L). Each subsequent batch within the same calendar day must have a mid-range LCS (0.250 mg/L) and a low-range CCVL (0.100 mg/L).

7.13.1 High Range LCS (0.400 mg/L): Add 0.400 mL of the *50 ppm* Intermediate **Complex** Cyanide Standard (**7.11**) to 50 mL of DI H_2O. Carry 6 mL through the same distillation procedure as outlined for samples in Section 11.0.

7.13.2 Mid Range LCS (0.250 mg/L): Add 0.250 mL of the *50 ppm* Intermediate **Complex** Cyanide Standard (**7.11**) to 50 mL of DI H_2O. Carry 6 mL through the same distillation procedure as outlined for samples in Section 11.0.

7.13.3 Low Range Check CCVL (0.100 mg/L): Add 0.100 mL of the *50 ppm* Intermediate **Free** Cyanide Standard (**7.12**) to 50 mL of DI H_2O. Carry 6 mL through the same distillation procedure as outlined for samples in Section 11.0.

7.13.4 Intermediate Cyanide STD **10 ppm** for **Matrix Spikes**; Complex: **0.5mL** of the 1000ppm **Complex** Cyanide standard is added to 50mL DI H_2O. Expires within one week. Must be stored refrigerated and in the dark. When an aliquot is needed to prepare other solutions, pour off a portion, protect from light, and immediately return the stock to the refrigerator. Prevent the stock from coming to room temperature for more time than needed. Used the poured off portion as quickly as possible once it is to room temperature to prepare the working standards and then discard the rest.

Massachusetts Contingency Program (MCP) regulations require an LCSD be distilled with each batch of samples. This LCS/LCSD should be distilled at 0.250 mg/L.

8.0 Sample Collection, Preservation, Shipment and Storage

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time [1]	Reference
Waters	Glass or Plastic	200mL	NaOH, pH >12; Cool 4 $\pm$ 2°C	14 Days	40 CFR Part 136.3 SM 4500-Cn^-
Soils	Glass or Plastic	50g	Cool 4 $\pm$ 2°C	14 Days	N/A

[1] Inclusive of distillation and analysis.

8.1 The sample should be collected in plastic or glass bottles 125mL or larger size. All bottles must be thoroughly cleansed and rinsed to remove soluble material. TestAmerica Buffalo purchases pre-cleaned bottles that come with a certificate of analysis.

8.2 Samples must be preserved with 2 mL of 10 N NaOH per liter of sample (pH>12) at the time of collection.

8.3 Samples should be analyzed as rapidly as possible after collection. If storage is required, the samples should be stored in a refrigerator/cooler to maintain temperature at 4±2° C. Distillation and analysis for cyanide must be completed within 14 days after sample collection for methods 9012 and 335.4.

9.0 Quality Control

9.1 All QC samples must be in the established acceptable range set by Test America Laboratories.

Quality Controls	Frequency	Control Limit
Method Blank (MB)	1 in 20 or fewer samples	< 0.01 mg/L
Laboratory Control Sample (LCS/LCSD)*	1 in 20 or fewer samples	90-110%
Continuing Calibration Blank (CCB)	1 in 10 or fewer samples	< 0.01 mg/L
Continuing Calibration Verification (CCV)	1 in 10 or fewer samples	90-110%
Sample Duplicate (DU)	1 in 20 or fewer samples	</=20% RPD
Matrix Spike (MS/MSD)	1 in 10 or fewer sample	90-110%

If MCP samples are distilled an LCSD must also be distilled within each batch of samples

9.2 All blanks must read less than the TA Buffalo reporting limit.

9.2.1 Reporting limit (RL) is 0.01 mg/L for aqueous samples

9.2.2 Reanalyze all samples associated with an unacceptable blank unless:

9.2.2.1 Detected concentrations in the sample < RL or

9.2.2.2 Detected concentration in the method blank < 10X amount in associated sample.

9.3 Duplicates are distilled and analyzed every twenty samples or less. Matrix spikes are distilled and analyzed every ten samples or less. Acceptance limits for spikes and duplicates are specified in each method (335.4/9012/4500 CN). If a duplicate or spike falls outside the acceptance limits, the data should be reviewed to determine cause. Re-analysis may be necessary if unacceptable values are due to lab error.

9.3.1 Reanalyze the LCS /CCV

9.3.2 If 2nd analysis is acceptable, analytical sequence can continue, however the previous 10 samples must be reanalyzed.

9.3.3 If 2nd analysis is unacceptable, analyze a new ICAL.

9.4 If sample specific spikes and duplicates have not been requested by a client, you must choose one for the batch. Be sure to include all information pertinent to the analysis, such as spike levels, date of analysis, analyst's initials, weights and volumes of samples in the Cyanide logbook. Also, be sure to include any out of the ordinary observations, comments or any problems that may occur.

9.4.1 Matrix interference can be assumed and corrective action is not required if both of the following conditions are met:

9.4.1.1 LCS recovery is acceptable

9.4.1.2 Recoveries in both MS and MSD are consistent (%RPD<20)

9.4.1.3 If LCS is unacceptable – re-analysis is required.

9.4.1.4 If recoveries in MS/MSD are different (e.g.: 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.

9.5 A non-conformance memo (NCM) must be completed and filed with the Project Manager and QA Manager for any of the following conditions:

9.5.1 Holding times exceeded

9.5.2 Insufficient sample volume for reanalysis

9.5.3 In the event of unknown positives or sample matrices 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.

9.6 Instrument QC

9.6.1 Initial Calibration Verification (ICV)

9.6.1.1 A calibration curve is made by preparing a series of standards and a blank, using suitable volumes of the Intermediate Calibration Standard.

9.6.1.2 The Intermediate Calibration Standard: 2.5ml stock 1000ppm STD into 50 ml of deionized water. The 50ppm intermediate standard for instrument

analysis can be used.

9.6.1.3 The calibration curve is to be distilled if using a complex cyanide standard. If a free cyanide standard is used to prepare the calibration curve then distillation is not required.

9.6.1.4 Initial Calibration Verification (ICV): Is run from the distilled 0.25ppm LCS in the first batch of distilled samples. This insures accuracy when curving with free cyanide intermediate and testing that curve with complex cyanide intermediate.

9.6.1.5 Calibration Curve is prepared using the following:

Curve Concentration	Intermediate STD into 50ml of 0.25N NaOH
0 mg/L	50ml of 0.25N NaOH
0.01 mg/L	0.01 ml Intermediate STD
0.05 mg/L	0.05 ml Intermediate STD
0.10 mg/L	0.1 ml Intermediate STD
0.20 mg/L	0.2 ml Intermediate STD
0.30 mg/L	0.3 ml Intermediate STD
0.40 mg/L	0.4 ml Intermediate STD
0.50 mg/L	0.5 ml Intermediate STD

A calibration curve containing these nine points is analyzed monthly, or when new reagents are made, whichever comes first.

9.6.1.6 If RCP/MCP samples are to be analyzed a calibration curve needs to be analyzed prior to analysis of samples.

9.6.2 Continuing Calibration Verification (CCV)

9.6.2.1 Continuing Calibration Verification (CCV) is made by adding 0.25mL of the 50ppm intermediate to 50mL of 0.25N NaOH for a final concentration of 0.25ppm.

9.6.2.2 A CCB and CCV must be run every ten samples on the instrument.

9.6.3 Calibration Acceptance Summary

Step	*Standards*	*Type*	*Control Limit*	*Frequency*
Initial Cal	0.0-0.5mg/L	Linear	R^2-value ≥0.995	Once every month at a minimum
ICV/CCV/LCS	0.4mg/L 0.25mg/L(ICV) 0.1mg/L	Linear	90-110%	Once after a new curve
ICB/CCB/MB	<.01	Linear	<RL	Every 10 samples or fewer
Low Level CLP Std (ICVL)	.01mg/L		70-130%	Once, immediately after calibration has been run

9.6.3.1 ICAL: Acceptance criteria for the calibration curve is a correlation coefficient (R-value) ≥0.995. If the R-value is less than 0.995, the calibration standards must be remade and a new curve analyzed.

9.6.3.2 The calibration curve must be analyzed at a minimum of once every month, unless CLP samples are being analyzed. If a batch contains CLP samples, a calibration curve must be run, along with a .01mg/L low level standard, before samples can be analyzed.

9.6.3.3 ICV/CCV: Obtained values must be within ±10% of true value.

9.6.3.4 Low-Level CLP Standard (.01mg/L): To be run immediately after calibration curve has been analyzed. Standard is made by adding 10uL of intermediate standard to 50mL of .25N NaOH. If standard is not within 70-130% acceptance limits, calibration must be run again, with low-level standard run immediately after.

10.0 Sample Pretreatment

10.1 Treatment for Potential Interferences

10.1.1 Oxidizing agents, such as chlorine, decompose most cyanides. Test by placing a drop of sample on a strip of potassium iodide (KI) starch paper previously moistened with acetate buffer solution, pH 4. A bluish color indicates the need for treatment. Add L-ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper, adding an additional 0.006g of ascorbic acid for each 100 mL of sample volume.

10.1.2 Oxidized products of sulfide convert CN^- to SCN^- rapidly, especially at high pH. Test for S_2^- by placing a drop of sample on lead acetate paper previously moistened with acetic acid buffer solution, at a pH of 4. Darkening of the paper indicates presence of S_2^-. Add lead acetate, or if the S_2^- concentration is too high, add powdered lead carbonate

[$Pb(CO_3)2$] to avoid significantly reducing pH. Repeat test until a drop of treated sample no longer darkens the acidified lead acetate paper. Filter sample before raising pH for stabilization. When particulate, metal cyanide complexes are suspected, filter solution before removing S_2^-. Reconstitute sample by returning filtered particulates to the sample bottle after the S_2^- removal. Homogenize particulates before analysis.

10.1.3 Aldehydes convert cyanide to cyanohydrin. Longer contact times between cyanide and the aldehyde and the higher ratios of aldehyde to cyanide both result in increasing losses of cyanide that are not reversible during analysis. If the presence of aldehydes is suspected, stabilize with NaOH at time of collection and add 2ml 3.5% ethylene diamine solution per 100 ml of sample.

10.2 Cyanide amenable to chlorination (**CATC**)

10.2.1 When determining cyanide amenable to chlorination part of the sample is first chlorinated to decompose the cyanides. Both the chlorinated and untreated samples are then subjected to distillation. The difference between the CN^- concentrations found in the two samples is expressed as cyanide amenable to chlorination.

10.2.2 To prepare the non-amenable portion of sample, pour 50ml of sample into a 250ml Erlenmeyer flask completely wrapped in aluminum foil. To this add $Ca(OCl)_2$ solution dropwise while agitating and maintaining a pH of 11-12 (adding NaOH if necessary.) Test for proper chlorination by placing a drop of solution on a strip of KI-starch paper. Cover flasks with aluminum wrapped watch glass and maintain residual chlorine for 1 hour while agitating. After 1 hour remove any residual chlorine by dropwise addition of $NaAsO_2$ solution or H_2O_2, followed by 4 drops of $Na_2S_2O_3$ solution. Test with KI-starch paper after each addition, until there is no color change.

CAUTION!: The initial reaction product of alkaline chlorination is the very toxic gas cyanogen chloride; therefore, it is necessary that this reaction be performed in a hood.

11.0 Procedure for Distillation using SimpleDist® Micro Distillation

11.1 Laboratory Control Standards, Method Blanks, and Matrix Spikes

11.1.1 Refer to Section 7.14 for instructions on preparation of Laboratory Control Samples (LCS) and Low Range Checks (CCVL).

11.1.2 Add 6 mL of deionized water to one sample tube. This is the Method Blank (MB).

11.1.3 For sample matrix spikes, add 6.0 mL of sample to the sample tube and then spike with 0.060 mL of the ***10 ppm*** Intermediate Matrix Spike Standard (7.14).

11.2 Turn on the heating blocks: Adjust set point of blocks to 120^0C. Block temperatures need to be verified that they are above 100^oC (to ensure boiling) at both the start and the end of the distillation using the block thermometer. Record temperatures in the spots provided in the logbook.

11.3 Place as many collector tubes as needed for the batch in the rack with the "D" end down and the "M" end up.

11.4 Pipette 1.5 mL of 1.0 N NaOH into the M end of the User-Fill collector tubes. Center a 30 mm membrane over the M end and seat a cap firmly on the end. If using pre-filled collector tubes, place in the rack with the M end up. Label the side of the tube with the sample ID.

11.5 Place disposable distillation sample tubes in the sample tube rack.

11.6 Pipette 6.0 mL of aqueous sample into each sample tube.

11.6.1 Add 0.250 mL of Sulfamic acid solution and 0.750 mL of 7.11M H_2SO_4 / 0.79M $MgCl_2$ Releasing Agent to each sample tube.

11.7 After adding reagents, immediately push the D end of the collector tube over the open end of each sample tube to start the seal.

11.8 Place the assembled tube into the press, putting the sample tube through the hole in the white base.

11.9 Grip the collector tube at the breakaway point to keep the tube from shifting during the pressing procedure. Press down on the press handle until the stop ring on the sample tube hits the D end of the collector tube. Use smooth constant pressure to avoid damaging the tubes.

11.10 Push the sample tube / D end of each tube into the preheated block so that the collector tube stop ring touches the block. **NOTE: Ensure the sample tube is pushed completely into the block or recoveries may be low.**

11.11 Set timer for 30 minutes. Do not pull the tubes out before 30 minutes to check them as this will cause the sample to suck back from the collector tube into the sample tube.

11.12 After 30 minutes, wearing heat resistant gloves, remove the first tube from the block. Immediately pull off the sample tube using a downward, twisting motion. **Important: Detach the sample tube within 4 seconds of removing the tube from the block or suck back of the sample from the collector tube back into the sample tube may occur.**

11.13 Dispose of acid solution in an appropriate waste container. Discard sample tube into trash container.

11.14 Repeat this procedure for the rest of the sample tubes.

11.15 Invert all collector tubes and place them in the collector tube rack with the D end up and allow to cool for 10 minutes.

11.16 After cooling, hold each tube horizontally and rinse the walls with the distillate. Slowly roll the tube so that the drops clinging to the walls settle down into the bulk of the distillate.

11.17 With the D end up, flick the tube with a finger to cause stubborn drops to fall into the M end.

11.18 With the D end up, break the collector tube in half at the breakaway point by pulling the D end hard towards yourself. Twist off and discard the D end.

11.19 Place the collector tube in the rack with the M end down.

11.20 Dilute up to the 6.0 mL mark on the tubes with DI water and mix with a gentle swirling motion, resulting in the original sample volume in 0.25N NaOH.

11.21 Seal the both the open end of the tube and the capped end with Parafilm if the sample is not going to be analyzed immediately.

12.0 Sample Analysis Procedure

12.1 System Start-up Procedure

12.1.1 Prepare reagent and standards as described in section 9.6.

12.1.2 Set up manifold as shown in Attachment 20.1

12.1.3 Input data system parameters as in Attachment 20.2

12.1.4 Allow 15 minutes for heating unit to warm up to 60^0C.

12.1.5 Place samples and/or standards in autosampler. Input the information required by the data system, such as concentration, replicates, and QC scheme.

12.1.6 Calibrate the instrument by injecting the standards.

12.1.7 If sample concentrations are greater than 0.5 mg/L, the distilled sample should be diluted with 0.25N NaOH diluent. Do not dilute samples or standards with DI water.

12.2 For analyzing distilled samples, prepare a standard curve by plotting the peak area of standards against known concentration values. Compute concentrations by comparing sample peak area with standard curve.

13.0 Calculations / Data Reduction

13.1 Sample results are calculated from the calibration curve by using linear regression.

13.2 For liquid samples, the result is expressed as mg/L.

13.3 For solid samples, the result is expressed as mg/Kg on a dry basis.

13.4 To convert the mg/l result obtained from the calibration curve to mg/Kg use the following equation:

mg/Kg (wet) = [mg/L X final vol. of leached sample] / grams sample used

mg/Kg (dry) = mg/g (wet) / decimal dry weight

13.5 Percent Recovery for Analyses Involving Spikes:

$$\%\,\text{Recovery} = \left[\frac{(SSR - SR)}{SA}\right] \text{ x } 100$$

where:

SSR = spiked sample result
SR = sample result
SA = spike added

13.6 Relative Percent Difference (RPD):

$$RPD = \frac{|x_1 - x_2|}{\left(\frac{x_1 + x_2}{2}\right)} \text{ x } 100$$

where:

x_1 = analytical % recovery
x_2 = replicate % recovery

13.7 Measured Concentration by Linear Regression:

$$x = \frac{a - b}{}$$

where:

a = area counts for analyte to be measured
m = slope
x = concentration
b = intercept

13.8 Percent Recovery for LCS:

$$\%\ \text{Recovery (LCS)} = 100\left(\frac{E}{C}\right)$$

where:

E = obtained (experimental) value C = true value

14.0 Method Performance

14.1 Method Detection Limit Study (MDL)

Method Detection Limit: A valid method detection limit for each analyte of interest must be generated. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B. See TestAmerica SOP S-Q-003, "Method Detection Limit Studies," current revision, for further guidance. Current TestAmerica Buffalo MDLs are maintained the QA department and are easily viewed in the laboratory LIMs system.

14.2 Demonstration of Capabilities

14.2.1 A one–time initial demonstration of performance for each individual method for both soil and water matrices must be generated.

14.2.2 This requires quadruplicate analysis of a mid–level check standard containing all of the standard analytes for the method using the same procedures used to analyze samples, including sample preparation.

14.2.3 Calculate the average recovery and standard deviation of the recovery for each analyte of interest.

14.2.4 Compare these results with the acceptance criteria given in the Method or to laboratory historical limits (if available).

14.2.5 Repeat the test for any analyte that does not meet the acceptance criteria. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

14.3 Training Requirements

14.3.1 The supervisor has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience.

14.3.2 The following analyst validation information is maintained for this method in the laboratory QA files.

14.3.3 The analyst must complete the laboratory safety orientation training that includes, but is not limited to, chemicals, PPE requirements, and electrical safety.

14.3.4 The analyst must read and understand this SOP.

14.3.5 The analyst must read and understand the Method used as reference for this SOP.

14.3.6 The analyst must complete a DOC or successfully analyze PT samples annually.

14.3.7 The analyst must complete the TestAmerica Quality Assurance Training.

15.0 Pollution Control

Waste Streams Produced by the Method from the instrument contains pyridine, which has a pH >7 and is disposed of in the “D Pyridine” waste container.

16.0 Waste Management

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.”

17.0 References / Cross-References

17.1 USEPA Methods for the Determination of Inorganic Substances in Environmental Samples, Method 335.4, EPA/600/R-93/100, Revised August 1993

17.2 Method 9010B, "Total and Amenable Cyanide: Distillation," Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition, Update III, December 1996.

17.3 Method 9012A, "Total and Amenable Cyanide (Automated Colorimetric, with Off-line Distillation)," Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, Update III, September 1996.

17.4 Method 9012B, "Total and Amenable Cyanide (Automated Colorimetric, with Off-line Distillation)," Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, Update III, August 2002.

17.5 Physiologically Available Cyanide (PAC) Method, Massachusetts Department of Environmental Protection, January 1996 Protocol.

17.6 Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2012, Method 4500-CN E and 4500-CN G.

17.7 Lachat Method 10-204-00-1-X, Total Cyanide; MicroDIST® method; Revision Date November 29th, 2007.

18.0 Method Modifications:

Item	Method	Modification
1	Lachat 10-204-00-1	Solutions are not degassed. There is no interference from gas in the solutions or reagents

19.0 Attachments

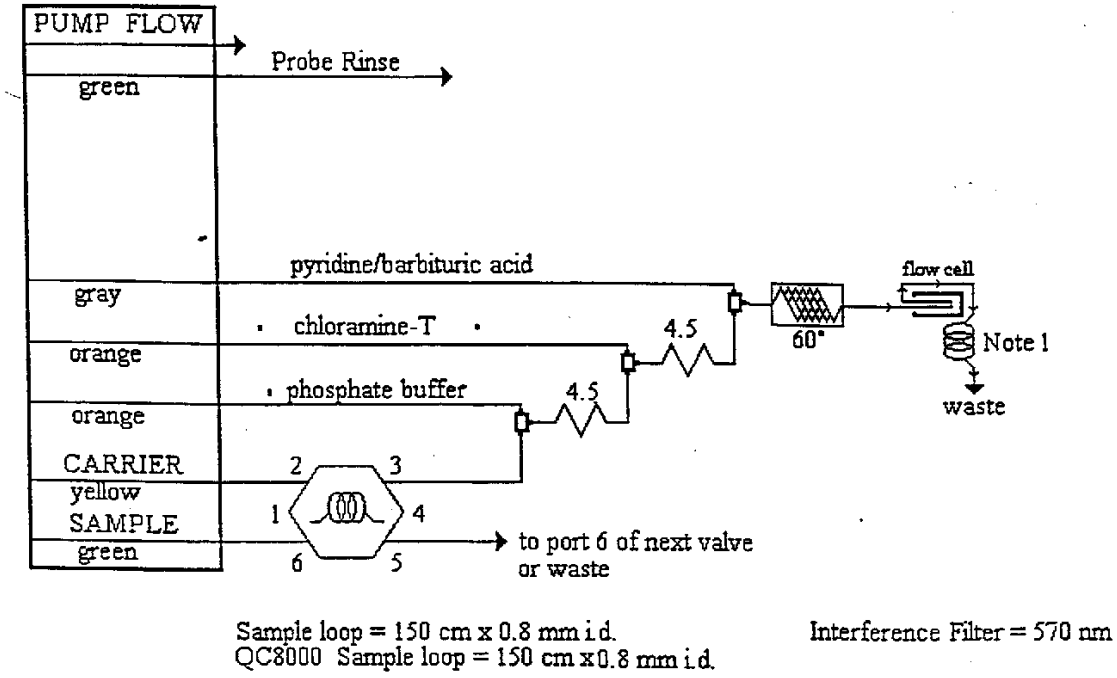
20.1: Cyanide Manifold Diagram
20.2: Data System Parameters for QC8000
20.3: Analytical Sequence
20.4: Analytical Batch
20.5: Distillation Batch
20.6: Wet Chemistry Batch Summary

20.0 Revision History

- Revision 1, Dated 4 February 2019
  - Updated Approval signatures

- Revision 0, Dated 11 October 2017
  - Adapted from SOP BF-WC-015 Rev. 11; removed all references relating to conventional midi-distillation procedure and replaced with instructions for micro-distillation via Lachat Method 10-204-00-1-X

Attachment 20.1
Cyanide Manifold Diagram



Carrier is 0.25 N sodium hydroxide solution. All manifold tubing is 0.8mm (0.030 in) i.d. This is 5.2 uL/cm. 4.5 is 70 cm tubing on a 4.5 cm coil support.

APPARATUS: An injection valve, a 10mm path length flow cell, and a colorimetric detector module

are required. The shows 650 cm tubing wrapped around the heater block at the specified temperature.

Note 1: 2 meter back pressure loop, 0.52 mm i.d.

Attachment 20.2
Data System Parameters for QC 8000

The timing values listed below are approximate and will need to be optimized using graphical events programming.

Sample Throughput:	80 samples/h, 45 s/sample
Pump speed:	35
Cycle period:	45

Analyte Data:

Concentration Units:	mg CN-/L
Peak Base Width:	39s
% Width Tolerance:	100
Threshold:	25000
Inject to Peak Start:	24 s
Chemistry:	Direct

Calibration Data:

Levels	1	2	3	4	5	6	7	8	9
Concentration mg/L	0.50	0.40	0.30	0.20	0.10	0.05	0.01	0.00	0.00

Calibration fit Type:	1ST Order Polynomial
Calibration Rep. Handling:	Replace
Weighting method:	No
Concentration Scaling:	None
Force through Zero:	No

Sampler Timing:

Min. Probe in wash Period:	14 s
Probe in Sample Period:	20 s

Valve Timing:

Load Time:	0.0 s
Load Period:	20 S
Inject Period:	25 s

Attachment 20.3
Analytical Run Sequence

Cyanide Non CLP sequence		**Cyanide MCP sequence**
CCV		CCV
CCB	Second distillation	CCB
MB	MB	MB
LCS 0.400	LCS 0.250	LCS 0.250
LCS 0.250	CCVL 0.100	LCSD 0.250
CCVL 0.100	Sample	CCVL 0.100
Sample	Etc	Sample
Sample		Sample
Sample		Sample
Sample		Sample
Sample		Sample
Sample spike (MS)		Sample spike (MS)
CCV		CCV
CCB		CCB
Sample		Sample
Sample		Sample
Sample		Sample
Sample		Sample
Sample		Sample
Sample		Sample
Sample		Sample
Sample		Sample
Sample duplicate (DU)		Sample duplicate (DU)
Sample spike (MS)		Sample spike (MS)
CCV		CCV
CCB		CCB

Attachment 20.4
Analytical Run

I

Attachment 20.5
Distillation Logbook

Analyst:_____ Date:_____ TestAmerica BUFFALO Logbook # [EXAMPLE]
TALS Batch #:_____ Cyanide Micro-Distillation Logbook

Job #	Sample I.D.	Dist. Flask	Sample Volume (mL)	Soil Weight (g)	Spike Volume	If Spiked Please Check:	Comments

Start Time:_____
End Time:_____
Cl_2 Check:_____
H_2S Check:_____

0.400 mg/L Complex CN LCS:_____
0.250 mg/L Complex CN LCS:_____
0.100 mg/L Free CN CCVL:_____
10 ppm Complex CN MS:_____
10 ppm Free CN MS:_____
ERA Soil Lot:_____

1.0 N NaOH:_____
7.11M H_2SO_4 / 0.79M $MgCl_2$:
H_3NSO_3:_____
$NaCH_3COO$:_____
$ZnCH_3COO$:_____

SimpleDist ____: Set Temp. (^oC):_____ Measured Start Temp. (^oC): ____Measured End Temp. (^oC):____

Reviewed By:_____Date: _____

Attachment 20.6 Wet Chemistry Batch Summary

Title: The Analysis of Digestates for Hexavalent Chromium by EPA SW846 7196A

Once printed, this is considered an uncontrolled document

Approvals (Signature/Date):

Jasmine Parillo — 03/05/2018	Dan Helfrich — 03/05/2018
Jasmine Parillo — Date	Dan Helfrich — Date
Department Manager	Health & Safety Manager /Coordinator
Carl Armbruster — 03/05/2018	03/05/2018
Carl Armbruster — Date	Mark Acierno — Date
Quality Assurance Manager	Laboratory Director

1.0 Scope and Application

1.1 Analytes, Matrix(s), and Reporting Limits

1.1.1 This SOP is applicable to the determination of hexavalent chromium digestates of solid samples using SW846 Method 7196A. Solid samples must be first digested according to Method 3060A USEPA SW846 3rd Edition, TestAmerica Edison SOP ED-WET-010 (The Alkaline Digestion of Soil Samples for the analysis of hexavalent chromium).

1.1.2 The laboratory's reporting limit for hexavalent chromium in soil is 2.0 mg/kg.

1.1.3 On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in Sections 7 (Review of Work Request) and 19 (Test Methods and Method Validation) of TestAmerica Edison's Quality Assurance Manual (ED-QA-LQM).

2.0 Summary of Method

Solid samples are digested utilizing SOP ED-WET-010, alkaline digestion of soil samples via Method 3060A. Following the sample preparation and digestion procedure, dissolved hexavalent chromium is determined spectrophotometrically at 540 nm by reaction with diphenylcarbazide in acid solution.

3.0 Definitions

For a complete list of definitions refer to Appendix 2 in the most current revision of TestAmerica Edison's Quality Assurance Manual (ED-QA-LQM).

4.0 Interferences

4.1 Molybdenum and Mercury react to form color with diphenylcarbazide, however the intensity of color is much lower than those for chromium at the specified pH. Concentrations up to 200 mg/L can be accepted.

4.2 Vanadium interferes strongly, but can be tolerated up to 10 times the concentration of Cr (VI) present.

4.3 Iron may cause a yellow color but should not affect the colorimetric measurement at 540 nm.

4.4 Reducing matter may reduce hexavalent Cr to trivalent Cr in varying amounts. No preventative measure is available at this time; however, interference is checked by post digestion spike samples.

4.4.1 The reducing/oxidizing tendency of each matrix may be determined by characterization of samples for additional analytical parameters, such as pH, ferrous iron, sulfides, and Oxidation Reduction Potential. Other indirect indicators of reducing/oxidizing tendency include Total Organic Carbon

(TOC), Chemical Oxygen Demand (COD), and Biological Oxygen Demand (BOD).

4.5 For waste materials or soils containing soluble Cr (Ill) concentrations greater than four times the laboratory Cr (VI) reporting limit, Cr (VI) results obtained using this method may be biased high due to method-induced oxidation.

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

Samples that contain high concentrations of carbonates or organic material or samples that are at an elevated pH can react violently when acids are added.

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.

(1)		Limit (2)	
Nitric Acid	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Potassium Dichromate	Oxidizer Corrosive Carcinogen	0.1 Mg/M3 TWA as CrO3	Extremely destructive to tissues of the mucous membranes and upper respiratory tract. May cause ulceration and perforation of the nasal septum. Symptoms of redness, pain, and severe burn can occur. Dusts and strong solutions may cause severe irritation. Contact can cause blurred vision, redness, pain and severe tissue burns. May cause corneal injury or blindness.
Sulfuric Acid	Corrosive Oxidizer Dehydrator Poison Carcinogen	1 Mg/M3-TWA	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.

6.0 Equipment and Supplies

6.1. Instrument

- Spectrophotometer for use at 540 nm, providing a light path of 1cm or longer
- pH meter, Orion benchtop or equivalent

6.2. Supplies

- Nalgene 115-ml disposable filter unit with 0.45um filter
- Membrane filters, 0.45um and 0.1 um
- Specimen cups (plastic)
- Eppendorf or Finnpipettes, varying volumes
- Class A volumetric flasks
- Class A graduated cylinder
- Vacuum pump
- Magnetic stirrer (Teflon coated)
- Transfer pipettes

7. Reagents and Standards

7.1. Reagents

7.1.1. Sulfuric acid (10% v/v): Measure 100 ml of concentrated reagent grade H_2SO_4 into a 1000 ml volumetric flask (1/2 filled w/D.I. water) and dilute to mark with deionized water. Stable for six months, store at room temperature.

7.1.2. Indicator solution (DPC): Place 5.0 g 1,5-Diphenylcarbazide (AR Grade) in an amber 1000 ml volumetric flask and dilute to mark with acetone. Prepare monthly or when solution becomes cloudy. Store at room temperature.

7.1.3. Acetone: reagent grade; for stability and storage information refer to manufacturer's instructions.

7.1.4. 1:1 HNO3: Add 500ml DI to a 1 Liter volumetric flask and then slowly add 500ml of concentrated reagent grade HNO3. Solution is stable for 6 months. Store at room temperature.

7.1.5. 1N NaOH: Place 4.0g reagent grade NaOH in a 100ml volumetric flask and dilute to the mark with deionized water. Stable for six months, store at room temperature.

7.2 Standards

7.2.1 Potassium Dichromate Primary Standard Solution (1000 mg/L Cr+6): Weigh 0.2829 g of Potassium Dichromate ACS grade, J.T. Baker, cat# 3093-01 (dried for 1 hour at 105ºC) and dissolve in deionized water in a 100 ml flask. Dilute to the mark. Stable for 6 months, store at room temperature.

7.2.2 Potassium Dichromate Secondary Standard Solution (1000 mg/L Cr+6): Weigh 0.2829 g of Potassium Dichromate ACS grade, J.T. Baker, cat# 3090-04 (dried for 1 hour at 105ºC) and dissolve in deionized water in a 100 ml flask. Dilute to the mark. **Note**: Prepare the secondary standard from a source or lot different from the primary standard solution. Stable for 6 months, store at room temperature.

7.2.3 Hexavalent Chromium Primary Spiking Solution (100 mg/L Cr+6): Prepare by adding 10 ml of 1000 mg/L Cr+6 primary standard (Sec 7.2.1) to a 100 ml volumetric flask and dilute to volume with deionized water. Stable for 6 months, store at room temperature.

7.2.4 Hexavalent Chromium Secondary Spiking Solution (100 mg/L Cr+6) Prepare by adding 10 ml of 1000 mg/L Cr+6 secondary standard (Sec 7.2.2) to a 100 ml volumetric flask and dilute to volume with deionized water. Stable for 6 months, store at room temperature.

7.2.5 Lead Chromate: AR Grade; for stability and storage information refer to manufacturer's instructions.

8. Sample Collection, Preservation, Shipment and Storage

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	Container[1]	Size[2]	Preservation	Holding Time[3]	Reference
Soils	Glass, plastic	2.5 grams	Cool 4 ± 2 C	30 Days - *from sampling to extraction*	SW846 Method 3060A
				168 Hours – *from extraction to determinative analysis*	SW846 Method 7196A

[1] Containers should not contain stainless steel
[2] Additional volume may be required if the sample is chosen for QA or if a re-prep is required.
[3] The alkaline digestate must be analyzed within 168 hours after extraction from the soil.

9. Quality Control

9.1. **Sample QC** - The following quality control samples are prepared with each batch of 20 samples or less.

9.1.1. Method Blank: One method blank must be digested and analyzed per batch. A method blank consists of 50 ml digestion solution and is carried through the entire digestion and analytical procedure. The concentration of the method blank must be less than the reporting limit or the entire batch must be re-digested and re-analyzed.

9.1.2. Laboratory Control Sample: Two secondary source (LCS) shall be digested and analyzed per batch.

- **LCS soluble (LCSSRM)** is obtained from an independent source (ERA). Prepare the LCS soluble solution by diluting the concentrated LCS solution as indicated in the manufacturer's instructions. If necessary, prepare a different dilution so that the concentration after analysis falls within the calibration curve. Add 5ml of the diluted LCS soluble solution into 50ml digestion solution. The results must be within vendor specified QC limits or the entire batch must be redigested and re-analyzed. Document the preparation of the LCS soluble solution in the Reagent module in TALS.

- **LCS insoluble (LCSI)** is prepared by adding 0.010g-0.020g of PbCrO4 into 50ml digestion solution. The results must be within 80-120% of the true value or the entire batch must be redigested and re-analyzed. (Typical amount of $PbCrO_4$ added to LCSI is 0.011g, this is equivalent to 708 mg Cr (VI)/Kg).

9.1.3. Predigestion Matrix Spikes: Both a soluble and insoluble pre-digestion matrix spikes must be analyzed per batch of ≤ 20 field samples.

9.1.3.1 Soluble matrix spike (MSS): spike the sample with 1.0 ml of the 100 ppm Cr (VI) primary spiking solution prepared in Sec 7.2.3 (equivalent to 40mg/kg Cr(VI)).

9.1.3.2 Insoluble matrix spike (MSI): to a separate sample aliquot add 0.010g- 0.020g of $PbCrO_4$. It is used to evaluate the dissolution during the digestion process. Typical amount of $PbCrO_4$ added to LCSI is 0.011g, this is equivalent to 708 mg Cr (VI)/Kg.

9.1.3.3 Both matrix spikes are then carried through the digestion process. The acceptance range for the matrix spike recoveries is 75-125%. If the matrix spike recoveries fall outside these recovery limits, the entire batch must be rehomogenized, redigested, and reanalyzed.

- Note: If redigesting/reanalyzing the batch, the Soluble matrix spike (MSS) is spiked at twice the sample concentration or 40mg/kg Cr(VI) whichever is greater.

9.1.3.4 If upon reanalysis, the matrix spike is not within the recovery limits of 75%-125%, but the LCS is within the criteria specified in Section 9.1.2, additional laboratory characterization of each sample in the batch for ORP (see TestAmerica Edison SOP ED-WET-066, Redox by SM2580) and pH (see TestAmerica Edison SOP ED-WET-061, pH Soil by SW846 9045C) may be required by the client to determine if the sample exhibits reducing conditions. Further characterization for total sulfides, Total Organic Carbon (TOC), Chemical Oxygen Demand (COD), or Biochemical Oxygen Demand (BOD) may also be required by the client.

9.1.4. Duplicate (DU): One duplicate laboratory sample must be analyzed per batch. The sample used for the predigestion spike should be used for this purpose. Duplicate samples must have a Relative Percent Difference (RPD) of ≤20%, if both the original and the duplicate are ≥ four times the laboratory reporting limit. A control limit of ± 2.0mg/kg (laboratory reporting limit) is used when either the original or the duplicate sample is < four times the laboratory reporting limit.

9.1.5. Post Digestion Spike (PDS): Following the analysis (colorimetric determination), a post-digestion spike must be analyzed per batch. The spike concentration must be equivalent to 40mg/kg or twice the sample concentration, whichever is greater. To spike the extract with 40mg/Kg Cr

(VI), add 0.50 ml of 100 ppm Cr (VI) primary standard to a 50.0 ml alkaline extract, pour out 45.0 ml of the spiked sample and add color indicator and adjust pH (see Sec 10.3.4 & 10.3.5); bring the final volume to 50ml with deionized water. The post digestion spike must be performed on a field sample, not on a field blank or preparation blank. If possible perform the post digestion spike analysis on the sample used for the matrix spike. Recovery limits for the post-digestion spike are 85-115% of the true value. If the post digestion spike fails to meet the recovery limits, a post spike must be re-analyzed using the alkaline extract. Adjust the pH of the sample Duplicate (alkaline extract) back up to 8.0-8.5 using 1N NaOH; then respike and reanalyze following Sec. 10.3.4-10.3.5.

9.2. Instrument QC

9.2.1. Initial Calibration Verification (ICV): The ICV (0.50 mg/L Cr (VI)) is analyzed immediately after an acceptable initial calibration. The ICV standard must be from a source separate from the calibration standards (i.e., different manufacturer or separate lot) and its recovery must be within ±10% of the expected value. The ICV is prepared and analyzed similar to the calibration standards; prepare by adding 0.5 ml of 100 ppm Cr (VI) Secondary Spiking Solution (Sec. 7.2.4) into a specimen cup containing 50 ml of digestion fluid. If the measured concentration exceeds the ±10% limit, a second analysis should be performed. If the result still exceeded the ±10% limit, the analysis should be terminated until the source of the problem is identified and corrected.

9.2.2. Continuing Calibration Verification (CCV): A CCV is a mid-point calibration Cr (VI) standard (0.5ppm) from a different source than the calibration standards. Add 0.5 ml of 100 ppm Cr (VI) Secondary Spiking Solution (Sec. 7.2.4) into a specimen cup containing 50 ml of digestion fluid. The CCV is analyzed after every 10 samples (20 readings including backgrounds), and after reading the last sample. Acceptance criteria for the CCV are 90-110% of the true value. If the result is not within the acceptance limits, all samples following the last acceptable CCV must be re-analyzed.

9.2.3. Initial Calibration Blank and Calibration Check Blank (ICB,CCB): An initial calibration blank (ICB) must be analyzed immediately following the calibration curve and a continuing calibration blank (CCB) is analyzed after each CCV. The sample consists of 50 ml digestion solution and is carried through the entire analytical procedure. The concentration of the CCB must be below the reporting limit if not, all samples following the last acceptable CCB must be re-analyzed.

10. Procedure

10.1. Sample Preparation:

10.1.1. Just prior to analysis, SLOWLY adjust the pH of the sample extract to a pH of 7.0-8.0 with constant stirring using 1:1 nitric acid. Record pH and time. If a flocculent precipitate forms after the addition of 1:1 HNO3, filter the sample through a 0.45 um membrane filter, a larger size filter may be used to pre-filter the sample. Monitor the pH with a calibrated pH meter. If the pH drops below 7.0, discard the sample extract and re-digest the sample.

10.1.1.1. Remove and rinse the stir bar. Quantitatively transfer the sample extract to a 100 ml volumetric flask and dilute to the mark with deionized water.

10.1.1.2. If necessary, the solution can be diluted to eliminate the effects of color on the analytical determination. Use the smallest dilution necessary and record results.

10.2. Calibration

10.2.1. Prepare fresh calibration standards everyday or before each analysis.

10.2.2. Prepare a set of 6 calibration standards. Prepare 0.0, 0.05, 0.1, 0.5, 0.75, and 1.25 mg/l $K_2Cr_2O_7$ standards by aliquoting 0, 0.05, 0.1, 0.5, 0.75 and 1.25 mls of 100ppm Cr (VI) Primary Spiking Solution (Sec 7.2.3) respectively into the specimen cups containing 50mls of digestion fluid. At the same time prepare the mid-point Initial Calibration Verification and Initial Calibration Blank, see Sec 9.2.

10.2.3. Adjust pH to 7.5±0.5 with 1:1 HNO_3 and dilute to 100 ml with DI water. Record pH reading and analysis time in the logbook.

10.2.4. Develop the color for the standards as explained in Section 10.3 of this SOP.

10.2.5. Following the preparation of the calibration standards, “zero” the spectrophotometer with the 0 ppm standard. Analyze the standards.

10.2.6. The correlation coefficient must be 0.995 or better.

10.2.7. Immediately following calibration of the spectrophotometer and before reading samples, verify the calibration of the spectrophotometer by analyzing an ICV and ICB.

10.3. Sample Analysis

10.3.1. Warm up spectrophotometer and set to 540nm.

10.3.2. Prepare two rows of plastic cups and label them accordingly (first row with sample no. and the 2nd row as background).

10.3.3. Pour out 45.0 ml of the sample extracts, which have already been pH adjusted to between 7.0 and 8.0, into the appropriately labeled cups. Do the same for the background cups using 10 ml of the sample extract.

10.3.4. Add 1.0 ml indicator solution and swirl. (Do not add reagent to background sample).

10.3.5. Slowly add 10% H_2SO_4 (Sec 7.1.1) dropwise while swirling and monitoring pH until pH is 2 ±0.5. Record reading in the appropriate logbook.

10.3.6. Transfer sample to 50 ml volumetric flask and bring to volume with deionized water. Empty contents into labeled specimen cup to mix.

10.3.7. Let stand 5-10 minutes for full color development.

10.3.8. Read calibration standards, QC samples, and samples in a 1 cm cell on a spectrophotometer at 540 nm. (Note: Calibration standards and samples must be read within the same timeframe following full color development).

10.3.9. Continue analyzing samples and quality control samples by first reading the sample followed by its background sample.

10.3.10. Dilute samples that exceed calibration curve using deioinized water and analyze following Sec. 10.3.3-10.3.7. Add dilution factor to TALS under "dilution" column. Note: The dilution should be made from the sample extract that has not had the indicator added.

10.3.11. After every twenty readings (10 samples) and after reading the last sample in the batch, verify the spectrophotometer calibration by reading a calibration check standard (CCV) and calibration check blank (CCB).

11.0. Calculations / Data Reduction

11.1. Accuracy:

$$\text{ICV / CCV, LCS \% Recovery} = \frac{\text{observed concentration}}{\text{known concentration}} \times 100$$

$$\text{MS \% Recovery} = \frac{\text{(spiked sample) - (unspiked sample)}}{\text{spiked concentration}} \times 100$$

11.2. Precision (RPD):

$$\text{Matrix Duplicate (MD)} = \frac{|\text{orig. sample value - dup. sample value}|}{[(\text{orig. sample value + dup. sample value})/2]} \times 100$$

11.3. Concentration = Hexavalent Chromium in mg/Kg = $\frac{A \times B \times E * 100}{C \times D}$

Where:

A = Concentration from the calibration curve in mg/L
B = Final digested volume in Liters
C = Wet sample weight in kg
D = percent solids
E = Dilution (if necessary)

NOTE: All dry weight corrections are made in TALS at the time the final report is prepared.

11.4. Trivalent Chromium Calculation: When required, the calculation for trivalent chromium is completed using TALS Method '7196a_CR3.' Samples must be logged in under this method as well as the methods for Total chromium (metals) and Hexavalent chromium. Upon completion of the total and hexavalent chromium analyses the analyst may process the trivalent chromium results as follows:

- In order for TALS to perform an automated trivalent chromium calculation enter '1' (for 'yes') in trivalent chromium batch information page in response to the prompt 'automatically perform calculation.' As long as both methods are at 2nd level review status in TALS the program will automatically pull in the metals results for chromium and the hexavalent chromium results to perform the automated calculation. TALS will display an 'ok' message on the worksheet tab if the Cr6 result is less than Total Cr result.
- In cases where Total Cr results are not linked to TALS method 7196a_CR3, trivalent chromium is calculated manually. Enter '0' (for 'no') in batch information page 'Perform calculation.' Results will be entered manually.

11.5. Data reduction:

11.5.1. All data is recorded directly in TALS and recorded in the logbook at the time the analysis is performed.

11.5.2. Attach the prep and analytical logbook pages and calibration curve to the batch as a pdf file.

11.5.3. On the worksheet tab, enter the sample absorbance under 'Uncorrected Abs' and background absorbance under 'Color Blank Abs.' Also, enter the pH between 7-8 as 'initial pH',' pH between 1.5-2.5 as 'Final pH' and the background pH under 'Notes.'

11.5.4. Record special notes and observations in the "worksheet" tab and record reagent information in the prep batch information page (see "view batch information" page of ADII).

11.5.5. Analyst must fill out the Wet Chem Data Review checklist (WI# EDS-WI-008) during the first level review. After the batch is second level reviewed, the checklist is filed in wetchem department and scanned in the network drive.

12.0. Method Performance

12.1. Method Detection Limit Study (MDL)

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 19 (Test Methods and Method Validation) of TestAmerica Edison's Quality Assurance Manual (ED-QA-LQM). 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.

12.2. Demonstration of Capabilities

For DOC procedure refer to Section 19 in the most current revision of TestAmerica Edison's Quality Assurance Manual (ED-QA-LQM).

12.3. Training Requirements

Refer to TestAmerica SOP No. ED-GEN-022, Training, for the laboratory's training program.

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

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 TestAmerica SOP No. ED-SPM-008 (Laboratory Waste Disposal Procedures).

14.2. The following waste streams are produced when this method is carried out:

- Expired Standards – The vials are collected in a 1 gallon polyethylene bucket. These vials are then transferred to an open top 55 gallon steel or polyethylene waste drum. These drums are transported to a waste facility for proper disposal.
- Sample waste-After analysis, the samples and standards are collected in a polyethylene container labeled 'Cr6+ waste.' Once the container is full, it is brought to the waste room for disposal.

15.0. References / Cross-References

15.1. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd ed., U.S. Environmental Protection Agency, Office of Solid Waste and Emergency

Response. U.S. Government Printing Office: Washington, DC, 1995; SW-846, Method 7196A.

15.2. Test America Edison SOP ED-WET-010, The Alkaline Digestion of Soil Samples for the Analysis of Hexavalent Chromium, most current revision.

15.3. TestAmerica Edison Document No. ED-QA-LQM, *Laboratory Quality Manual*, most current revision.

15.4. TestAmerica Edison SOP ED-GEN-022, *Training*, most current revision.

15.5. TestAmerica Edison SOP No. ED-SPM-008, *Laboratory Waste Disposal Procedures*, current revision.

15.6. TestAmerica Edison SOP ED-WET-066, Redox, Analysis of Oxidation-Reduction Potential, most current revision.

15.7. TestAmerica Edison SOP ED-WET-061, Analysis of pH for soil and organic samples electrochemically, Method 9045C, most current revision.

15.8. Wetchem Data Review Checklist Work Instruction # EDS-WI-008, current revision.

15.9. TestAmerica Corporate Environmental Health and Safety Manual, Document No. CW-E-M-001, most current revision.

16. Method Modifications:

N/A

17. Attachments

N/A

18. Revision History

- **Revision 11, dated 05 March 2018**
  - Sec 11.4: Added procedure for Trivalent chromium calculation using TALS method 7196a_CR3; subsequent section adjusted accordingly.

- **Revision 10, dated 23 February 2016**
  - Sec 9.1.2 and 9.1.3.2: Revised the allowable amount of PbCrO4 to add to the QC sample LCSI to reflect the range referenced in the Method. Also included the typical amount of $PbCrO_4$ that is added to the QC sample (LCSI and MSI).
  - Sec 9.1.3.3: Added spiking instructions for MSS when redigesting a batch; MSS should be spiked at 2x sample concentration or 40mg/kg, whichever is greater.

- **Revision 9, dated 25 September 2013**
  - Sec 1 & 12: Updated LQM section references to reflect the most current LQM

revision.

- Sec. 9.1.2: Changed nomenclature to LCSSRM and revised the acceptance limits from 85-115% to vendor specified QC limits.
- Sec. 9.1.3.3: Deleted text: '*Note: If the spiked sample concentration is greater than 4X the predigestion spike concentration, no redigestion/reanalysis is required unless the samples are from a NJ site in which case the project manager should be contacted for further guidance.'*

  Per method 3060a, all batches must be rehomogenized, redigested and reanalyzed if MSS or MSI fail regardless of location.
- Sec. 10.3.5: Changed pH range from 1.6-2.2 to pH 2.0 +/-0.5 as per the method.
- Sec. 11.4.3: Changed pH range from 1.6-2.2 to pH 1.5-2.5 as per the method.

- **Revision 8, dated 06 September 2011**
  - Sec 3: Revised the LQM reference for the list of definitions.
  - Sec 9.1.3.4: Clarified lab procedures for failing matrix spikes.
  - Sec. 9.2.2: Added procedure if the CCV is not within acceptance limits.
  - Sec. 9.2.3: Added procedure if CCB is not below reporting limit.
  - Sec. 11.4: Revised data reduction section to reflect actual laboratory practices.
  - Sec 15.9: Reference added.

- **Revision 7, dated 25 August 2009**
  - Revised SOP format in accordance with TestAmerica Corporate Quality SOP No. CW-QS-002 (Rev 0) Writing a Standard Operating Procedure (SOP).
  - Sec 1.1: added laboratory's reporting limit; change the range of analysis to 0.05-1.25mg/L to reflect actual laboratory practices.
  - Sec 9.1.5: Added preparation instruction for Post digestion spike.
  - Sec. 9.2: added ICV in the Instrument QC.
  - Sec 10.1: Added procedure for adjusting pH of sample extract; procedure formerly described in the Digestion SOP (ED-WET-010).
  - Sec 15: Added applicable references.

- **Revision 6a, dated 21 April 2009**
  - Sec.4.3: Added membrane filters, 0.45um and 0.1um.
  - Sec 4.4: Delete Erlenmeyer flasks and beakers
  - Sec 4.8:Add: Eppendorf or Finnipettes; varying volume
  - Sec 5.1, 5.2 & 5.4: Add stability and storage information.
  - Sec 5.5: Added reagent used for the pH adjusted PS: 1N NaOH: Place 4.0g NaOH in a 100 volumetric flask and dilute to the mark with deionized water. Solution is stable for 6 months. Store at room temperature.

- Sec. 6.1: Potassium Dichromate Primary Standard Solution (1000mg/L Cr+6): Weight 0.2829g of dried (105ºC) potassium dichromate and dissolve in deionized water in a 100ml flask. Dilute to the mark. Store at room temperature. Solution is stable for 6 months.
- Sec 6.1: Deleted pre-made standard purchased from Inorganic Ventures. Cr6+ Primary Standard will be prepared in the lab.
- Sec 6.2: Specified source of the 1000 ppm Cr(VI).
- Sec 6.3 and 6.6: Deleted the 10mg/L Cr (VI) working standard for soil analysis.
- Sec 6.5: Add storage information.
- Sec 6.4: Add text: Source must be different from the primary standard.
- Sec 9.2.2: Replace 100 ppm stock standard with 100 ppm Cr6+ Primary spiking solution.
- Sec. 9.2.3: Add text: Record pH reading in the logbook.
- Sec. 9.3.8: Add text: Make the dilution from the sample that has not had the indicator added.
- Sec 9.3.6: Add text: Before reading samples, verify the calibration of the spectrophotometer by analyzing a CCV and CCB.
- Sec. 10.7: Added procedure for reanalyzing Post Spike sample to conform to method requirements: *If the post digestion spike fails to meet the recovery limits, a post spike must be reanalyzed using the alkaline extract. Adjust the pH of the sample Duplicate (alkaline extract) back up to pH 8.0-8.5 using 1N NaOH; then respike and reanalyze*.

- **Revision 6, dated March 2007**

  - Section 7.2: Section deleted (start color development for digested samples within one hour after adjusting pH between 7.5±0.5); section not applicable.
  - Section 9.3.7: The text in italics was inserted to clarify the time period for measuring sample absorbance.

    "Note: Calibration standards and samples must be read within the same timeframe following full color development."
  - Section 10.2: Deleted the requirement that 'CCS is taken through the entire digestion process' to reflect actual laboratory practices.
  - Section 10.4. Revised to specify the types of LCS used including their source and acceptance limits.

- **Revision 5, dated 30 October 2006**

  - Section 9.2.2: Revised the high point of the calibration curve from 1.0 ppm to 1.25 ppm. Standards preparation instructions revised accordingly.
  - Section 9.2.2: Revised to include instructions for preparation of a second source mid-point Calibration Check Standard.

- Section 10: Inserted a new Section 10.1 explaining the QA batching system and inserted a new section 10.4 detailing the LCS requirements. All existing sections renumbered accordingly.
- Section 10.6 (previously Section 10.5): The italicized text was added to the following sentence:

  "NOTE: If the spiked sample concentration is greater than 4x the predigestion spike concentration, no redigestion/reanalysis is required *unless the samples are from a NJ site in which case the lab project manager should be contacted for further guidance."*
- Section 10.6 (previously Section 10.5): Added STL Edison SOP and method references for ORP and pH.
- Section 10.7 (previously Section 10.6): Added the following text: "If the post digestion spike fails to meet the recovery limits, a new aliquot of the sample must be re-spiked and re-analyzed."
- Section 10.8 (previously Section 10.7): Revised first sentence to read "One duplicate laboratory sample per batch *must* be analyzed." ('Must' previously read 'should').

AECOM

ATTACHMENT B

DATA VALIDATION STAFF RESUMES

Robert Davis Jr
Senior Chemist

Professional History

10/2003 - 03/2007, AES Laboratories
Chemist
01/1995 - 10/2003, TestAmerica Laboratories, Inc. Chemist

Education

Bachelor of Science (BS), Environmental/Environmental Health Engineering, University of Georgia, 1994

Years of Experience

With AECOM: 12
With Other Firms: 18

Training

CPR Training

Robert has 17 years of experience within the environmental industry, including 11 years within the environmental laboratory arena and 6 years within the environmental consulting arena. He is currently responsible for the review and development of quality assurance/quality control (QA/QC) procedures to comply with contract and regulatory requirements with regard to data acquisition. His environmental consulting experience includes working as a liaison between the laboratory and the AECOM project manager to ensure that the scope of work is followed; submitting bottle orders; reviewing all chain of custody (CoC) forms and laboratory sample log-in acknowledgments; performing data validation as per the National Function Guidelines and the sampling and analysis plan; and generating analytical tables using the Environmental Quality Information System (EQuIS) database platform. Davis's laboratory experience includes extensive knowledge of wet chemistry parameters, knowledge of sample preservation techniques and sample holding time requirements, familiarity with requirements and protocols for sample collection, and extensive experience reviewing data, compiling data packages, writing standard operating procedures (SOPs), and managing personnel within an environmental laboratory.

Experience

Norfolk Southern, Data Management – 12 Sites, , . Providing data management support for 12 concurrent NS sites. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform. Liaison between the site project managers and the analytical laboratories to resolve any issues that may be associated with the bottle set orders, analytical sampling, chain of custody forms, and laboratory sample log-in acknowledgements.

Gulfstream, Site Data Validation, Savannah, Georgia. Providing ongoing data validation support for the Gulfstream site in Savannah, Georgia.

ITT Corporation, Data Management – Two Sites, , . Providing data management support for two concurrent ITT sites. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform. Liaison between the site project managers and the analytical laboratories to resolve any issues that may be associated with the bottle set orders, analytical sampling, chain of custody forms, and laboratory sample log-in acknowledgements.

Cintas Corporation, Data Management – Two Sites, , . Providing data management support for two concurrent Cintas sites. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform. Liaison between the site project managers and the analytical laboratories to resolve any issues that may be associated with the bottle set orders, analytical sampling, chain of custody forms, and laboratory sample log-in acknowledgements.

Mobile Gas, Site Data Management, , Alabama. Providing data management support for the Mobile Gas site in Prichard (Eight Mile), Alabama. Loads all data into the database using the Environmental Quality Information System (EQuIS) database platform.

Confidential Clients, Data Management, , . Providing data management support for confidential clients. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform.

Brainerd Tie, Site Data Management, , . Providing data management support for the Brainerd Tie site. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform.

International Paper Company, Carter Adams Site, Savannah, Georgia. Providing data management support for the International Paper Carter Adams site. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform.

Rahway, Site Data Management, , . Providing data management support for the Rahway site. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform.

United Technologies Corporation, Site Data Management, Memphis, Tennessee. Providing data management support for the UTC Memphis site. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform. Liaison between the site project managers and the analytical laboratories to resolve any issues that may be associated with the bottle set orders, analytical sampling, chain of custody forms, and laboratory sample log-in acknowledgements.

North Carolina Department of Transportation, Data Validation – Six Sites, , North Carolina. Providing ongoing data validation support for six concurrent NCDOT sites.

BASF Corporation, Data Management – Two Sites, , . Providing data management support for two concurrent BASF sites. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform.

Textron Inc., Data Validation – Three Sites, , . Providing ongoing data validation support for three concurrent Textron sites.

Parker Hannifin Corporation, Data Management – Two Sites, , . Providing data management support for two concurrent Parker Hannifin sites. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform.

Knoxville Utility Board, Site Data Management, , Tennessee. Providing data management support for the KUB site in Tennessee. Performs data validation and generates analytical tables using the Environmental Quality

Information System (EQuIS) database platform.

Lowndes County, Site Data Management, , Georgia. Providing data management support for the Lowndes County site in Georgia. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform. Liaison between the site project managers and the analytical laboratories to resolve any issues that may be associated with the bottle set orders, analytical sampling, chain of custody forms, and laboratory sample log-in acknowledgements.

US Coast Guard, Data Management - Two Sites, , . Providing data management support for two concurrent USCG sites. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform.

Channel Master, Site Data Management, , . Providing data management support for the Channel Master site. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform.

Avaya Inc., Site Data Management, , . Providing data management support for the Avaya site. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform. Liaison between the site project managers and the analytical laboratories to resolve any issues that may be associated with the bottle set orders, analytical sampling, chain of custody forms, and laboratory sample log-in acknowledgements.

Lucent, Site Data Management, Oklahoma City, Oklahoma. Providing data management support for the Lucent Oklahoma City site. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform.

Former BP Casper Refinery, Data Management, , Wyoming. Providing data management support for the BP Casper site. Performs data validation and generates analytical tables using the Environmental Quality Information System (EQuIS) database platform. Took on a more senior role within the EQuIS platform by providing EQuIS training to the on-site consulting firm at the request of BP. Positive feedback was obtained from the trainees.

George Kisluk
Scientist

Education

MBA, Organizational Management,
Syracuse University, 1991
BS, Biology, Alliance College
Minor, Polish, 1980

Years of Experience

With AECOM: 24
With Other Firms: 13

Technical Specialties

Project Quality Assurance/Quality Control

Mr. Kisluk is a Senior Environmental Chemist with broad experience in environmental programs ranging from the analytical laboratory to hazardous waste remediation projects. Responsibilities have included IIWA, SC, RI, IRM, SM and SVI coordination, preparations of work plans, budgets, implementation of DQOs, development of site specific SAP and QAPPs, onsite supervision of technical activities, and qualitative HRAs. Mr. Kisluk has a detailed understanding of analytical methods that are employed on projects, performed data validation, preparing and reviewing DUSRs and is proficient in data interpretation. He has performed QA reviews for technical issues relating to chemistry on reports, plans, and correspondence. Mr. Kisluk has also possesses a working knowledge of geology and hydrogeology. His duties and responsibilities on projects included the review of project specific SOW. As an technical coordinator, he has been responsible for procuring as well as the coordination of investigation activities such as drilling, direct-push boring, heavy equipment, mobile laboratories, and surveying subcontractors, as well as data interpretation and preparation of RI, SC, SM, PRR and IIWA reports in accordance with DER-10 requirements. He has been a technical coordinator for emerging contaminant investigations, including PFAS contaminated sites.

Experience

Petersburgh Landfill SC: Technical Coordinator whose responsibilities include all facets of the SC work including budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing. This project is for the identification of sources of PFAS contamination in surface water, landfill leachate and groundwater. SC activities include rock coring, monitoring well installations, determination of screen intervals based on down-hole geophysical logging and packer testing/sampling. Geophysics consists of caliber, single point resistivity, acoustic televiewer, optical televiewer, heat pulse flow meter, and gamma logging.

NYSDEC, Former Klink Cosmo Cleaners RI/FS: Technical Coordinator responsible for all facets of the site RI and FS which includes budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing, and a pilot test. This site contaminant is PCE in groundwater and soil. Team member of the soil-vapor extraction pilot test completed in November 2015.

Former Lombardy Street Lacquer and Soap Mfg. RI/FS
Technical Coordinator responsible for all facets of the site RI and FS which includes budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing. This site is part of a co-mingled PCT contaminated area is PCE in groundwater and soil.

Former Goodman Brothers Steel Drum Co. RI/FS
Technical Coordinator responsible for all facets of the site RI and FS which includes budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing.

Former Spic and Span Cleaners & Dyers, Inc. RI/FS
Technical Coordinator responsible for all facets of the site RI and FS which includes budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing. IRM activities are currently being performed at this site which entails dense non-aqueous phase liquid

(DNAPL) removal by pumping with peristaltic pump into a storage drum. Piot test is anticipated to commence in Fall 2017 which involves surfactant enhanced DNAPL removal.

Cold Spring Former MGP Site RD/CO Technical Coordinator responsible for all facets of the pre-design investigations which includes budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing. Required additional analytical and geotechnical and geophysical sampling and testing for the remedial design. Site is a former manufactured gas plant (MGP) located in a residential area. Remedial design included sheet pilings to protect adjacent roadway during site excavation. Excavation of MGP contaminated soils was conducted within a temporary containment structure. Remote video cameras recorded construction activities.

Tonawanda Forge RI/FS: RI Coordinator responsible for all facets of the site RI which includes budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing. This project is for the identification of the nature and extent of PCB contamination in soil and groundwater in an industrial area of Tonawanda, NY. IRM activities are currently being performed at this site which entails light non-aqueous phase liquid (LNAPL) removal by pumping with peristaltic pump into a storage drum.

Old Agway Store RI/FS: Technical Coordinator responsible for all facets of the site RI which includes budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing. This project is for the identification of the nature and extent of pesticide and herbicide contamination in soil and groundwater in a residential/commercial area of Ballston Spa, NY. Mr. Kisluk is the primary author of the Phase I RI Report.

Rose Valley Landfill SM: Technical Coordinator responsible for all facets of the site management which includes budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing. This project is for the monitoring and maintenance of a former municipal landfill. The site requires a heightened vigilance because of the all-terrain vehicle use adjacent to the landfill. Installation of jersey barriers, fence repairs, expanded fencing and other measures have been taken to restrict access and maintain the landfill cover. Trend analysis has been performed to

Camp Summit, Camp Georgetown and Camp Pharsalia RD, CO and SM: Project chemist during pre-design investigation, remedial design and construction oversight activities for these former wood treatment sites. The primary contaminants were pentachlorophenol, petroleum–related components and dioxins/furans. Performed immunoassay testing procedures on site samples to determine if use of this procedure would provide statistically valid results for determining excavation limits. Technical Coordinator responsible for all facets of the site management which includes budget estimates, work plans, health and safety plans, subcontractor procurement, project planning and tracking, coordination with subcontractors and report writing. Trend analysis has shown all contaminants of concern show decreasing or no trend, therefore the frequency of monitoring has been reduced to semiannually.

Ann Marie Kropovitch

Environmental Chemist

Education
BA, Chemistry, University College of New York at Buffalo, 1987

Years of Experience
With AECOM: 18
With Other Firms: 14

Ms. Kropovitch is an Environmental Chemist with hands-on experience at commercial environmental laboratories and a hazardous waste disposal facility. She is currently involved in sampling/laboratory coordination, data validation (for both internal and external clients of AECOM) and data usability for compliance monitoring and remedial investigations. Responsibilities at past employers have included laboratory analysis, internal Laboratory Information Management System (LIMS) support, review of wet chemistry (WC) and metals data, Project Manager (PM) and Supervisory functions (workload scheduling, interviewing/hiring/reviewing of employees, progress and confidential meetings with management).

Experience

Plattsburgh Air Force Base, New York (2003-2016): Lead Chemist – Coordination/Communication/Problem Resolution/Accounting –

Responsible for all communication between the site and several analytical laboratories (ordering sampling supplies, sample tracking, laboratory scheduling, and problem resolution) on an on-going basis. Validation of all laboratory data for the site in accordance with the AFCEE QAPP 4.0.02. Responsible for the generation of data assessment reports and updating/maintenance of the database (ACCESS) including assisting with EQUIS submittals to the US Air Force.

Assisted in the successful capture of additional years of the contract (competitive bid against other firms) – responsible for developing the scope of work and obtaining/evaluating quotes from laboratories. Worked with our Tampa/Austin offices to finalize the laboratory contract and verified all invoices against the contract. Worked with the vendor and our internal offices to resolve any issues.

Assisted the PM with special projects at the site (out of scope of the original contract) - SS-041 area (multiyear project involving metals contamination in a challenging matrix and rush turnaround/communication) and storage area (pesticide contamination involving air sampling), ect. Duties including researching the best methods and sampling equipment to use to successfully complete the work. Obtained quotes from labs, evaluated them, and was involved with setting up final contracts for the additional work.

New York State Department of Environmental Conservation (NYSDEC) Various Projects (2001-current): (multiyear projects - too many to include all of them) recent examples are 315 N. Meadow Street, College Point, E. 90th Street, Lapp Insulators, Kleigman Brothers, Meeker Avenue, N. of 720 Melrose Avenue, 315 N. Meadow Street, Oser Avenue, Ozone Industries, Polymer Applications site, Tonawanda Forge, and West Side): Responsible for communication between the on-site samplers and the analytical laboratory. This included obtaining sampling supplies, coordinating laboratory availability, and problem resolution. Responsible for updating/maintenance of the databases. Reviewed laboratory reports and prepared Data Usability Summary Reports (DUSR) in accordance with NYSDEC guidelines.

Main Mill Dam, New York State Dormitory Authority (DASNY) (2015) – Responsible for processing of laboratory data into ACCESS and generation of tables for the PM and clients use. Also verified invoices for correct information in terms of samples/tests and pricing provided.

UTC/Carrier Corporation (2016) – Lead Chemist – Very large investigation (hundreds of samples collected across 4 sites including rush turnaround and extract/hold samples) Responsible for communication between the site and the analytical laboratories (ordering sampling supplies, sample tracking, laboratory scheduling, and problem resolution). Responsible for updating/maintenance of the databases under strict time constraints. Reviewed laboratory reports and prepared DUSRs in accordance with NYSDEC guidelines.

Orphan Mine Soil Investigation, National Parks Service (2012): Provided validation support for the AECOM Denver office - reviewed organics, metals, radiological and WC parameters in order to meet a time critical deadline. Also involved in report generation and table construction.

US Steel (2009-2012): Provided validation support for the AECOM Chicago office in the review of organics, metals, and WC parameters. Also involved in report generation and table construction.

Pfohl Brothers Landfill, Town of Cheektowaga, New York (2002-current): Lead Chemist - Responsible for all communication between the on-site samplers and the analytical laboratory. This includes obtaining sampling containers, coordinating laboratory availability, and problem resolution. Responsible for updating/maintenance of the database. Reviewed laboratory reports and prepared Data Assessment Reports (DAR) in accordance with NYSDEC guidelines.

US Army Corps of Engineers Projects: Baltimore District projects including Chillium Spill Site and Mattioni-American Recovery. Responsible for validation of analytical data and creation of validation reports in accordance with USEPA guidelines.

Bailey Creek, DOL Storage Yard (Fort Eustis, Virginia), Felker Fuel Farm (Fort Eustis, Virginia) - Malcolm Pirnie: Performed data validation in accordance with the USEPA Region III guidelines for various organic and inorganic parameters. Clarified data problems with the laboratory and prepared validation reports in accordance with USEPA guidelines.

Coopers Creek, Boone Creek, Cluster 19, and Hogs Point at the Aberdeen Proving Ground (ARMY mutations site) - General Physics: Performed data validation in accordance with the USEPA Region III guidelines for various organic and inorganic parameters including explosives. Clarified data problems with the laboratory and prepared validation reports in accordance with USEPA guidelines.

Consolidated Edison Company - Former MPG (Manufactured Gas Plant) site: Performed data validation in accordance with the USEPA Region II guidelines for various organic and inorganic parameters. Clarified data problems with the laboratory. Prepared DUSRs in accordance with NYSDEC guidelines.

Titan Missile Site: Responsible for validation of analytical data and preparation of a Quality Control Summary Report (QCSR) and Analytical Data Packa es ADP .

SKILLS/ACTIVITIES

Laboratory Analysis:
Metals - Used atomic absorption (AA) and inductively coupled plasma (ICP) to analyze non-potable water, soil, and waste samples.

Wet Chemistry - Familiar with various techniques including filtration, distillation, colorimetric methods, and incubation. Actual analysis performed included: total organic carbon, phenols, biochemical oxygen demand, cyanide, fecal coliform, chemical oxygen demand, and ammonia.

PCBs - Used an HP5890 gas chromatograph to analyze both soil and oil hazardous waste samples for PCBs. Familiar with the extraction of water samples using separatory funnels and soils using the soxhlet technique.

Data Review: Performed quality control (QC) review on metals and WC data at a commercial laboratory as the supervisor of the inorganic review group. Familiar with both LIMS data and contract laboratory protocol (CLP) metals forms and QC requirements. Used both the Ward® and Metals Analytical Reporting System (MARS®) software for the processing of metals following USEPA and NYSDEC guidelines.

Validation Review: Validated reports as a 3rd party (outside clients) and in-house (AECOM Buffalo/Chicago/Denver offices). Using guidelines provided by the USEPA and in accordance with various methods I review for usability: Volatiles, Semivolatile, Pesticide/PCB, Metals, Wet Chemistry, and Radiochemistry data for various matrices.

Project Manager: Interacted with several clients as a Project Manager at a commercial laboratory. Responsible for all client contact and problem resolution. Created bottle orders, verified chain-of-custody (COC) when samples arrived, kept clients informed of problems or delays, and approved final reports.

Supervision: Past experience includes supervision of an inorganic processing group and metals laboratory. Handled day-to-day operational issues such as workload scheduling and supply ordering. Also conducted training and maintenance of documents pertaining to new hires for group. Managed personnel matters including reviews, problem resolution, and conflicts between personnel. Created training manuals and Standard Operating Procedures (SOP's) for both internal and external programs used.

LIMS Support: Provided support for the internal LIMS System of a commercial laboratory. Interacted with other laboratory locations (Pittsburgh and Houston) to provide advice and problem resolution. Assisted the Information Services Department maintain and repair problems within the database (Foxpro).

Greg Malzone
Laboratory Coordinator/Project Chemist

Education

Bachelor of Science (BS), Biochemistry, University of Pittsburgh

Years of Experience

With AECOM: 20
With Other Firms: 13

Technical Specialties

Project Quality Assurance/Quality Control

Mr. Malzone has experience in Laboratory Quality Assurance. He specializes in systems and performance audits of environmental testing laboratories; project management, including data validation; statistical analysis of analytical data for quality improvement; establishment of standard operating procedures and quality manuals; and analytical laboratory analyses - wet chemistry/product quality testing.

Experience

Data Validator for International Xylem Sites: Performed validation of data generated in support of site investigation, operations, maintenance, monitoring and remediation activities at sites in Europe, North and South America and Asia. Generated data usability reports to summarize findings.

Data Validator for Various Texas Sites: Performed validation of data generated in support of site investigation, operations, maintenance, monitoring and remediation activities under the Texas Risk Reduction Program (TRRP) using Texas Commission of Environmental Quality (TCEQ) guidance protocols.

Data Validator for General Electric, South Dawson Street site, Seattle WA: Performed validation of data generated in support of site investigation, operations, maintenance, monitoring and remediation activities at site in Seattle WA. Generated data usability reports to summarize findings.

Data Validator for PP&L Electric Utilities, Former Manufactured Gas Plant (MGP) Sites: Shenandoah, Pen Argyl, Northumberland, Bangor and Sunbury, Performed validation of data generated in support of site investigation and remediation activities in Pennsylvania. Generated data usability reports to summarize findings.

Laboratory Co-ordination and Data Validation, BP, Consolidated Edison, United Technologies Corporation, and Norfolk Southern, Various sites, Laboratory coordinator and data validator for analytical data generated in support.

Various Clients, Former Manufactured Gas Plants; Wood Treating, Coke, and Tar Plants; Remediation Sites; and Data Validation, Various Locations. Validated organic (volatiles, semivolatiles, pesticide/PCBs, herbicides, dioxins, PAHs, DRO/GRO) and inorganic (metals, TOC, anions) data related to Superfund and RCRA sites of various US Environmental Protection Agency regions using USEPA approved guidelines and region-specific amendments.

AECOM

APPENDIX D

HEALTH AND SAFETY PLAN (HASP)

The final Health and Safety Plan will be
maintained at the Study Area during field activities.

HAZWOPER Health and Safety Plan (DCSA)

DRAFT

Corning-Painted Post School District

Property Soil Cover Sampling

Corning, New York 14830

Expiration Date: **May 29, 2021**
(Max. 1-Year from signature date)

Prepared for: Corning Incorporated
Corning, New York

Prepared by: AECOM
1 Federal Street, Suite 800
Boston, Massachusetts 02110

Prepared By:
Name Joshua Loomis Signature: _____
Title Environmental Engineer Date: _____

Reviewer: Area/Regional/ Business Line/Client SHEM:
Name _____ Signature: _____
Title _____ Date: _____

Approval: Project Manager:
Name _____ Signature: _____
Title _____ Date: _____

HASP Summary

Note: This Summary is intended to provide key information only and cannot be substituted for reading, understanding, and complying with the full HASP. This summary may be continually updated as tasks and personnel change. Use Continuation Sheets if necessary.

Project Name:	CPPSD Property Soil Cover Sampling	**Project Number:**	851046
Summary Revision Date:	April 2, 2020	**Client Name:**	Corning Incorporated

Report ALL SH&E Incidents, no matter how minor, to the Incident Hotline: 800-348-5046
Injury, Property Damage, Vehicle, Security, Regulatory Inspection, Environmental Impact, and any potentially work related injury, discomfort/ pain, or damage.

Identify the nearest Occupational Clinic and Hospital to the site that accepts AECOM Workers Compensation Insurance (see **Attachment A** for instructions). If the nearest such clinic or hospital is an unreasonable distance from the site, identify nearer hospitals or clinics. Attach maps and directions to the clinics and hospitals in **Attachment A**.

Occupational Clinic:	Sheila L. Butler, MD	**Nearest Hospital:**	Corning Hospital
Address:	130 Center Way Corning, NY 14830	**Address:**	1 Guthrie Drive Corning, NY 14830
Phone Number:	607-973-8039	**Phone Number:**	607-937-7200

Key Personnel

Project Manager (PM):	Aimee Ruiter	**Cell Phone:**	978-580-7616
Site Supervisor (SS)	Keith Stahle	**Cell Phone**	607-398-4284
Safety Officer (SSO):	Stephen Wright Chris Call Jared Plank	**Cell Phone**	978-852-7620 484-459-3306 518-225-1439
AECOM SH&E Mgr.	Scott Dietz	**Cell Phone:**	240-344-5892
Client PM:	Greg Haack	**Cell Phone:**	607-329-9234

List ALL Short-Service Employees, including subcontractors (<6 Months with Company in Current Area/Job Description):

Advanced Geological Services and Cascade.

List ALL Subcontractors and their Site Safety Officers:
Advanced Geological Services: Chris Call
Cascade: Jared Plank

PM must positively verify subcontractors, including lower-tier subs (i.e. 'subs of subs') are approved in Subport (or by an equivalent evaluation process) for the work described. If there were any limitations/ conditions of approval, describe them and how they are being met.

☒ I have verified that all subcontractors are approved in Subport (or equivalent), and that all conditions of approval are met.

Aimee Ruiter		
Project Manager Name	**Project Manager Signature**	**Date**

Table of Contents

Attachments

Attachment A: Hospital/Clinic Maps and Incident Reporting Flow Chart

Attachment B: Project Risk Register/Hazard Assessment, THA Forms, and Tailgate Safety Meeting Form

Attachment C: AECOM SHE Procedures

Attachment D. Stretch/Flex Poster

Attachment E. Safety Data Sheets

Attachment F. Site Orientation

Attachment G. Coronavirus Control Information

1. Introduction

This written HASP is designed to identify, evaluate, and control safety and health hazards, and to outline emergency response actions for AECOM-managed activities. This HASP must be kept on site during wok activities and made available to all workers including subcontractors and other site occupants for informational purposes. AECOM subcontractors are expected to independently characterize, assess, and control site hazards created by their specific scope of work.

This section of the HASP summarizes important AECOM SH&E Procedures that apply to all Design and Consulting Services (DCS) Americas jobs. See **Attachment B** for the Project Risk Register/ Hazard Assessment and Task Hazard Assessment forms and **Attachment C** for complete copies of applicable field SH&E Procedures. This template has been designed primarily for use in the United States.

1.1 Applicable References

This Health and Safety Plan (HASP) conforms to the regulatory requirements and guidelines established in the following documents:

- Title 29, Part 1910 of the Code of Federal Regulations (29 CFR 1910), Occupational Safety and Health Standards (with special attention to Section 120, Hazardous Waste Operations and Emergency Response).
- National Institute for Occupational Safety and Health/Occupational Safety and Hazards Administration/U.S. Coast Guard/U.S. Environmental Protection Agency, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Publication No. 85-115, 1985.
- The requirements in this HASP also conform to AECOM's Safety for Life Program requirements as specified in the AECOM Safety, Health and Environment (SH&E) Manual.

Project Assumptions

- AECOM is serving as Engineer of Record at the site.
- The property owner will assist in locating subsurface utilities, vessels, and structures located on the property and outside the scope of the utility locator service.
- No confined spaces will be entered on this project.
- No excavations will be entered.
- Work will be performed during daylight hours.

2. Site Information and Scope of Work

2.1 Site Description

The Study Area is located in the City of Corning, New York, as illustrated on Figure 1-1 of the work plan. In general, it is bound by the Chemung River to the south; Post Creek and Interstate 86 to the east and north; and the Guthrie Medical Center, the City of Corning Fire Department, and Centerway to the west. The Study Area is separated into five OUs, which are depicted in Figure 1-2 of the work plan:

- OU1 – Residential Area (includes 212 residential properties)
- OU2 – Residential Area at the Eastern End of Corning Boulevard (includes five residential properties)
- OU3 – School/Community Use Areas (includes the Corning-Painted Post School District, Corning Christian Academy, and City of Corning Memorial Stadium properties)
- OU4 – Flood Control Areas
- OU5 – Residential Expansion Area (includes 109 residential properties)

2.2 Site Background/History

The City of Corning has a long history of manufacturing, particularly in brick and glassmaking. Historical references indicate that in the late 1800s and early 1900s, one of the country's largest brick manufacturers and more than sixty glass manufacturers were located in the City of Corning (Dimitroff and Janes, 1991) (Sinclaire and Spillman, 1997), including Corning Incorporated, which was formerly known as Corning Glass Works. During that time frame, coal was the primary fuel source in the Corning, New York area and most of the local industries and municipalities used coal to heat their furnaces. In the early 1900s, when natural gas was introduced to the region, some industries converted their fuel sources to natural gas.

Between 1949 and at least 1968, the City of Corning operated a municipal incinerator that created significant volumes of ash. Historical City Council meeting minutes indicate that the City applied ash and cinders to roadways within the City to control ice during the winter months during, at least, the mid-1950s (City of Corning, 1936; 1941; 1958; 1959). These records also indicate that when land within the Study Area (now comprising OU3) was being considered for redevelopment as a school in the late 1950s, the City of Corning stated that it would require "a considerable amount of work and expense involved in filling and grading to render the track suitable for recreational and educational purposes." (City of Corning, 1950). Ultimately, a school that opened in 1962 was constructed on this portion of the Study Area.

The Chemung River overflowed its banks several times during the City of Corning's history; this resulted in construction and improvement of flood control structures within the Study Area on multiple occasions, including in the mid-1940s and again after Hurricane Agnes in the mid-1970s, according to NYSDEC and U.S. Army Corps of Engineers (USACE) records (USACE, 1941; USACE, 1973). Such construction efforts would have likely required the import of significant volumes of material of uncertain origin, the removal or relocation of material deemed unsuitable as foundation for earthworks, the creation and filling of borrow areas from which soils suitable for construction were obtained, and other potential grading and filling activities. These activities occurred within and surrounding the perimeters of the Study Area, including along the Chemung River, along Post Creek, and along what is now Interstate-86 (USACE, 1941; USACE, 1973).

Over time, the land use within the Study Area has developed from farmland into a residential area and a school/community use area. In general, aerial photographs indicate that the development of the residential area north of Corning Boulevard began prior to 1938 along Pyrex Street and Houghton Circle. The residential area subsequently expanded in an easterly direction across farmlands until about 1964, by which time the Study Area was mostly developed. During development activities, fill material was commonly used as sub-grade material for construction, to fill in low-lying areas and to serve as an aid to drainage.

Through a title search of property deeds, it was found that part of the Study Area encompasses lands previously owned by Corning Homes, Inc. (a residential developer not affiliated with Corning Incorporated). The deeds for these properties included a condition that allowed Corning Glass Works (not a party to the transaction) to maintain structures, buildings, and "ash dumps as now located" on the properties. Despite reviewing available historical maps, aerial photographs, documents, and public records, Corning Incorporated has not, to date, located any maps or records that depict the location, if any, of potential "ash dumps" as referenced in the deeds (i.e., that may have existed as of 1920).

Soil sampling is planned in at the Corning-Painted Post School District Property (Figure 1-1 and 1-2 of the work plan).

2.3 Client or Third-Party Operations at Site

Work is planned for the Corning-Painted Post School District Property.

2.4 Scope of Work

Work performed is for investigation purposes. The tasks consist of soil sampling.

2.5 Scope of Work Risk Assessment

- ☐ **Low Risk** *(examples: non-intrusive work, occasional exposure and/or low risk hazards)*
- ☐ **Medium Risk** *(examples: intrusive work, heavy equipment use, frequent exposure and/or moderate hazards)*
- ☒ **High Risk** *(examples: complicated scope, large/ multiple work crews, and/or constant exposure to hazards).*

The following tasks/ hazards automatically trigger high risk ranking. Check all which apply. Include hazard mitigation procedures later in the appropriate Physical, Chemical, or Environmental section of the HASP.

- ☐ Heights > 4 ft
- ☐ Confined Space
- ☐ Trench deeper than 4 ft
- ☐ Lock out/tag out
- ☐ Work on energized equipment
- ☐ Working with electricity
- ☒ Mobile equipment
- ☐ Materials under pressure
- ☐ Avalanche areas
- ☐ Work on water or ice
- ☒ Extreme heat or cold
- ☐ Remote/wilderness work
- ☐ Work in controlled areas
- ☐ Possible threat of violence including civil unrest
- ☐ Use of power tools or equipment
- ☒ Operating heavy equipment or machinery
- ☐ Hazardous substances or materials
- ☒ Work around live traffic
- ☐ Isolation from first aid services or immediate emergency assistance

3. AECOM Safety Health and Environment Program

3.1 AECOM Policy

Safety, Health & Environment Policy

Purpose

This policy establishes the framework to attain best-in-class Safety, Health and Environmental (SH&E) performance in the interest of benefitting AECOM's employees and stakeholders in the global marketplace.

Policy

AECOM is committed to exceptional levels of performance in safeguarding people and the environment as one of our Core Values. In recognition of the right to a safe and healthy working environment, keeping our people and stakeholders safe is our most important measure of success. We strive to be the beacon of safety excellence in the industries and global communities in which we work.

To advance our SH&E program, we are committed to:

- Zero work-related injuries to AECOM employees and stakeholders, and protection of the environment as a result of our activities.
- Providing a safe and healthy work environment, and a highly effective SH&E management system that drives continual review and improvement.
- Meeting client requirements and properly incorporating all applicable safety, health and environmental legal requirements and regulations at the local, state, provincial and national levels.
- Developing an exceptional safety culture where our people and stakeholders embrace ownership for the safety of themselves and others.
- Advancing our goals of pollution prevention, resource conservation and environmental sustainability.
- Setting and meeting aggressive SH&E performance goals and Core Value Metrics to promote continuous improvement.
- Working with employees and business partners in order to continuously improve SH&E performance.
- Recognizing and celebrating those who contribute to excellent SH&E performance.
- Striving to make AECOM the provider of choice for the safe execution of design, build, finance, operate and maintenance work globally.

The commitment to this policy by the leadership, management and employees of AECOM provides the foundation for a safe workplace, operational excellence and long-term business success.

Expectations

Safety is a core value and a key to our success. We demand continuous improvement in our journey toward a "zero" incident culture, where everyone is committed to safety, health and environmental excellence.

To that end, we demand our leaders, managers, supervisors, employees, and subcontractors:

- Demonstrate their commitment in their actions and decisions to assure that every person goes home safe every day.
- Embrace safety as a core value both on and off the job.
- Commit to his/her own safety and that of his/her fellow employees.
- Incorporate AECOM's Life-Preserving Principles into work planning and execution.
- Proactively and aggressively identify, manage and eliminate hazards and reduce risk in the workplace.
- Engage in training and preparations to have the knowledge, skills, competency and equipment required to work safely.
- Take action to stop work if the work cannot be executed safely or if conditions or behaviors on the work activity are unsafe.
- Immediately report safety, health and/or environmental incidents, near-misses, unsafe conditions, and at-risk behaviors to their supervisor; and that we diligently work to correct the problem.

Our SH&E expectations will be accomplished by the demonstrated leadership of management, compliance with regulatory requirements, and consultation with and participation of AECOM personnel.

Review and Communication

This Policy will be reviewed annually to ensure it meets the needs of the company, and will be made available and communicated to all persons under the control of the company.

March 6, 2020

Michael S. Burke — Date

Chairman and Chief Executive Officer

3.2 Safety for Life

"Safety for Life" is a comprehensive integrated AECOM Safety Management System that drives our nearly 100,000 employees toward AECOM's commitment to achieving zero work-related injuries and/or illnesses; preventing damage to property and the environment; and maintaining an environmentally friendly and sustainable workplace. Our Safety for Life program is supported by nine Life Preserving Principles that apply to all AECOM activities.

3.3 Life Preserving Principles

Demonstrated Management Commitment
Our Executive, senior and project managers will lead the SH&E improvement process and continuously demonstrate support and commitment.

Employee Participation
Our employees will be encouraged and empowered to become actively engaged in our safety processes through their active participation in safety committees, training, audits, observations and inspections. Employees will be encouraged to participate in health initiatives and adopt a healthy lifestyle.

Budgeting and Staffing for Safety
Our safety staff will be competent, fully trained and qualified to provide technical resources to our internal and external clients. A budget to support safety activities will be included in project proposals.

Pre-Planning
Our design, engineering, project and construction management staff will deploy effective risk mitigation efforts to design, plan and build safety into every project. Pre-Project and Pre-Task planning will be an effective tool in protecting our employees and the environment.

Contractor Management
Our project staff will work closely with our sub-consultants, subcontractors, contractors and Joint Venture Partners to provide a safe work environment for employees and members of the public. Our goal of SH&E performance excellence will be equally shared by all project participants.

Recognition and Rewards
Our employees will be recognized for their efforts in working safely and their support of our safety efforts.

Safety Orientation and Training
Our employees will be provided with effective safety training in order to identify and mitigate hazards in the workplace to prevent injuries to themselves and others who may be affected by their actions.

Incident Investigation
Our managers and safety professionals will investigate all recordable incidents and serious near misses to identify contributing factors and root causes in order to prevent a reoccurrence. Lessons learned shall be identified, communicated and implemented.

Fit for Duty
Our employees are responsible to report to work each day fit for duty and not to pose a health and safety hazard to themselves or others.

3.4 Driving and Vehicle Safety

The proper operation of vehicles is critical to protecting the safety of AECOM employees and subcontractors. Drivers face numerous hazards while operating vehicles. Some of the hazards include collision with another vehicle, collision with a fixed object, vehicle break down or failure, or falling asleep or becoming otherwise incapacitated while driving. All employees will adhere to Driving procedure S3AM-005-PR, which includes the following key practices:

1. **Authorized Drivers**
   Managers must authorize drivers following evaluation of driver criteria to drive and maintain an AECOM-owned, leased or rented vehicle, a client or customer-owned vehicle, or a personal vehicle operated in the course of conducting AECOM business.

2. **Electronic Devices Prohibited**

AECOM prohibits use of all portable electronic devices while operating a motor vehicle/ equipment which includes being stopped at a traffic light or stop sign. This includes cell phones, two-way radios and other items whether hand-held or hands-free. Electronic devices include, but are not limited to, all mobile phones, pagers, iPods, MP3s, GPS, DVD players, tablets laptops and other portable electronic devices that can cause driver distraction. Hands-free device use is not allowed.

- GPS units and devices used for navigation may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road. Electronic devices shall be setup for operation prior to commencing driving activities and shall not be changed by the driver while driving.

3. **Vehicle Inspections**

The driver shall conduct pre-trip vehicle inspections prior to each trip. A vehicle inspection checklist, S3AM-005 FM2, can be used to guide and document the inspection process. Vehicle inspection is to include a 360-degree walk around and visual inspection under the vehicle for leaks and obstructions prior to moving the vehicle.

4. **Training**

All drivers shall complete defensive driver training. Additional training (i.e., hands-on defensive driver training) may apply for medium and high-risk drivers; see Driving procedure S3AM-005-PR and SHE Training procedure S3AM-003-PR for more details.

5. **Journey Management Plan**

Drivers who undertake trips in excess of 250 miles (400 kilometers) one way, drive in remote or hazardous areas, or when otherwise deemed necessary, shall develop and document a Journey Management Plan using S3AM-005-FM1 or equivalent.

6. **Secure Loads**

Cargo is only to be carried within the passenger compartment of a vehicle when segregated and restrained to prevent objects from becoming distractions, obstructions or projectiles to occupants should emergency vehicle maneuvers be required (e.g., harsh braking or crash). All goods transported on flatbed trucks or in pickup beds must be securely fastened to prevent them from becoming hazards. All applicable laws and regulations regarding securing of loads must be met. It is prudent to check the load after a few miles to ensure that load has not shifted or loosened prior to completing the remainder of the trip.

7. **Backing Up**

Reversing the vehicle is to be avoided if at all possible. If backing up is necessary, use the following guidelines:

- Pre-plan all vehicle movements.
- If the pull-through method of parking is not possible, drivers will scan parking spot/area for hazards and back in; thereby, facilitating departure where the first move is forward.
- A light tap of the horn should be used to alert others of your intention to back up.
- Avoid tight spaces.
- Vehicles over 10,000 pounds gross vehicular weight are required to have a competent spotter in place when backing. A competent spotter is one that has received spotter training.
- All vehicles shall have a competent spotter in place when backing in an active work zone. Parking and public access areas are recommended but not required to have a spotter.

3.5 Fitness for Duty

One of AECOM's nine Life-Preserving Principles is Fitness for Duty (see Fitness for Duty procedure S3AM-008-PR). Fitness for Duty means that individuals are in a state (physical, mental, and emotional) that enables them to perform assignments competently and in a manner that does not threaten the health and safety of themselves or others. On certain projects or for specific tasks, fit for duty certifications may be requested of medical providers by SH&E Managers or Human Resources (HR). Employees should report to work fit for duty and unimpaired by substances or fatigue. Supervisors must observe their employees and work with the employee, SH&E staff, and HR to address deficiencies. AECOM will not tolerate retaliation against any employee for filing a complaint or concern regarding their fitness for duty or participating in any way in an investigation.

Due to COVID-19, we must ensure that if an employee feels unwell or shows any signs or symptoms of the coronavirus, they do not come to work. Current CDC guidance indicates that if an individual has a temperature above 100.4 F [37.8 C], or has been in close contact with someone suspected of having the coronavirus, then they must stay home. An employee with an elevated temperature should not come to work and should contact his/her healthcare provider and the AECOM Occupational Health Services by calling the DCS Nurse Hotline at 512-419-5016. By coming to work, employees are self-certifying that they do not have a temperature or show other signs of being unwell and are able to work within the guidelines of the CDC. In addition, a Project Entry Screening Set Up & Operations Protocols will be implemented prior to employees entering the project site to ensure worker health for themselves and others.

3.5.1 Medical Surveillance

AECOM's S3AM-128-PR, Medical Screening and Surveillance, details the requirements to participate in a medical monitoring program. Medical Surveillance provides a streamlined process to determine if employees meet the physical requirements to perform assigned duties as defined by applicable regulations. It is also designed to provide a means to collect data relevant to exposure to chemical and physical agents for the protection of the workers and to confirm the effectiveness of health and safety programs.

3.5.2 Proactive Health

AECOM is committed to promoting proactive health activities in addition to the planning for prevention of safety and environmental incidents. Proactive health activities will be completed on an on-going basis at AECOM on a corporate-wide basis (i.e. Wellness program associated with employee benefits), at offices, and at this project site. Management will be actively involved in providing and encouraging opportunities for health and wellness education and improvement. Health initiatives and education will be discussed periodically during office based meetings as the safety moment or during the daily tailgate meeting as a toolbox talk. Topics may be related to, but are not limited to:

- Heart health;
- Stress management;
- Smoking cessation;
- Diabetes prevention;
- Diet; and
- Exercise benefits.

Topics and educational materials can be located on the AECOM Wellness page, National Institutes of Health website, Centers for Disease Control and Prevention website and other reputable sources online.

In addition, the field team will be encouraged to participate in a daily stretch and flex routine (a standardized way to avoid soft tissue damage from work activities) to the best of their abilities, given their own personal limits. It is particularly beneficial to warm and loosen muscles before repetitive work, manual handling of loads, and when working in cold temperatures or with static postures. The Stretch and Flex manual and poster (Attachment D) serve as guidance for the leader to follow.

3.5.3 Fatigue

One aspect of fit for duty is fatigue management. AECOM has developed procedures that limit work periods or requires additional rest under certain circumstances, including during long-distance travel or when working at high altitudes. These procedures also set limits on extended work periods of 14 hours per day or 60 hours per week. A fatigue management plan is required if longer working hours are necessary (see Fatigue Management Procedure S3AM-009-PR).

3.5.4 Substance Abuse

Drug and alcohol abuse pose a serious threat to the health and safety of employees, clients, and the general public as well as the security of our job sites, equipment and facilities. AECOM is committed to the elimination of illegal drug use and alcohol abuse in its workplace and regards any misuse of drugs or alcohol by employees to be unacceptable. AECOM Substance Abuse Prevention Procedure (S3AM-019-PR) prohibits the use, possession, presence in the body, manufacture, concealment, transportation, promotion or sale of the following items or substances on company premises. Company premises refer to all property, offices, facilities, land, buildings, structures, fixtures, installations, aircraft, automobiles, vessels, trucks and all other vehicles and equipment - whether owned, leased, or used.

- Illegal drugs (or their metabolites), designer and synthetic drugs, mood or mind altering substances, and drug use related paraphernalia unless authorized for administering currently prescribed medication;
- Controlled substances that are not used in accordance with physician instructions or non-prescribed controlled substances; and
- Alcoholic beverages while at work or while on any customer- or AECOM-controlled property.

This policy does not prohibit lawful use and possession of current medication prescribed in the employees name or over-the-counter medications. Employees must consult with their health care provider about any prescribed medication's effect on their ability to perform work safely and disclose any restrictions to their supervisor.

Although some states may pass laws legalizing medical or recreational marijuana use, the use, sale, distribution and possession of marijuana are violations of federal law and AECOM policy, and will subject an employee to disciplinary action up to and including termination in accordance with controlling law.

3.6 Rewards and Recognition

One of AECOM's Life Preserving Principles is Recognition and Rewards for proactive safety, health and environmentally focused behaviors. All projects are expected to participate in the rewards and recognition programs available on the Corporate and DCS Americas SH&E ecosystem pages. Large, long term projects are encouraged to establish a project specific rewards and recognition program which incorporates project specific goals and activities (template available S3AM-020-FM1). ***All rewards and recognition programs must emphasize the 9 Life Preserving Principles and proactive SH&E activities NOT solely the achievement of lagging metrics ("injury/incident-free" hours, etc.) as those may discourage incident reporting.***

There are several possible appropriate methods of rewarding and recognizing employees and contractors:

1. **Informal** – recognition via verbal acknowledgment, email, spot awards, luncheons, etc.
2. **Formal** – Safety Star Award nomination (link)
3. **Formal** – SH&E Challenge Coins (see local SH&E manager for details)

3.7 Hand Safety

The hands are exposed to hazards more than any body part. SH&E Hand Safety Procedure S3AM-317-PR describes requirements and best practices including these notable practices:

- **All personnel shall have gloves in their immediate possession 100%** of the time when in a shop or on a work site. Gloves that address the hazard shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc. Use the Gloves Needs Assessment (S3AM-317-FM1) to help determine the appropriate glove for the hazard(s).
- **Fixed open-blade knives are prohibited** from use during the course of AECOM work. Examples of fixed open-blade knives include pocket knives, multi-tools, hunting knives, and standard utility knives. For more information about cutting tools, see S3AM-317-ATT1 Safe Alternative Tools.

3.8 Hazard Communication

Hazardous materials that may be encountered on-site as existing environmental or physical/health contaminants are addressed in this HASP. Their properties, hazards, and associated required controls will be communicated to all affected staff and subcontractors in accordance with the requirements of AECOM Procedure S3AM-115-PR1 Hazardous Materials Communication including these key elements:

- All personnel shall be briefed on the hazards of any chemical product they use and shall be aware of and have access to the Safety Data Sheets (SDS).
- All containers on site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential health and safety hazards (flammability, reactivity, etc.).

In addition, any employee or organization (contractor or subcontractor) intending to bring any hazardous material onto this AECOM-controlled work site must first provide a copy of the item's SDS to the Site Supervisor or Site Safety Officer for review and filing. The Site Supervisor or Site Safety Officer will maintain copies of all SDS on site and in **Attachment E**. SDS may not be available for locally obtained products, in which case an alternate form of product hazard documentation will be acceptable.

3.9 Hazardous Material handling and Waste Management

If hazardous, solid, and/or municipal wastes are generated during any phase of the project, the waste shall be accumulated, labeled, and disposed of in accordance with applicable Federal, State, Provincial, Territorial and/or local regulations and SH&E Procedure S3AM-116-PR Hazardous Materials Shipping. A site-specific Entity Letter may be required for the site/client; if so, only persons named on the entity letter are allowed to sign waste shipping papers "***on behalf of [client name]***". Any individual signing shipping papers must have valid Department of Transportation and Resource Conservation and Recovery Act training for waste shipment. Consult the HZM/HZW & TDG page on ecosystem or the SH&E Manager for further guidance on AECOM and regulatory procedures and training requirements.

3.10 Housekeeping and Personal Hygiene

Basic housekeeping requirements for offices and work sites, as well as personal hygiene and sanitation standards can be found in S3AM-013-PR Housekeeping. Inspections should be performed at the regular interval specified below. The housekeeping inspection form S3AM-013-FM1 is available for use.

Complete the table below regarding site-specific Housekeeping and Personal Hygiene requirements:

Housekeeping:	*Inspection Frequency:*	Daily	*Inspector:*	Keith Stahle
Eating, Drinking, Smoking:	Permitted only in designated area(s) located at the staging area.			
Handwashing:	Water, soap and paper towels or equivalent supplies are located at the staging area. Site staff will wash hands and face after completing work activities and prior to breaks or meals.			
Toilets:	**Toilets** are located at the staging area. *NOTE: A minimum of one toilet must be provided for every 20 personnel on site. For mobile crews where work activities and locations permit transportation to nearby toilet facilities on-site facilities are not required.*			
Water:	**Water** is located at the staging area. A water supply meeting the following requirements will be utilized: *Potable Water:* An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Disposable drinking cups for single use and a waste receptacle will be provided as needed. Water containers will be refilled daily and disinfected regularly. Potable water containers will be properly identified in order to distinguish them from non-potable water sources. *Non-Potable Water:* Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating ***"Non-Potable Water, Not Intended for Drinking Water Consumption"***			
Illumination:	Natural light.			

3.11 Safety Observations

Safety observations are observations made by employees or subcontractors of a condition or behavior which could contribute to an incident, prior to the incident occurring. Observations can also identify positive behaviors or interventions which contribute to the prevention of incidents. Large, long-term projects may benefit from the use of LifeGuard to track and trend observations on a site level. All other projects should log their observations using IndustrySafe. Both reporting systems can be accessed on any safety page of ecosystem. Or the QR codes below can be used while off the AECOM network from a smartphone/ device.

LifeGuard

IndustrySafe
Safety Management Software

3.12 Short Service Employee

A Short Service Employee is an employee with fewer than 6 months experience working on field projects or an employee who has not completed the required training or received required certifications (see the Short Service Employee procedure, S3AM-002-PR). The Project Manager will identify all Short Service Employees working on the project, and each Short Service Employee will be assigned to an experienced team member so all activities may be monitored. Short Service Employees shall be easily identified in the field environment, such as through wearing a specific colored hardhat, a manufacturer-approved orange stripe applied to their hardhat, or be clearly identified by some other system. Any new employee shall wear the designated Short Service Employee identifier until the Project Manager determines the employee has the knowledge, skills, and ability related to the specific hazard on the project.

3.13 Stop Work Authority

AECOM empowers and expects all employees to exercise their Stop Work Authority (see Stop Work Authority Procedure S3AM-002-PR) if an incident appears imminent, or when hazardous behaviors or conditions are observed. A stop work request can be informal if the situation can be easily corrected, or may require shutting down operations if revised procedures are necessary to mitigate the hazard. If an AECOM employee observes an imminently hazardous situation on a site controlled by others (i.e., a client-managed contractor), the employee can always stop work for themselves by removing themselves from the situation. Employees also may attempt to stop work to avoid allowing the contractor to come to harm by immediately notifying the contractor foreman or site engineer, or if necessary, the client or party managing the contractor.

No employee should object to the issuance of a stop-work request, nor can any disciplinary action be levied against the employee. All employees must agree that the situation has been mitigated before resuming work. No employee will be disciplined for refusing to work if they feel it is unsafe.

3.14 Coronavirus

Coronavirus (COVID-19) is the result of a virus identified as SARS-CoV-2. Coronaviruses are a large family of viruses found in both animals and humans. Some infect people and are known to cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) with symptoms such as fever, cough, and shortness of breath. There is currently no human vaccine available for this virus. The AECOM procedure related to COVID-19 is “SRI_003_PR2” and is included in Attachment C. In addition to the procedure and housekeeping and personal hygiene measures summarized in Section 3.10, COVID-19 will be addressed in individual hazard assessments and tailgate safety meetings.

4. Roles and Responsibilities

Roles and responsibilities for the project team are defined in SH&E Procedure S3AM-117-PR1, Hazardous Waste Operations. The Project Manager (PM) is ultimately responsible for the development of this HASP and establishing a budget to implement the controls and training required. The Project Manager is also responsible for ensuring that the plan is implemented, that appropriate documentation is generated, and that records are maintained. The SH&E Manager is responsible for reviewing and approving this HASP, and assisting with other SH&E matters upon request. A Site Safety Officer may be appointed to oversee implementation of the HASP in the field. All project team members are responsible for reviewing and abiding by this HASP, performing daily (or more frequent) task hazard assessments, stopping work when necessary to correct unsafe behaviors or conditions, and reporting incidents promptly to the PM and AECOM Incident Reporting Hotline (Incident Hotline 800-348-5046).

4.1 Project Manager

The Project Manager has overall management authority and responsibility for all site operations, including safety. The Project Manager will provide the site supervisor with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations. Some of the Project Manager's specific responsibilities include:

- Project start-up activities require appropriate SH&E planning prior to work commencing, including identification of hazards, associated risk, and appropriate controls for each task and operation found in the work scope.
- Completed project risk registers /task hazard assessments shall be incorporated into the Project's SH&E Plan.
- Verifying that personnel, to whom this HASP applies, including AECOM subcontractors, have received a copy of it, with ample opportunity to review the document and to ask questions.
- Providing the concurring SH&E Manager with updated information regarding conditions at the site and the scope of site work if changes occur that will affect the accuracy of this HASP.
- Providing adequate authority and resources to the Site Supervisor or Site Safety Officer to allow for the successful implementation of all necessary SH&E Procedures.
- Maintaining regular communications with the Site Supervisor or Site Safety Officer and, when necessary, the AECOM Client SH&E Program Manager.
- Coordinating the activities of AECOM subcontractors and ensuring that they are aware of the pertinent health and safety requirements for these projects, when applicable.
- Conducting Safety System Auditing by way of Management Site Visits and/or Project Manager Self-Assessments on a regular basis.
- Approving amendments to the HASP (in conjunction with the Site Supervisor or Site Safety Officer).
- Coordinating activities with the client as needed to ensure the safe implementation of this HASP.

4.2 Site Supervisor

The Site Supervisor has the overall responsibility and authority to direct work operations at the job site according to the provided work plans and HASP. The Project Manager may act as the Site Supervisor while on site. The Site Supervisor's responsibilities include:

- Discussing deviations or drift from the work plan with the Site Safety Officer and Project Manager.
- Discussing safety issues with the Project Manager, Site Safety Officer, and field personnel.

- Assisting the Site Safety Officer with the development and implementation of corrective actions for site safety deficiencies.
- Assisting the Site Safety Officer with the implementation of this HASP and ensuring compliance.
- Assisting the Site Safety Officer with inspections of the site for compliance with this HASP and applicable SH&E Procedures.
- Reviewing Project Risk Register/ Task Hazard Assessments and Task Hazard Assessments (THAs) with the work crew.
- Reporting incidents and ensuring incidents and observations are logged into Lifeguard or IndustrySafe.
- Verifying that all operations are in compliance with the requirements of this HASP, and halting any activity that poses a potential hazard to personnel, property, or the environment.
- Temporarily suspending individuals from field activities for infractions against the HASP pending consideration by the Site Safety Officer, the SH&E Manager, and the Project Manager.

4.3 Site Safety Officer

The Site Safety Officer supports the Site Supervisor in providing a safe work environment. Not all sites will have a designated Site Safety Officer; the decision should be made by the Project Manager and SH&E Manager taking into consideration the complexity and risks of the scope of work. The Site Supervisor may act as the Site Safety Officer on sites without one. The Site Safety Officer's responsibilities include:

- Updating the site-specific HASP to reflect changes in site conditions or the scope of work. HASP updates must be reviewed and approved by the SH&E Manager.
- Inspecting the site for compliance with this HASP and the SH&E Procedures using the appropriate field audit inspection checklist found in IndustrySafe.
- Coordinating with Site Supervisor to review THAs with the work crew.
- Assisting as needed to report incidents and verify that incidents and observations are logged into Lifeguard or IndustrySafe.
- Working with the Site Supervisor and Project Manager to develop and implement corrective action plans to correct deficiencies discovered during site inspections. Deficiencies will be discussed with project management to determine appropriate corrective action(s).
- Contacting the SH&E Manager for technical advice regarding safety issues.
- Determining emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation.
- Checking that all site personnel and visitors have received the proper training, orientation and medical clearance prior to entering the site.
- Establishing controlled work areas (as designated in this HASP or other safety documentation).
- Facilitating or co-leading daily tailgate meetings and maintaining attendance logs and records.
- Discussing potential SH&E hazards with the Site Supervisor, the SH&E Manager and the Project Manager.
- Selecting an alternate Site Safety Officer by name and informing him/her of their duties, in the event that the Site Safety Officer must leave or is absent from the site.
- Verifying that all operations are in compliance with the requirements of this HASP.
- Issuing a "Stop Work Order" under the conditions set forth in this HASP.
- Temporarily suspending individuals from field activities for infractions against the HASP pending consideration by the SH&E Manager and the Project Manager.

4.4 Employees

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the SH&E Procedures specified in the HASP and other applicable safety policies, and clarifying those areas where understanding is incomplete.
- Providing feedback to SH&E management for continuous improvement relating to omissions and modifications in the HASP or other safety policies and procedures.
- Notifying the Site Supervisor or Site Safety Officer of unsafe conditions and acts.
- Stopping work if there is doubt about how to safely perform a task or if unsafe acts or conditions are observed (including subcontractors or team contractors).
- Speaking up and refusing to work on any site or operation where the SH&E procedures specified in this HASP or other safety policies are not being followed.
- Contacting the Site Supervisor or Site Safety Officer or the SH&E Manager at any time to discuss potential concerns and update the THA in the field to reflect the modifications
- Provide THA feedback to the supervisor for continuous improvement

4.5 Subcontractors

The requirements for subcontractor selection and subcontractor safety responsibilities are outlined in AECOM Procedure *S3AM-213-PR Subcontractor Management*. Each AECOM subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required personnel protective equipment (PPE) and all required training.

AECOM considers each subcontractor to be an expert in all aspects of the work operations for which they are tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services as well as all other requirements applicable to their work. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, in order to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to AECOM for review prior to the start of on-site activities.

Hazards not listed in this HASP but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed to the AECOM Project Manager or the Site Supervisor prior to beginning work operations. The Site Supervisor or authorized representative has the authority to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

4.6 Visitors

Authorized visitors (e.g., client representatives, regulators, AECOM management staff, etc.) requiring entry to any work location on the site will be briefed by the Project Manager, Site Supervisor, or Site Safety Officer on the hazards present at that location. Visitors will be escorted at all times at the work location and will be responsible for compliance with their employer's health and safety policies. In addition, this HASP specifies the minimum acceptable qualifications, training and PPE that are required for entry to any controlled work area; visitors must comply with these requirements at all times.

If the site visitor requires entry to any exclusion zone (EZ), but does not comply with the above requirements, all work activities within the EZ must be suspended. Unauthorized visitors, and visitors not meeting the specified qualifications, will not be permitted within established controlled work areas.

5. Training and Documentation

The following sections describe the standard practices or programs that AECOM will establish to prepare employees to perform work safely and consistent with AECOM policy and Procedures.

5.1 HASP/SITE Orientation

The Project Manager shall conduct a project/site-specific HASP orientation prior to the start of field operations, with support as needed by the SH&E Manager, Site Safety Officer, or Site Supervisor. This meeting will involve representatives from all organizations with a direct contractual relationship with AECOM on the job site. Minimum items to be covered are listed in **Attachment F**. Participants will then sign the HASP Personnel Acknowledgement register at the end of the HASP.

5.2 Daily Tailgate Meetings and THA Review

The Site Supervisor, Site Safety Officer or designee shall facilitate a tailgate meeting to discuss the specific requirements of this HASP and review the applicable THAs prior to the commencement of daily project activities. Attendance at the daily tailgate meeting is mandatory for all employees and subcontractors at the site contracted to AECOM. Simultaneous operations are encouraged to attend each other's tailgate meetings or at the very least the supervisors shall discuss the coordination of activities and associated hazards of each other's tasks. The supervisor will then convey the information to the work crew. The Tailgate Meeting must be documented by the Site Supervisor or Site Safety Officer on a Daily Tailgate Meeting form, a blank copy of which is included in **Attachment B**.

As part of the daily tailgate meeting, employees and subcontractors will be encouraged to voluntarily warm up and stretch select muscle groups to the best of their ability and within each person's individual limitations. Stretching is particularly beneficial to warm and loosen muscles before repetitive work, manual handling of loads, and when working in cold temperatures or with static postures. The exercises included in Attachment D may be used to facilitate these efforts.

5.3 Worker Training and Qualifications

All personnel at this site must be qualified and experienced in the tasks they are assigned. SH&E Training Procedure S3AM-003-PR establishes the general training requirements for AECOM employees. In addition, S3AM-117-PR, Hazardous Waste Operations, explains the HAZWOPER training and S3AM-128-PR, Medical Screening and Surveillance, details the medical surveillance requirements.

Check all required training on the table below. Verify training records of employees and subcontractors.

Site-Specific Training Requirements	
Training	**Applies to**
☒ HASP Orientation	All Employees and Subcontractors
☒ HAZWOPER 40 –HR	On HAZWOPER sites, in EZ, exposed to hazardous contamination
☒ HAZWOPER Supervisor	Employees managing others in HAZWOPER activities
☐ Field Safety	Anyone visiting the field that does not require HAZWOPER
☒ Speak-Up/Listen Up	All Field Employees and Supervisors
☐ Fit Test/ Respiratory Protection	Employees needing to wear respirators
☐ Hazardous Materials Shipping	Employee responsible for shipping HZM/HZW/DG and/or signing manifests

Site-Specific Training Requirements	
Training	**Applies to**
☒ Annual Medical Surveillance/ Clearance	Employees working in an exclusion zone and the regulatory required exposure limit **is** exceeded for 30 or more days a year
☐ Biennial Medical Surveillance/ Clearance	Working in an exclusion zone more than 30 days a year and the regulatory required exposure limit is **not** exceeded
☒ OSHA 10 hr. Construction	Employees working near heavy equipment, including drill rigs and remediation equipment (see Section .5.3.1)
☒ OSHA 30 hr. Construction	Supervisor/SSO overseeing work with heavy equipment (see Section 5.3.1)
☐ Local requirements:	
☐ Client requirements:	

5.3.1 OSHA 10 Hr/OSHA 30 Hr Training

OSHA 10/30 training is required for projects with construction or construction-like hazard, including. work where we, our client, or another contractor are presently building, removing, or disassembling structures or digging excavations of any size by mechanical means. This includes projects where we serve as PMCM, GC, Inspectors, or any work where our employees are exposed to construction site hazards. "Construction-like" hazards exist on n sites where the focus is NOT construction/demolition, but where our work scope includes use of heavy machinery movement, work at heights, confined space, hot work, lifting/hoisting loads, and/or ground breaking (includes drill rig, direct push and vac truck use).If these hazards exist, OSHA 10 hr training is required for field staff. ***All training OSHA must be complete by the end of FY2019.***

OSHA 30 hr training is required for supervisors. The term "supervisor" has many different meanings. As with HAZWOPER supervisor training, the requirement to complete the OSHA 30 hr construction course will be based on field supervisory roles and responsibilities, not administrative supervision roles. Field supervisors required to take the OSHA 30 construction course are defined as those individuals who provide work direction and leadership directly to AECOM field personnel and/or our subcontractors for construction/demolition activities or tasks that have construction-like hazards. These supervisors must be knowledgeable of construction hazards and controls because they are responsible for:

- Field implementation of a construction/demolition scope of work
- Controlling performance on the job site
- Evaluating and controlling hazards & preventing site safety risks
- Intervening to prevent unsafe actions or conditions of employees, clients, and subcontractors related to construction/demolition hazards

As with OSHA 10, OSHA 30 is being phased in and must be completed by the end of FY2019.

5.4 Competent Person

A competent person is an employee who, through education, training and experience, has knowledge of applicable regulatory requirements, is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

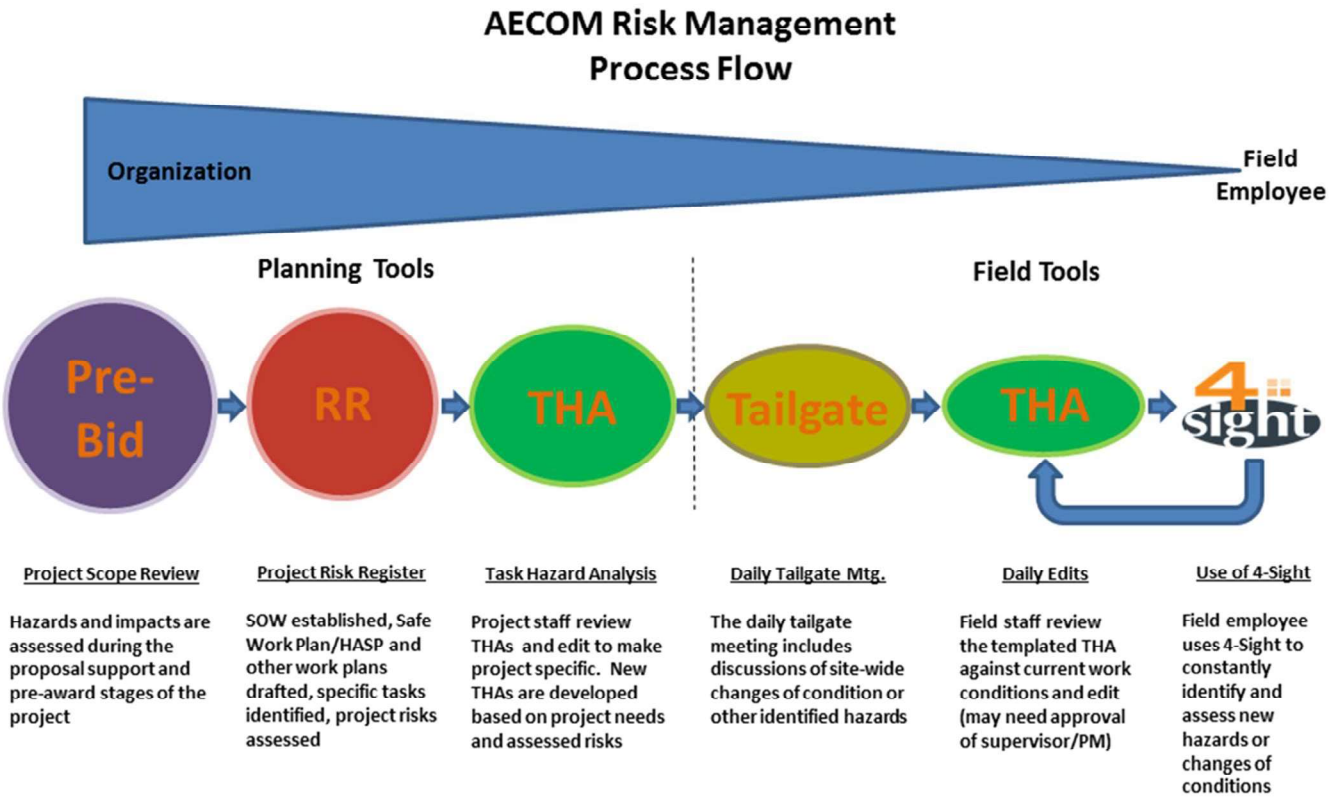
AECOM's Competent Person Designation Procedure, S3AM-202-PR, explains the roles, responsibilities and procedures of naming a competent person. Complete the table below and include a S3AM-202-FM1 Competent Person Designation Form for each AECOM competent person (subcontractors to use an equivalent process).

These activities require a competent person. Mark all that apply and list the name of the person.

	Activity	Name of Person
☐	Asbestos	
☐	Assured Equipment Grounding Conductor	
☐	Blasting & Explosives	
☐	Concrete & Masonry Construction	
☐	Confined Spaces	
☐	Control of Hazardous Energy (Lockout-Tagout)	
☐	Crane Assembly / Disassembly	
☐	Cranes & Derricks	
☐	Demolition	
☐	Electrical Wiring Design & Protections	
☐	Elevated Work Platforms & Aerial Lifts	
☐	Fall Protection	
☒	Hearing Protection	Stephen Wright
☒	Heavy Equipment	To be determined from Cascade
☐	Ionizing Radiation	
☐	Lead	
☐	Material Hoists & Personnel Hoists	
☐	Respiratory Protection	
☐	Rigging Equipment	
☐	Scaffolds	
☐	Stairways & Ladders	
☐	Steel Erection	
☐	Trench & Excavations	
☐	Underground Construction	
☐	Welding & Cutting	

6. Hazard Assessment and Control

AECOM has adopted an approach to hazard assessment and control that incorporates both qualitative and quantitative methods to identify hazards and the degree to which they may impact employees and AECOM operations. See S3AM-209-PR, Risk Assessment and Management, for details regarding AECOM's process. This approach is illustrated below and described in the following section.



6.1 SH&E Procedures

All AECOM SH&E procedures, in their controlled copy version, are available on the internal SH&E Policy and Procedures ecosystem page. Programmatic procedures referenced in this document (for example SH&E Training) do no need to be printed for inclusion in this HASP. Only procedures that are needed for field activity reference and application MUST be printed in full and included in this HASP. The applicable field procedures checklist is in the Physical Hazards section below and procedures are included in **Attachment C**.

6.2 Project Risk Register/ Hazard Assessment

Project start-up activities require appropriate SH&E planning prior to work commencing, including identification of hazardous tasks required to complete the Scope of Work (SOW). A Project Risk Register/Hazard Assessment shall be developed to guide work. Form S4[DCS]AM-209-FM4-A may be used and should be included in **Attachment B**.

6.3 Task Hazard Assessments (THAs)

A task hazard assessment (THA) form (located in S3AM-209-PR1) shall be prepared for each task to be performed as part of the scope of work. This includes driving to the site, parking, and walking as well as the hazards, associated risk, and appropriate controls for all other work activities. The DCS Americas Templated THA Library may also be used to find previously approved THAs. The preparer shall have one THA form for each task in the Scope of Work found in this work plan and shall also include blank copies in Attachment B.

In the field, the THA forms are to be reviewed at the location where the work will take place, just prior to beginning work on that task. Many times when employees arrive in the field, situations are different than originally planned for or additional job steps are required. The THA asks workers update or 'dirty up' the THA in the 'On-Site Edits' rows to assess the risks presented by the changed condition and requires the worker to describe steps to reduce the risk. If the hazard(s) cannot be successfully mitigated, the work is not allowed to proceed.

6.3.1 Hazard Categories

THAs should include consideration of the following hazard categories when identifying hazards and task specific controls:

- Biological
- Chemical
- Electrical
- Gravity
- Mechanical
- Motion
- Pressure
- Noise
- Radiation
- Thermal

6.4 4-Sight

When preparing hazard assessments and throughout the day workers should use 4-Sight. This is a mental process through which workers ask themselves (and each other) four questions designed to effectively assess hazards. Using these questions during each task, especially those without established THAs, will help workers identify hazards and condition changes so that they can control them or stop work to seek assistance.

1) What am I about to do?
2) What could go wrong?
3) What could be done to make it safer?
4) What have I done to communicate the hazards?

6.5 Speak Up/Listen Up

All AECOM employees have a responsibility to help create the environment where the expectation is Safety for Life. Speak Up/Listen Up (SULU) is a technique to steward jobsite safety by utilizing 4-Sight as a basis for safety feedback conversations. SULU has two main parts:

- **Speak Up** where employees use three simple steps when providing feedback to others about unsafe acts:
  - Ask to discuss their hazard assessment or 4-Sight for the task
  - Get a commitment from the employee to apply the hazard controls and perform the task according to the accepted procedures
  - Follow up to ensure the employee is working safely

- **Listen Up** where employees use two simple steps when responding to safety feedback:
  - Listen – Focus on the message, not the messenger
  - Commit to performing the task the safer way

SULU conversations should happen consistently throughout the work day to create clear expectations of how work should be performed. All employees should recognize safe work behaviors in order to reinforce them and keep them going. An occasional correction is much more effective when employees are frequently encouraged and positively recognized for their safe actions. Managers and supervisors should be having SULU conversations during site visits and ensure peer to peer and site supervisor to crew SULU conversations are being held.

7. Physical Hazard Assessment

7.1 Physical Hazards

A physical hazard is a hazard that threatens the physical safety of an individual; contact with the hazard typically results in an injury. The following table summarizes the physical hazards or activities containing physical hazards present at the site and the associated procedures that address protection and prevention of harm.

All checked procedures MUST be included in **Attachment C** for implementation and reference.

Check all applicable hazards/ activities and add site specific description of the hazard.

	Hazard/ Activity *(note: text in this column links to procedure)*	Site Specific Description *[where, what phase of work, frequency, etc.]*	Applicable Procedure
☐	**Abrasive Blasting**		S3AM-335-PR
☐	**Aerial Work Platforms**		S3AM-323-PR
☐	**All-Terrain Vehicles**		S3AM-319-PR
☐	**Blasting and Explosives**		S3AM-336-PR
☐	**Bloodborne Pathogens**		S3AM-111-PR
☐	**Cofferdams**		S3AM-344-PR
☒	**Cold Stress**	Added in case of delay.	S3AM-112-PR
☐	**Compressed Air Systems and Testing**		S3AM-337-PR
☐	**Compressed Gases**		S3AM-114-PR
☐	**Concrete Work**		S3AM-338-PR
☐	**Confined Spaces**		S3AM-301-PR
☐	**Corrosive Reactive Materials**		S3AM-125-PR
☐	**Cranes and Lifting Devices**		S3AM-310-PR
☐	**Demolition**		S3AM-339-PR
☐	**Diving (scientific and commercial)**		S3AM-334-PR
☒	**Drilling, Boring & Direct Push Probing**	Soil sampling.	S3AM-321-PR
☐	**Electrical Safety**		S3AM-302-PR
☒	**Excavation**		S3AM-303-PR
☐	**Fall Protection**		S3AM-304-PR
☐	**Flammable and Combustible Liquids**		S3AM-126-PR
☐	**Gauge Source Radiation**		S3AM-122-PR
☐	**Hand and Power Tools**		S3AM-305-PR
☐	**Hazardous Waste Operations**		S3AM-117-PR
☒	**Heat Stress**	Planned for summer field work.	S3AM-113-PR
☒	**Heavy Equipment**	Drill rig	S3AM-309-PR
☐	**High Altitude**		S3AM-124-PR
☐	**Highway and Road Work**		S3AM-306-PR
☐	**Hoists Elevators and Conveyors**		S3AM-343-PR
☐	**Hot Work**		S3AM-332-PR
☐	**Ladders**		S3AM-312-PR
☐	**Lockout Tagout**		S3AM-325-PR
☐	**Machine Guarding Safe Work Practice**		S3AM-326-PR

	Hazard/ Activity *(note: text in this column links to procedure)*	Site Specific Description *[where, what phase of work, frequency, etc.]*	Applicable Procedure
☐	**Marine Safety and Vessel Operations**		S3AM-333-PR
☐	**Material Storage**		S3AM-316-PR
☐	**Mine Site Activities**		S3AM-341-PR
☐	**Mining Operations**		S3AM-345-PR
☐	**Non Ionizing Radiation**		S3AM-121-PR
☒	**Overhead Lines**		S3AM-322-PR
☐	**Powder-Actuated Tools**		S3AM-327-PR
☐	**Powered Industrial Trucks**		S3AM-324-PR
☐	**Radiation**		S3AM-120-PR
☐	**Railroad Safety**		S3AM-329-PR
☐	**Respiratory Protection**		S3AM-123-PR
☐	**Scaffolding**		S3AM-311-PR
☐	**Steel Erection**		S3AM-340-PR
☐	**Temp. Floors, Stairs, Railings, Toe-boards**		S3AM-342-PR
☒	**Underground Utilities**		S3AM-331-PR
☐	**Underground Work**		S3AM-330-PR
☒	**Wildlife, Plants and Insects**		S3AM-313-PR
☐	**Working Alone**		S3AM-314-PR
☐	**Working On and Near Water**		S3AM-315-PR

8. Chemical Hazard Assessment

AECOM will perform tasks that can expose personnel to a variety of hazards due to the operational activities, physical conditions of the work locations, and potential presence of environmental contaminants. This section presents a variety of potential chemical hazards, exposure pathways, and related mitigation actions. See S3AM-110-PR, Toxic and Hazardous Substances, for information on planning, training, monitoring, and details on several specific chemicals (Benzene, Cadmium, Chromium, Hydrogen Sulfide, Lead, and Silica).

8.1 Potential Chemical Hazards

The chemicals in the table below are known or suspected to be present at the site.

Summary of Hazardous Properties of Contaminant Exposure Hazards

PEL: Permissible Exposure Limits

TLV: Threshold Limit Values

		Chemical Name	Media	Primary Routes of Exposure	PEL	TLV	IP electron volts (eV)
Metals	☒	Arsenic	Soil and Water	Dermal	0.5 mg/m^3	0.2 mg/m^3	n/a
	☒	Cadmium	Soil and Groundwater	Dermal	0.005 mg/m^3	0.01 mg/m^3	n/a
	☒	Lead	Soil and Groundwater	Dermal	0.05 mg/m^3	0.05 mg/m^3	n/a
SVOCs	☒	Benzo(a)pyrene	Soil and Groundwater	Inhalation	0.2 mg/m^3	0.1 mg/m^3	~11.1

8.2 Potential Exposure Pathways

Occupational exposure to chemical hazards associated with the work activities could potentially occur by two primary routes (inhalation and skin contact) and one indirect route (incidental ingestion).

8.2.1 Inhalation

The primary risks associated with AECOM's scope of work pertain to potential exposure to airborne contaminants and explosion hazards. Constituents that potentially pose an occupational concern to employees by the inhalation route are carbon monoxide, hydrogen sulfide, methane, and volatile organic compounds. Air monitoring will be performed within the employee breathing zone to assess the need to implement appropriate control measures or stop work. In addition, air monitoring will be performed at the source to assess potential explosion hazards.

8.2.2 Skin Contact

Personnel handling residual product or waste and associated equipment may be exposed to chemical hazards by skin contact or adsorption. However, exposure is expected to be limited since workers will be required to wear appropriate PPE (i.e. appropriate work gloves, body clothing, and/or face shield).

8.2.3 Ingestion

Personnel handling residual product or waste and associated equipment, including project hazardous materials, may be exposed by incidental ingestion. Typically, this exposure occurs if proper PPE was not used or personal hygiene was not

practiced. Personal protection against exposure via ingestion can be accomplished by performance of proper decontamination procedures when exiting contaminated work areas as well as using the correct PPE.

8.3 Decontamination

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities. Decontamination steps are outlined in Hazardous Waste Operations procedure S3AM-117-PR. Some key elements are as follows:

- All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to exiting to clean areas of the site.
- Avoid reactions between the solutions and contaminated materials. Review the applicable SDS.
- All contaminated PPE and decontamination materials shall be contained, stored and disposed of in accordance with site-specific requirements determined by site management.
- Use caution while working around decontamination stations, including the decontamination pad, which may be a slip or trip hazard.
- Use disposable equipment when possible and practical.
- All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors.
- All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone (CRZ).

Decontamination Procedures & Equipment	
Procedure	***Equipment Needed***
Remove any Gross debris from gloves and place it in the designated waste accumulation point.	Nitrile gloves, paper towels, plastic sheeting, & containers for storage
Remove nitrile gloves, taking care not to contact the outside of the gloves, and place the gloves in the designated waste accumulation point.	Nitrile gloves, paper towels, plastic sheeting, & containers for storage

Equipment Decontamination Procedures		
Type Equipment	***Decontamination Solution***	***Procedure***
Drilling equipment	Potable water	Position equipment on the pad to avoid release of debris or overspray beyond the pad area. Remove Goss debris from equipment and contain at a designated waste accumulation point. Thoroughly wash the equipment using a steam cleaner and potable water. Contain wastewater at a designated accumulation point.
Non-Dedicated Sampling Equipment	Potable water & non-phosphate soap solution	Remove any Gross debris or expendables and place it into the designated waste accumulation point. Was the equipment in a non-phosphate soap solution. Thoroughly rinse the equipment with potable or distilled water. Contain wastewater at a designated accumulation point.
Field Monitoring Equipment	Moist towel	Remove and Gross debris and place it into the designated waste accumulation point. Wipe the outside of the equipment with a moist towel.
Pumps and Electrical Equipment	Potable water & non-phosphate soap solution	Place the submersible pump into a non-phosphate soap solution and operate the pump to ensure adequate rinsing of the internal pump assembly. For water level measurement devices, unreal the tape into the soap solution and agitate. Place the equipment into a potable water rinse. Operate pumps as described above to

		remove and residual soap solution. Rinse measurement tapes by agitating in potable or distilled water.

Waste Handling for Decontamination	
Waste Streams/Products	***Disposal Procedures***
Expendable Materials	Expendable items are commercially acquired materials used in support of field activities. These materials may include but are not limited to packaging, paper towels, plastic sheeting, etc. These materials should be placed into plastic garbage bags placed within the areas of activity or carried on the vehicle. Upon completion of the activity or when the bag has filled, the wastes should be placed into a designated disposal area for disposal of solid waste.
Solid Media IDW	Sampling-IDW included in this category may include the following: • Soil cuttings • Solids accumulated during decontamination • Personal protection equipment (PPE) Unless otherwise authorized, cuttings should be placed into 55-gallon drums, sealed, labeled with the date, contents, and location; and subsequently transferred to a designated soil staging location until the waste can be adequately characterized and properly disposed. Solids accumulated during decontamination should be placed into 55-gallon drums. Once filled, each drum should be sealed, identified with the contents and date, and transferred to the onsite staging area for subsequent testing prior to disposal. PPE coated in solid IDW should also be placed into a 55-gallon drum, sealed, labeled with contents and date, and transferred to the onsite staging area for subsequent testing prior to disposal. PPE with little or no solids, can be decontaminated by removing solids and/or washing in accordance with the decontamination procedure and disposed of with general household waste.
Liquid Media Waste	Liquid wastes potentially generated during investigation activities may include the following: • Drilling fluids • Purged well water • Decontamination fluids Unless otherwise authorized, liquid wastes generated during the investigation should be containerized in 55-gallon drums, or other appropriate storage (i.e. polyethylene tanks). Containerized liquids should be labeled with the date, contents and location, and transferred to the staging pad for subsequent testing prior to disposal.

8.4 Air Monitoring

Air monitoring will be conducted in accordance with the NYSDEC-approved Community Air Monitoring Plan (CAMP) (Appendix E). Monitoring shall be performed within the work area on site in order to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Monitoring shall be in accordance with Exposure Monitoring Procedure S3AM-127-PR and specified in the work permit and/or THA for the tasks. Key elements of the procedure include:

- Calibration of monitoring equipment and/or daily bump tests to verify calibrations and confirm alarm function.
- Personal monitoring and result evaluation must be directed by a Certified Industrial Hygienist or Certified Safety Professional.

8.4.1 Real-Time Exposure Measurement/ Equipment

Monitoring shall be performed within the work area on site in order to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Monitoring shall be conducted as specified in the work permit and THA as work is performed. All instrumentation need to be rated intrinsically safe to prevent fire or explosion.

Check which real-time monitoring equipment will be used and update the model type if needed:

	Instrument	Manufacturer/Model	Substances Detected
☒	**Particulate Monitor**	MIE Model PDM-3 mini-RAM	• Aerosols, mist, dust, and fumes

8.4.2 Health and Safety Action Levels

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area or other environmental conditions. The concentration level (above background level) and the ability of the PPE to protect against that specific contaminant determine each action level. The action levels are based on concentrations in the breathing zone.

If ambient levels are measured which exceed the action levels in areas accessible to unprotected personnel, necessary control measures (barricades, warning signs, and mitigation actions to limit, etc.) must be implemented prior to commencing activities at the specific work area.

Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of Site Supervisor or Site Safety Officer or the Safety Manager.

Reasons to Upgrade:

- Known or suspected presence of dermal hazards;
- Occurrence or likely occurrence of gas, vapor, or dust emission; or
- Change in work task that will increase the exposure or potential exposure to hazardous materials.

Reasons to Downgrade:

- New information indicating that the situation is less hazardous than was originally suspected;
- Change in site conditions that decrease the potential hazard; or
- Change in work task that will reduce exposure to hazardous materials.

8.4.3 Monitoring Procedures

The monitoring procedures shown below are general guidelines for sampling activities. The reviewing SH&E Manager may modify any or all of these for site-specific application. A reading in excess of action level outlined below will require additional ventilation for 30 minutes, followed by re-monitoring.

Monitoring Procedures and Action Levels

Parameter	Zone Location and Monitoring Interval	Response Level	Response Activity
Dust not otherwise classified (total by aerosol monitor)	Breathing zone every 30 minutes during field activities where exposure to excessive dusts are possible	< 5 mg/m^3	Continue work in Level D and continue monitoring
		> 5 mg/m^3	Upgrade to Level C (P100 respirator cartridges), implement dust suppression measures; contact the Site Safety Officer & Site Supervisor.
		> 10 mg/m^3	Cease activities, implement more effective dust suppression measures; contact the Site Safety Officer & Site Supervisor.
Dust not otherwise classified (total by aerosol monitor)	Edge of Exclusion Zone, every 30 minutes during excavation activities	< 5 mg/m^3	Continue work in required PPE, monitor air, and implement engineering controls
		> 5 mg/m^3	Cease activities and contact the Site Safety Officer & Site Supervisor.

See also the perimeter monitoring requirements and criteria in the CAMP (Appendix E).

9. Environmental Impact Prevention

AECOM strives to avoid or control environmental impacts from our operations through planning and implementation of best practices as well as preparing responses to react to environmental incidents. Environmental Compliance procedure S3AM-204-PR provides details on permitting and planning requirements.

	Potential Environmental Impact	Description of Hazard and Permit or Control Being Implemented
☒	**Air Emissions**	Any operations where air emissions may negatively impact the surrounding environment, air emission permits, etc. and discuss associated control
☐	**Hazardous Waste Management**	Storage, treatment, or disposal of hazardous waste at the project site, RCRA Part B permits or equivalent, 90-day storage procedures, etc.
☐	**Storm Water Pollution**	Operations that may generate/discharge storm water from the project site, NPDES/general construction storm water discharge permits, etc.
☐	**Wetlands**	Use the FWS online wetlands mapper (http://www.fws.gov/wetlands/Data/mapper.html) to determine if any wetlands exists on your project site, are adjacent to your project, or may be negatively impacted by your project, any regulatory permits and control measures
☐	**Critical Habitat**	Use the FWS online critical habitat mapper tool (http://criticalhabitat.fws.gov/) to determine if any plant or animal critical habitats exists on, adjacent to, or may be otherwise impacted by your project, any regulatory permits and control measures
☐	**Other:**	

9.1 Incidental Spill Prevention and Containment

Spill prevention and containment planning must be conducted and appropriate control measures established, consistent with regulatory requirements. Personnel are not expected to perform a response action related to an uncontrolled release of a hazardous substance. However, in the event of an incidental release of a hazardous material, a response will be performed to absorb, neutralize or otherwise control the release within the immediate work area. Procedures contained in the SDS of the hazardous material will be implemented to perform the response. The Emergency Response section of this HASP contains information on spill reporting, pre- and post- spill evaluation, and response

9.1.1 Spill Prevention and Containment Practices

Work activities may involve the use of hazardous materials (i.e. fuels, solvents) or work involving drums or other containers. When these activities exist the procedures outlined below will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate containers and labelled.
- Tops/lids will be placed back on containers after use.
- Containers of hazardous materials will be stored appropriately away from moving equipment.
- Containers shall only be lifted using equipment specifically manufactured for that purpose.
- Drums/containers will be secured and handled in a manner which minimizes spillage and reduces the risk of musculoskeletal injuries.
- Equipment will be inspected daily for signs of leaks, wear, or strain on parts that, if ruptured or broken, would result in a spill.

- Refueling should occur in designated areas where incidental spills can be prevented from reaching permeable ground surfaces.
- Whenever possible, position parked or stationary equipment over secondary containment and/ or absorbent materials to prevent spills from reaching permeable ground surfaces.
- A spill response kit, to include an appropriate empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (i.e. speedy dri, absorbent pads, etc.) will be available on the project site and positioned for quick and easy access.

10. Personal Protective Equipment

PPE is considered the last line of defense in hazard control. PPE is meant to protect workers when all other methods (elimination, substitution, engineering, and administrative) have been exhausted. All employees must be trained in the proper use and maintenance of PPE. See Procedure S3AM-208-PR1, Personal Protective Equipment.

A PPE assessment (see S3AM-208-FM1) can be performed to help determine PPE requirements. PPE upgrades for individual tasks or steps of a task are to be identified in the appropriate THA(s).

Minimum Required PPE (per AECOM PPE and HAZWOPER Procedures):

- Hard hat
- Safety glasses w/ side shields (may be clear or shaded)
- Safety toe work boots
- Long pants and shirts with sleeves (short or long- cover shoulders no tank or muscle shirt styles)

Complete the table below for site-specific PPE:

Additional PPE Needed On Site

(to encompass all task specific additions and upgrades)

Face/ Eyes		Head/ Ears	
☐ Spoggles (Safety Glasses with foam liner for dust protection)	☐ Chemical Goggles	☐ Helmet with Chin Strap	☒ Earplugs
☐ Welding Mask/Goggles	☐ Face Shield (splash)	☐ Wide Brimmed Hat	☐ Over-ear Hearing Protection
	☐ Face Shield (impact)		

Hands		Legs/ Feet	
☒ Nitrile	☐ Other Chemical Resistant : *(specify)*	☐ High Ankle Boots	☐ Metatarsal Guards
☐ Leather		☐ Snake Guards	☐ Electrically-resistant boots
☐ Cut, Abrasion and Puncture Resistant	_____	☐ Rubber Boots/Waders	
☐ Impact-resistant	_____		

Body	Equipment
☒ Sunscreen	☐ **Air/Noise Monitoring Equipment:** *(specify)*
☒ Insect Repellent (DEET)	_____
☐ Permethrin Applied to Clothing	_____
☐ Long-sleeved Shirt	☒ **Traffic/Work Zone Control Equipment:** *(specify)*
☒ High-visibility Vest	_____
☐ High-visibility Pants	_____
☐ Disposable Coveralls	☐ **Communication Beyond Cell Phones:** *(specify)*
☐ Flame Retardant Clothing	_____
☐ Fall Protection	_____
☐ Personal Floatation Device	☐ **Fire Controls:** *(specify)*
☐ Other: *(specify)*	_____
_____	_____
_____	

11. Site Control

The purpose of site control is to protect the public from inadvertently coming into contact with site hazards and to protect AECOM employees being impacted by hazards. This section details the equipment and actions needed to promote optimal site control.

11.1 Site Work Zones

Site layout and site control need to be coordinated achieve a productive work environment and efficient work process while minimizing exposure of employees and the public to hazards associated with the work. Consider the following items when planning the site layout and controls:

- "Line of Fire" hazards- overhead utilities, falling/ tipping equipment, release of energy/ pressure, flying debris,
- Noise, dust, odor suppression
- Contamination containment and decontamination area layout
- Traffic control for site vehicles/ equipment (public traffic control requires Traffic control Plan)
- Restricted access for areas requiring special training, skills, or certifications
- Restriction of work near railroads
- Presence or creation of excavations
- Loading/unloading areas
- Portable restrooms
- Dumpsters and bins
- Equipment lay down
- Heavy equipment parking
- Overnight safety and security needs

Check the description of the site controls **already** in place:

- ☒ Work area is within a facility/ property with secure and restricted access provided by client or third party
- ☐ Work area is enclosed within facility/ property but access is not restricted via locks, guards, or gates
- ☐ Work area is on a property that is open and access by the public is likely
- ☐ Work area is on a property that is open but access by the public is unlikely
- ☐ Work area is in a roadway or right of way of a roadway (Traffic Control Plan required S3AM-306-PR)
- ☐ Work area is on or near railroad (including right of way, active lines, and crossings)
- ☐ Other: *(describe)*

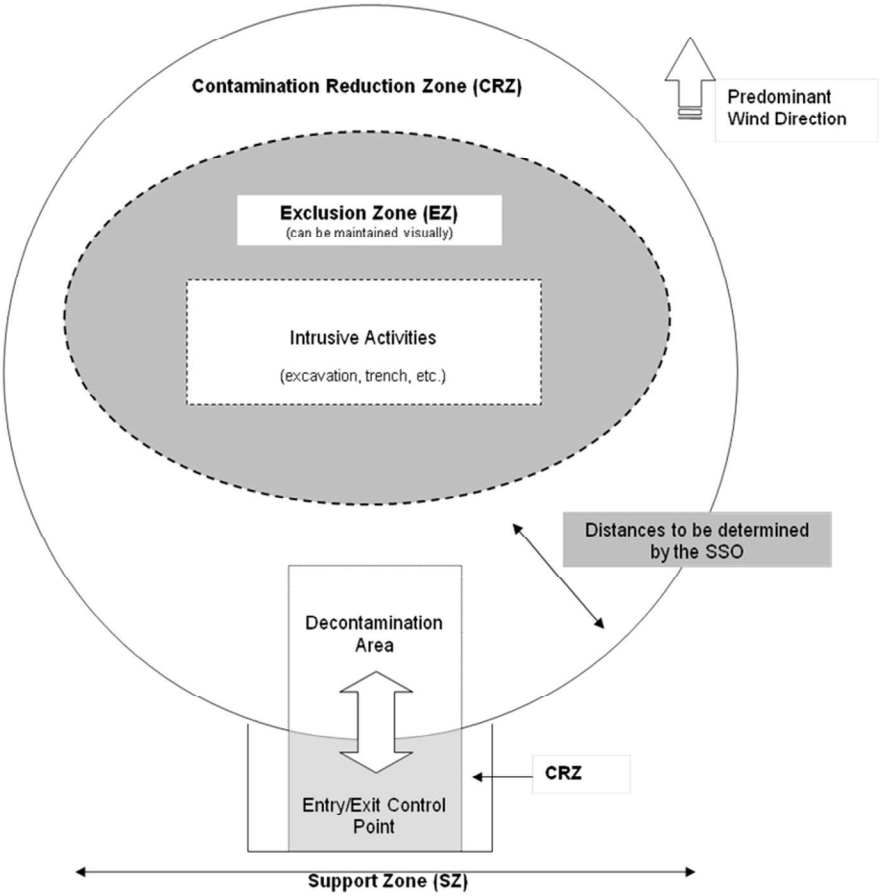
_____

_____

Check and describe the site controls that need to be added to protect the public and the AECOM work team.

	Control Item	Description of Type and Application
☒	**Fence**	
☐	**Locks**	
☒	**Barricades**	
☒	**Cones**	When required to isolate AECOM & their subcontractors from pedestrian & site traffic.
☒	**Tape**	When required to isolate AECOM & their subcontractors from pedestrian & site traffic.
☐	**Hole Covers**	
☐	**Other:**	

11.2 Site Control Map/ Diagram



11.3 Simultaneous and Neighboring Operations

Not applicable to AECOM's scope of work.

11.4 Site Security

All projects should be reviewed for the potential for personal security issues (e.g., assault, robbery, threat, etc.). Check all of the following that apply:

- ☐ Project site located in a higher crime area or has a history of security incidents
- ☐ Working outside of regular cellular telephone service
- ☐ Idle property with potential for trespasser(s) to shelter in buildings/structures and assault personnel
- ☐ Working at night

Detail the security measures to address the above risks: NA

12. Emergency Response

AECOM requires that all projects plan for reasonably foreseeable emergencies (see Emergency Response Planning Procedure S3AM-010-PR). Prior to the start of site operations, all personnel shall review the table below for site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures. An Incident Response Flow Chart is included in **Attachment A.**

12.1 Incident/ Emergency Contact Information

AECOM Contacts			
Name	**Title**	**Telephone Number**	**Mobile Phone**
Aimee Ruiter	Project Manager	NA	978-580-7616
Keith Stahle	Site Supervisor	NA	607-398-4284
Stephen Wright	Site Safety Officer for AECOM	NA	978-852-7620
Chris Call	Site Safety Officer for Advanced Geological Services	NA	484-459-3306
Jared Plank	Site Safety Officer for Cascade	NA	518-225-1439
Pete Wray	EBL SH&E Manager	NA	302-660-9178
Scott Dietz	Account SH&E Manager	NA	240-344-5892
Incident Reporting	DCS Incident Reporting & Help Line	800-348-5046	
AECOM Nurse direct	Use only after incident reporting line	877-878-9525	
Client Contacts			
Name	**Title**	**Telephone Number**	**Mobile Phone**
Greg Haack	Client Project Manager	NA	607-329-9234
Organization/Agency			
Police Department (local)			911
Fire Department (local)			911
Ambulance Service (EMT will determine appropriate hospital for treatment)			911
Hospital: (Site personnel to use for emergency care) Corning Hospital, 1 Guthrie Drive, Corning, NY 14830			607-937-7200
Occupational Clinic: (Site personnel to use for non-emergency care) Sheila L. Butler, MD, 130 Center Way, Corning, NY 14830			607-973-8039
Poison Control Center			(800) 222-1222
Pollution Emergency NRC			1-800-424-8802
INFOTRAC (AECOM's account number 74984)			800-535-5053
AECOM Hazardous Material Shipping Help Line			800-381-0664
Public Utilities			
Call Before You Dig			811

12.2 Muster Location

Entrance.

12.3 Communication Procedures

Cell phone.

12.4 CPR/ First Aid Trained Personnel

Keith Stahle.

12.5 Incident Reporting

Incidents involving or affecting an AECOM employee will be reported in a prompt manner verbally to the site supervisor and project manager.

1. If the incident is a significant or life-threatening emergency, the employee or supervisor shall immediately dial 911 or the appropriate emergency contact phone number for your site.
2. The employee or supervisor shall contact the Incident Hotline (800-348-5046). *Note: Do not report subcontractor injuries to the Incident Hotline as AECOM Nurses cannot provide direction to subcontractors. The Subcontractor should follow their injury reporting and response procedure. The incident should be reported to IndustrySafe as described below.*
3. The employee or supervisor must notify their operational leaders and the Area SH&E Manager.
4. The supervisor, or delegate, must make initial notification in IndustrySafe within 4 hours for significant incidents, including subcontractor injuries, or 24 hours for less significant events event.
5. Client and account management notifications may also apply. The Project Manager will make any necessary notifications.

Any injury, even if no treatment is required, and any incident for which assistance by SH&E Management is needed must be immediately communicated to the Incident Hotline at 1-800-348-5046.

All incidents are also to be reported to IndustrySafe within the timeframes listed below:

Incident Type	IndustrySafe Reporting Time Frame
Significant Incident, including any injury to an AECOM Employee or Subcontractor	➔ 4 Hours
All Other Incidents	➔ 24 Hours

Significant Incident:

- Fatality;
- Amputation;
- Hospitalization for treatment for more than 24 hours (admission);
- Any single event resulting in more than one employee requiring medical treatment or more than one employee being away from work more than 3 days;
- Any SH&E-related Consent Agreement/Order/Lawsuit or enforcement action seeking more than $10,000 or alleging criminal activity;
- Any spill or release of a hazardous material that is reportable to a regulatory agency;
- Any Notices of Violation resulting from not operating within a regulatory agency permit/license or consent;
- Any incident resulting in property damage expected to exceed $10,000 United States (US) dollars;
- Any security-related incident that could have caused significant harm to an AECOM employee; and/or
- Any Near Miss event that may have resulted in any of the above consequences but because of "luck" did not result in harm to persons, property or the environment.

All Other Incidents:

- Any injury or illness to an AECOM employee or subcontractor, even if it does not require medical attention, including work-related injuries/illnesses that have become significantly aggravated by the work environment;
- An injury to a member of the public, or clients, occurring on an AECOM-controlled work site;
- Re-occurring conditions such as back pain or cumulative trauma disorders (e.g., carpal tunnel syndrome);
- Fire, explosion, or flash that is not an intended result of a planned event (e.g., remediation process, laboratory Procedure);
- Any incident involving company-owned, rented, or leased vehicles (including personal vehicles used for company business); and/or
- Any failure to comply with the requirements of a regulatory permit issued to AECOM.
- Scan the QR code below to access IndustrySafe reporting system from your smartphone/ device.

IndustrySafe
Safety Management Software

12.6 Medical Emergencies

In the event of a life-threatening or critical emergency, AECOM employees should dial 911 and follow the recommended instructions. However, in less serious situations, an injured employee or a co-worker should contact the Incident Hotline at 800-348-5046 to ensure that the employee receives the best care at the best time (i.e., within the first hour following an injury or potential injury). By contacting the Incident Hotline, the worker can be connected with AECOM's nurses for first aid advice. If recommended by the nurse, the supervisor or a co-worker should drive the injured employee to the project-designated clinic or hospital. A map to the designated hospital and clinic is attached as **Attachment A** and the locations and addresses are included in the table above as well as in the HASP Summary on Page i.

12.7 Vehicle Incidents

All vehicles should be rented through Carson Wagonlit Travel (accessible via Ecosystem) to ensure that AECOM insurance is included in the rental rate. All other insurances should be declined. AECOM's rental vehicle insurance policy for National/Enterprise or Avis can be found on the DCS Americas United States or Canada travel pages. **Drivers MUST print and carry the applicable insurance policy for the rental**.

In the event of a vehicle incident (including collisions as well as mechanical difficulties such as breakdowns and flat tires) the following responses are recommended:

- For breakdowns and flat tires, contact an emergency provider.
- For rental vehicles, contact the rental company.
- To the extent possible, AECOM personnel should not change flat tires or perform similar repairs.
- If a collision has occurred, assess the situation and move all occupants (except the injured) out of further harm's way. If safe to do so, remove the car from the traveled way. Call 911 if necessary, and report the incident to the Incident Hotline at 800-348-5046 as soon as practical. If appropriate, wait for police to arrive before moving vehicles. Provide insurance information to other drivers if necessary or requested and collect the same. If possible, obtain names and phone numbers of witnesses. Take photographs of the scene if possible. DO NOT ADMIT LIABILITY, AGREE TO PAY FOR DAMAGE, OR SIGN A DOCUMENT RELATED TO AN INCIDENT EXCEPT AS REQUIRED BY LAW.

12.8 Spill or Release

AECOM employees are not expected to take action or to participate in rescues or responses to chemical releases (including of petroleum products) beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911), unless there is a contractual provision for this response and specially trained employees.

12.8.1 Environmental Spill/Release Reporting

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, will be reported according to the incident reporting procedure. In determining whether a spill or release must be reported to a regulatory agency, the Site Supervisor or qualified worker will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, applicable regulatory permit, and/or client-specific reporting procedures. **If reporting to a US state or Federal regulatory agency is required, AECOM has 15 minutes from the time of the spill/release to officially report it.**

Chemical-specific Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Reportable Quantities for the known chemicals onsite are shown in the table below.

Table 12-1: CERCLA Reportable Quantities

Hazardous Substance	Regulatory Synonyms	Final RQ (lbs.)
1,1,1-Trichloroethane	TCA	1,000
Arsenic	N/A	1
Benzene	N/A	10
Cadmium	N/A	10
Carbon Tetrachloride	N/A	10
Chromium	N/A	5,000
Ethyl Benzene	N/A	1,000
Lead	N/A	10
Mercury	N/A	1
Methyl Ethyl Ketone	MEK	5,000
Nickel	N/A	100
Pentachlorophenol	PCP	10
Selenium	N/A	100
Tetrachloroethylene	Perchloroethylene, PCE	100
Toluene	N/A	1,000

Trichloroethylene	Trichloroethene, TCE	100
Xylene	N/A	100

CERCLA RQ's can be found at: http://www.epa.gov/oem/docs/er/302table01.pdf

The spill containment program addresses the following site-specific information:

- Potential hazardous substance spills and available controls;
- Initial notification and response;
- Spill evaluation and response; and
- Post-spill evaluation.

12.8.2 Spill Evaluation and Response

The SSO is responsible for evaluating spills and determining the appropriate response. When this evaluation is being made, the spill area is isolated and demarcated to the extent possible. When an incidental release occurs, clean-up personnel receive instructions in a pre-clean-up meeting as to spill conditions, PPE, response activities, decontamination, and waste handling.

The procedures of the Emergency Response section of this HASP are immediately implemented when the spill is determined to require emergency precautions and action. If necessary to protect those outside the clean-up area, notification of the appropriate authorities is made. Table 12-1 lists the spill conditions that trigger notification of Federal, state, and local agencies.

The following are general measures that response/clean-up personnel take when responding to a spill:

- To minimize the potential for a hazardous spill, hazardous substances, control/absorbent media, drums and containers, and other contaminated materials are properly stored and labeled;
- When a spill occurs, only those persons involved in overseeing or performing spill containment operations will be allowed within the designated hazard areas. If necessary, the area will be roped or otherwise blocked off. Unauthorized personnel are kept clear of the spill area;
- Appropriate PPE is donned before entering the spill area;
- Appropriate spill control measures are applied during spill response;
- Whenever possible without endangerment of personnel, the spill is stopped at the source or as close to the source as possible;
- Ignition points are removed if fire or explosion hazards exist;
- Surrounding reactive materials are removed;
- Drains or drainage in the spill area are blocked or surrounded by berms to exclude the spilled waste and any materials applied to it;
- Provisions are made to contain and recover a neutralizing solution, if used;
- Small spills or leaks from a drum, tank, or pipe will require evacuation of at least Enter Distance feet in all directions to allow clean-up and to prevent employee exposure. For small spills, sorbent materials such as sand, sawdust, or commercial sorbents are placed directly on the spill to prevent further spreading and aid in recovery;
- Spill area is sprayed with appropriate foam where the possibility of volatile emissions exists;
- If the spill results in the formation of a toxic vapor cloud, from vaporization, reaction with surrounding materials, or the outbreak of fire, further evacuation may be required;
- To dispose of spill waste, all contaminated sorbents, liquid waste, or other spill clean-up will be placed in small quantities Enter QTY pounds) in approved drums for proper storage or disposal as hazardous waste; and

12.8.3 Post Spill Evaluation

As part of the incident investigation and reporting documentation, a written spill response report shall be prepared at the conclusion of clean-up operations. The report will include, at a minimum, the following information:

- Date of spill incident;
- Cause of incident;
- Spill response actions;
- Any outside agencies involved, including their incident reports; and
- Lessons learned or suggested improvements.

The spill area is inspected to ensure the area has been satisfactorily cleaned. The use of surface and air sampling is utilized in this determination as necessary. The root cause of the spill is examined and corrective steps taken to ensure the engineering and control measures in place have performed as required. If alternative precautions or measures are needed, they are made available and implemented.

All durable equipment placed into use during clean-up activities is decontaminated for future utilization. All spill response equipment and supplies are re-stocked as required.

12.9 Fire

AECOM employees are not expected to attempt to put out fires. Stop work; notify all AECOM personnel, move upwind and contact 911 and/or emergency response at the site. If employees have been properly trained in the operation of a fire extinguisher, they may attempt to put out a small fire, provided that the following conditions are met:

- The fire must be small (i.e., smaller than a trash can) and in its early stages
- The employee must have an escape route
- The employee must be trained and know they have the right type of extinguisher
- The employee must be safe from toxic gases
- There must be no hazardous conditions that could quickly accelerate the fire (i.e., presence of chemicals, especially dry grass, etc.)
- Above all, if in doubt, the employee must not attempt to fight the fire

13. Personnel Acknowledgement and Disclaimer

By signing below, the undersigned acknowledges that he/she has reviewed the AECOM Health and Safety Plan for the City of Corning Fire Department site. The undersigned also acknowledges that he/she has been instructed in the contents of this document and understands the information pertaining to the specified work, and will comply with the provisions contained therein. The employee understands that they are NOT to perform any work that they have not been adequately trained for and that they are to stop work if it is unsafe to proceed. Finally, the employee understands to notify the Site Supervisor and the Incident Hotline at 800-348-5046 for any incident, ***including ANY injury even if no first aid or medical treatment is required.***

Print Name	Signature	Organization	Date

13.1 Disclaimer:

This SH&E Plan, and each of its provisions, is applicable only to, and for use only by, AECOM, its affiliates, and its subcontractors. Any use of this Plan by other parties, including, without limitation, third party contractors on industrial sites or projects where AECOM is providing engineering, construction management or similar services, without the express written permission of AECOM, will be at that party's sole risk, and AECOM Corporation shall have no responsibility therefore. The existence and use of this Plan by AECOM shall not be deemed an admission or evidence of any acceptance of any safety responsibility by AECOM for other parties unless such responsibility is expressly assumed in writing by AECOM in a specific project contract.

Attachment A

Hospital and Clinic Directions/ Maps
Incident Reporting and Response Flow Chart

Attachment A. Hospital and Clinic Directions/ Maps Incident Reporting and Response Flow Chart

Hospital- Address, written directions, and mapped route from site

Corning Hospital, 1 Guthrie Dr. Corning, NY 14830

Occupational Clinic- Address, written directions, and mapped route from site

Butler Sheila L., 130 Center Way, Corning, NY 14830

AECOM

sedgwick

ON THIS PAGE Provider Information, Text Provider Information, Map, Driving Directions

PROVIDER INFORMATION

Copy to Clipboard Back to Results

Provider	**Corning Hospital**
Address	1 Guthrie Dr Corning, NY 14830
Specialty	Hospital: Acute Care
National Provider Identifier	1346241973
Phone	607-937-7200
LOB	Au Wc
Effective Date	11-01-2007

TEXT PROVIDER INFO TO MOBILE PHONE

Type a phone number Send

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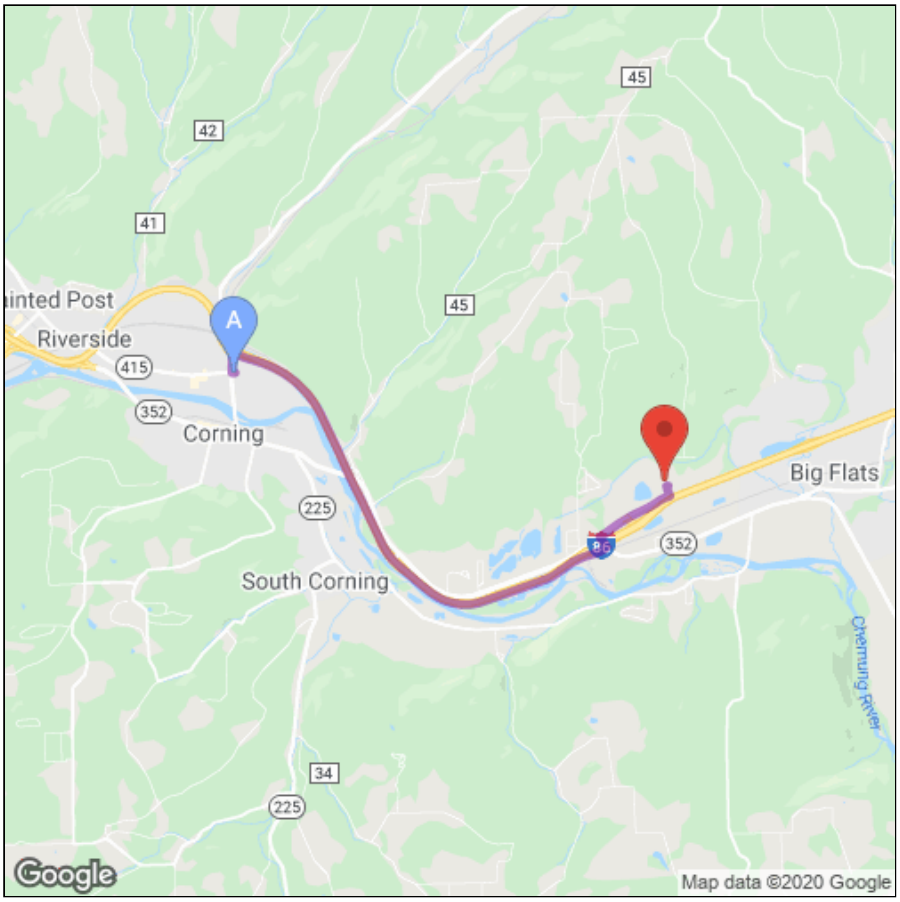
DRIVING DIRECTIONS

From: 174 East Pulteney Street Corning, NY 14830 New Start Address

To: 1 Guthrie Dr Corning, NY 14830

1. Head **west** on **E Pulteney St** toward **Center Way** 161 ft
2. Turn **right** at the 1st cross street onto **Center Way** 0.2 mi



3.	Turn **right** to merge onto **I-86 E**/ **NY-17 E**	4.7 mi
4.	Take exit **48** for **NY-352** toward **E Corning**	0.4 mi
5.	Turn **left** onto **NY-352 W**	0.1 mi
6.	Turn **right** onto **E Corning Rd**	0.8 mi
7.	Turn **left**	0.1 mi
8.	Turn **right**	23 ft
9.	Sharp **left**	85 ft
	Destination will be on the right	
	Estimated driving time: 9 minutes	6.4 mi

TEXT DRIVING DIRECTIONS TO MOBILE PHONE

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ON THIS PAGE Provider Information, Text Provider Information, Map, Driving Directions

PROVIDER INFORMATION

Copy to Clipboard Back to Results

Provider	**St James Mercy Hospital**
Address	411 Canisteo St Hornell, NY 14843
Specialty	Chemical/Alcohol Dependency Dentistry General Acute Care Short Term Acute Care Hospital Hospital: Acute Care Internal Medicine Mental Health Skilled Nursing Facility
National Provider Identifier	1104893320 1013985399 1699742270 1699839431
Phone	607-324-8000, 607-324-8294
Fax	607-324-8115, 607-324-8198, 607-324-8766
Accepting WorkComp Patients?	Y
Facility Name	Southern Tier Health Associates St James Mercy Health St James Mercy Hospital St. James Mercy Hospital

TEXT PROVIDER INFO TO MOBILE PHONE

Type a phone number Send

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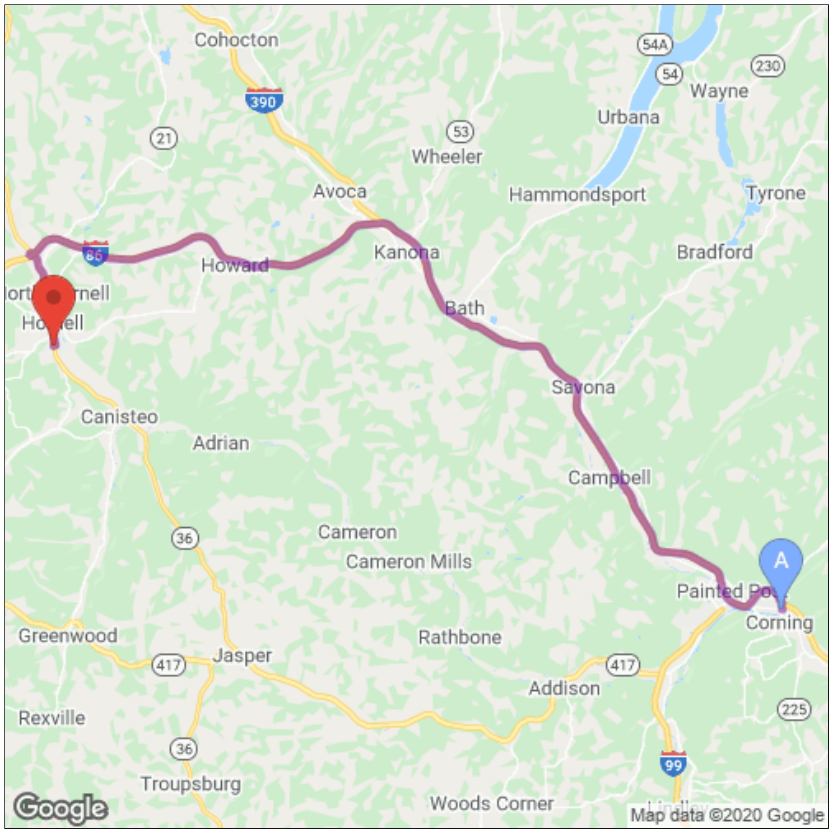
DRIVING DIRECTIONS



From: 174 East Pulteney Street Corning, NY 14830
[New Start Address]

To: 411 Canisteo St Hornell, NY 14843

1. Head **west** on **E Pulteney St** toward **Center Way**	161 ft
2. Turn **right** at the 1st cross street onto **NY-414 N/Center Way** Continue to follow NY-414 N	0.5 mi
3. Turn **left** to merge onto **I-86 W**	25.7 mi
4. Keep **right** at the fork to stay on **I-86 W**, follow signs for **Interstate 86 W/U.S. 17 W/ Hornell/Olean/Jamestown**	17.2 mi
5. Take exit **34S** to merge onto **NY-36 S** toward **Hornell**	4.5 mi
6. Turn **right** onto **W Van Scoter St**	397 ft
7. Turn **left** Destination will be on the left	187 ft
Estimated driving time: 49 minutes	48.1 mi

TEXT DRIVING DIRECTIONS TO MOBILE PHONE

Type a phone number Send

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AECOM

Work-Related Incident Flowchart for Employees | *Updated October 2016*

DCS - Americas

NOTE: The direct number to AECOM nurses, 1-877-878-9525, is active and can be used by employees. However, the AECOM SH&E team prefers that employees call the AECOM Incident Reporting Hotline. The Hotline will route all medical cases to AECOM nurses, AND they will trigger text messages directly to the SH&E team.

* Supervisor or Responsible Manager will initiate Client or Site Notification Process as appropriate

** If injured person is an AECOM subcontractor, call AECOM's nurses at 877-878-9525, or direct sub to their own provider.

*** For all AECOM vehicles, call Element at 1-800-446-7052.

Updated October 2016

Attachment B

Project Risk Register/ Hazard Assessment, THA Forms, and Tailgate Safety Meeting Forms

DCS Americas

Project Risk Register/ Hazard Assessment (DCSA)

S4[DCS]AM-209-FM4-A

Location: Corning, New York **Date:** 03/13/2020

Prepared By: Josh Loomis **Approved By:** Scot Dietz

Principal Tasks	Potential Safety/Health/Environmental Risks/Hazards	Risk/Hazard Control Methods
List principal tasks involved in the scope of work	Identify each safety, health, and environmental hazard associated with the completion of each task	Identify methods such as transfer of risk, creation of Safe Work Method Statements (SWMS), Task Hazard Assessments (THAs) & any specific required work plans (SWPP, SPCC, traffic control, hazardous weather contingency plan, etc.) to be drafted
TASK 1 – Driving to and from the Site	Trip planning, driving, stops/breaks during transit	THA
TASK 2 – Load and Unload Vehicle	Load & unload vehicle and secure & cover exposed loads	THA
TASK 3 – Site Walk – General Site Visit	Plan the site walk, arriving at site, walking site/observing work, and leaving site	THA
TASK 4 – Geoprobe Drilling Oversight	Mobilization, setting up at drilling location, oversight of rig inspection, and drilling oversight	THA

Principal Tasks	Potential Safety/Health/Environmental Risks/Hazards	Risk/Hazard Control Methods
TASK 5 – Hollow Stem Auger Drilling Oversight	Mobilization, setting up at drilling location, oversight of rig inspection, and drilling oversight	THA
TASK 6 – Soil Sampling (Surface) with Trowel	Setup equipment, collecting samples, and breakdown and decontaminate equipment	THA

Task Name:	**Driving to and From Site**	**Control #:**	**01-01-12-02**

Project Name:	**Study Area**	**Client:**	Corning Incorporated	**Date:**	3/13/2020
Permits Required? (list):		**Work Location:**	Corning, New York		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☐ Hard Hat ☐ Safety Glasses ☐ HiVis Vest ☐ Safety Toe Boots ☐ Gloves: Leather / Nitrile ☐ Hearing Protection ☐ Other:
Tools & Equipment:	Emergency kit Communication device (cell phone) Navigation system

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Trip Planning	1a. Unauthorized driving	9	1a. You must be an AECOM authorized driver to drive for AECOM business purposes. Consult the requirements of S3AM-005-PR1. Authorized Drivers shall maintain a current driver's license with full privileges applicable to the vehicle to be operated. Develop a Journey Management Plan if applicable.	4
	1b. Inclement weather	6	1b. Evaluate weather conditions prior to beginning the travel to determine if travel should proceed. Verify your vehicle is equipped to travel in poor weather. Have supplies on hand in the event that you become stranded, including a communication device to call for help.	4
	1c. Getting Lost	6	1c. Review route in advance and program GPS prior to leaving	3
	1d. Inadequate vehicle for the site/trip	7	1d. Understand what type of vehicle is necessary to transport tools & equipment to the site. Know site conditions before departure and obtain proper vehicle, 4-Wheel drive if necessary	4
	1e. Vehicle malfunction	8	1e. Inspect vehicle prior to leaving. Verify that maintenance records are current.	4
On-Site Edits:				
2. Driving	2a. Fatigue	**15**	2a. Start trip well rested & take breaks when needed. Share driving responsibilities where possible. **STOP DRIVING AND PULL OVER** in a safe place if you begin nodding off or showing other signs of fatigue.	4

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
	2b. Risky driving practices	**15**	2b. Practice defensive driving techniques and avoid bad driving habits • Allow for adequate time to make the trip • Do not speed or attempt to multi-task • Do not use cell phone or text or attempt to program GPS while driving	4
On-Site Edits:				
3. Stops/breaks during transit	3a. Theft of equipment/materials	6	3a. Place any likely theft items out of sight and lock vehicle when leaving it. Do not leave vehicle unattended for longer than necessary. If at all possible, avoid leaving packed vehicles in public parking areas overnight, unload if possible. Park in well lighted areas.	4
	3b. Personal security risk	**10**	3b. Be alert and aware of surroundings when making stops. Stop at areas which are well lit and have security if possible.	3
On-Site Edits:				
4.	4a.		4a.	
On-Site Edits:				

Additional Notes:

Task Name:	**Load and Unload Vehicle**	**Control #:**	**01-01-12-04**

Project Name:	**Study Area**	**Client:**	Corning Incorporated	**Date:**	3/13/2020
Permits Required? (list):		**Work Location:**	Corning, New York		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☐ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves: High vis mechanix style gloves ☐ Hearing Protection ☐ Other:
Tools & Equipment:	Hand truck or dolly

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Load & Unload Vehicle	1a. Sprains/strains/ overexertion	8	1a. To minimize the risk: • Use dollies, carts, come-alongs, or rollers whenever possible rather than the employee physically moving materials. • Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist. Do not lift over 49 lbs. without assistance. Seek assistance when needed and know your lifting limit • Minimize distance needed to move materials and stage loading and unloading areas as close as possible.	4
	1b. Pinch points between load and vehicle or between load items	**10**	1b. Know where your hands and other people's hands are at all times. Wear high vis gloves as a reminder. Avoid placing fingers under load while positioning. Use caution with tailgates and vehicle doors, especially under windy conditions.	4
	1c. Slips/trips/falls	**10**	1c. Inspect and clear walking path prior to beginning loading. Do not stack loads that impair visibility.	4
	1d. Nicks and cuts from equipment edges	6	1d. Inspect materials and equipment for rough edges and burrs. Wear cut resistant gloves.	4
On-Site Edits:				

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
2. Secure & cover exposed loads	2a. Line of fire hazards from straps/bungee cords	**15**	2a. Do not throw straps toward other personnel. Using extreme caution when stretching the bungee cord over a load. ALWAYS use safety glasses when handling bungee cords. Securing hook ends carefully and never extend the cord beyond its capacity of length or load. Keep your face and other parts away from the cord's rebound path just in case of failure or recoil.	4
	2b. Load shift in transit	**10**	2b. Use straps or bungee cords to properly secure load. Use a bulkhead to prevent heavy loads from shifting upon sudden stops.	4
	2c. Theft of tools & equipment	8	2c. Place any likely theft items out of sight and lock vehicle when leaving it. Do not leave vehicle unattended for longer than necessary. If at all possible, avoid leaving packed vehicles in public parking areas overnight, unload if possible. Park in well lighted areas.	4
On-Site Edits:				
3.	3a.		3a.	
On-Site Edits				
4.	4a.		4a.	

Task Name:	**Site Walk – General Site Visit**	**Control #:**	**01-01-10-06**

Project Name:	**Study Area**	**Client:**	Corning incorporated	**Date:**	3/13/2020
Permits Required? (list):		**Work Location:**	Corning, New York		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves: leather ☒ Hearing Protection ☐ Other: PPE for expected weather conditions
Tools & Equipment:	camera notebook/pen

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Plan the site walk	1a. Personal injury from not having proper PPE	4	1a. Determine what the basic PPE requirements are in advance and have available or know that they will be available to you to borrow once on site.	4
	1b. Vehicle getting stuck or damaged due to terrain/site conditions	4	1b. Determine what type of vehicle is needed for site conditions (4-wheel drive, truck or car).	4
	1c. Heat/cold stress, insect bites, sunburn from inadequate materials/supplies	4	1c. Determine what materials and supplies you must bring versus what is available on site such as insect spray, sunscreen, drinking water, food, etc.	4
	1d. Lack of site escort if needed	4	1d. Prearrange trip in advance where possible, determine who will be meeting you on site and when.	4
	1e. Inclement weather	6	1e. Plan for the anticipated weather conditions. Check the predicted weather for the worksite prior to departing. Reschedule site visit if severe weather such as lightning storms, sleet/ice storms, blizzards, etc., are predicted.	2
On-Site Edits:				
2. Arriving at site	2a. Getting stuck or sustaining slip/trip/fall injuries from parking in inappropriate areas	6	2a. Know where you are supposed to park prior to arrival or check in at site. Park in an area with firm, level surface, and with a good surface (avoiding wet/muddy conditions, poor walking surfaces, etc) available when you exit the vehicle.	2

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
	2b. Injuries from being struck due to 3rd party or client operations	**10**	2b. Park that you do not subject yourself or your vehicle to site hazards such as construction vehicle traffic, forklifts or other equipment, passing motorists, etc, ,	2
On-Site Edits:				
3. Walking Site/Observing Work	3a. Biological hazards	4	3a. There are many different types of biological hazards that can be encountered on a work site. These include ticks, spiders, mosquitoes, chiggers, poisonous or other noxious plants, alligators, bears, small mammals, bird droppings, small mammals, snakes, etc. Do not attempt to pick up, handle, or otherwise handle stray or wild animals such as dogs, cats, raccoons, squirrels, etc., no matter how tame they may appear.	2
	3b. Slips/trips/falls	4	3b. Be aware of walking surfaces at all times, wear footwear with good tread and ankle support, use handrails where available, avoid walking in muddy or wet areas when possible, identify and mark or have removed any obstructions that may be present in predicted walking paths.	2
	3c. Crossing roads, bridges, etc	6	3c. Keep to pathways appropriate for pedestrian traffic – sidewalks, walkways with handrails, etc. If no sidewalk is present, stay off the side of the shoulder, behind guardrails where possible, etc. Walk facing traffic. Never take photographs while walking to reduce risk of inadvertently wandering into traffic.	3
On-Site Edits:				
4. Leaving the site	4a. Transporting biological hazards into vehicle	4	4a. Inspect self for ticks before entering vehicle. If it possible that clothing and personal items such as jackets, backpacks, lunch bags, and so on have been exposed to poisonous plant oils or may harbor ticks or other insects, bag such items until they can be appropriately treated.	2
	4b. Hitting object when leaving causing vehicle or property damage	6	4b. Before moving the vehicle, perform a 360° walk around of the vehicle to verify that no changes have been made that may impact exit.	4

Task Name:	**Geoprobe Drilling Oversight**	**Control #:**	**01-01-03-01**

Project Name:	**Study Area**	**Client:**	Corning Incorporated	**Date:**	3/13/2020
Permits Required? (list):		**Work Location:**	Corning, New York		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves: Leather, nitrile ☒ Hearing Protection ☐ Other:
Tools & Equipment:	

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Mobilization	1a. Striking unidentified underground utilities	15	1a. Call public utility locating service prior to initiating work activities. Use private locating service to mark out areas on private property. Verify location of utility marks; do not perform intrusive work if utility location marks cannot be found or if marks are destroyed. Preserve utility marks as much as possible. Call to have utilities remarked if unsure as to their location.	4
	1b. Striking overhead utilities	15	1b. Follow the requirements of S3AM-322-PR1 Overhead Lines. Verify adequate clearance of all drilling locations prior to setting up at drilling location.	4
On-Site Edits:				
2. Setting up at drilling location	2a. Biological hazards causing bites, stings or other injury	8	2a. Examine ground surface for biological hazards prior to setting up equipment. If biological hazards exist, move equipment to a different area for set up if possible. Machetes, or other fixed open blade tools, are not permitted for clearing vegetation. Use insect repellent and check clothing for ticks periodically when applicable.	4
	2b. Struck by traffic	10	2b. Be alert to other vehicles or pedestrians if work area is in an area with public access. Communicate with any heavy equipment operators in the area to ensure they know where you and the equipment are located. Don high visibility vest.	4
	2c. Unstable Rig platform	10	2c. Verify with contractor that rig is set up level and properly chocked and blocked.	2
On-Site Edits:				

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
3. Oversight of rig inspection	3a. Mechanical failure of equipment	**10**	3a. Verify that drilling contractor inspects equipment daily using S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection or equivalent.	4
	3b. Emergency shut off disabled	6	3b. Verify that kill switch on rig is tested and operational	3
On-Site Edits:				
4. Drilling Oversight	4a. Flying debris, caught by/ struck by injuries	8	4a. Keep a safe distance away during rig operation. Do not talk on cell phone or be distracted by paperwork when in immediate proximity to rig. Wear PPE including hard hats, steel-toe safety boots, safety glasses, and hearing protection.	4
	4b. Caught in/by equipment	**10**	4b. Keep hands, feet and other body parts shall be kept away from moving parts. Do not approach operator without making eye contact and getting approval.	4
	4c. Exposure to contaminants	8	4c. Position yourself upwind of the borehole whenever possible. Perform air monitoring using a PID as described in the HASP. **STOP WORK** if the action level is exceeded.	4
	4d. Noise-induced hearing loss	5	4d. Setup away from noisy operations. Don't be near the rig when hammering. Wear hearing protection.	3
On-Site Edits:				
5.	5a.		5a.	
On-Site Edits:				
6.	6a.		6a.	
On-Site Edits:				

Task Name:	**Hollow Stem Auger Drilling Oversight**	**Control #:**	**01-01-03-05**

Project Name:	**Study Area**	**Client:**	Corning Incorporated	**Date:**	3/13/2020
Permits Required? (list):		**Work Location:**	Corning, New York		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves: Leather, nitrile ☒ Hearing Protection ☐ Other:
Tools & Equipment:	PID Noise/Sound Meter or app

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Mobilization	1a. Striking unidentified underground utilities	**15**	1a. Call public utility locating service prior to initiating work activities. Use private locating service to mark out areas on private property. Verify location of utility marks; do not perform intrusive work if utility location marks cannot be found or if marks are destroyed. Preserve utility marks as much as possible. Call to have utilities remarked if unsure as to their location.	4
	1b. Striking overhead utilities	**15**	1b. Follow the requirements of S3AM-322-PR1 Overhead Lines. Verify adequate clearance of all drilling locations prior to setting up at drilling location.	4
On-Site Edits:				
2. Setting up at drilling location	2a. Biological hazards causing bites, stings or other injury	8	2a. Examine ground surface for biological hazards prior to setting up equipment. If biological hazards exist, move equipment to a different area for set up if possible. Machetes, or other fixed open blade tools, are not permitted for clearing vegetation. Use insect repellent and check clothing for ticks periodically when applicable.	4
	2b. Struck by traffic causing serious bodily injury	**10**	2b. Be alert to other vehicles or pedestrians if work area is in an area with public access. Communicate with any heavy equipment operators in the area to ensure they know where you and the equipment are located. Don high visibility vest.	4
	2c. Unstable Rig platform causing tip/fall with cruching injuries	**10**	2c. Verify with contractor that rig is set up level and properly chocked and blocked.	2

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
On-Site Edits:				
3. Oversight of rig inspection	3a. Mechanical failure of equipment	**10**	3a. Verify that drilling contractor inspects equipment daily using S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection or equivalent.	4
	3b. Emergency shut off disabled	6	3b. Verify that kill switch on rig is tested and operational	3
On-Site Edits:				
4. Drilling Oversight	4a. Flying debris, caught by/ struck by injuries	8	4a. Keep a safe distance away during rig operation. Always stand outside of the tip/fall radius of the mast, recommended safe distance is to be no less than 30 feet away from the rig, or the mast height plus 5 feet. Do not talk on cell phone or be distracted by paperwork when in immediate proximity to rig. Stay a safe distance (minimum 5') from outriggers. Do not place or store any equipment on the rig. Verify that all personnel follow S3NA_321_PR1 Drilling, Boring, Direct Push Probing. Wear PPE including hard hats, steel-toe safety boots, safety glasses, and hearing protection.	4
	4b. Caught in/by equipment	**10**	4b. Keep hands, feet and other body parts shall be kept a minimum of 5' away from moving parts. When augers are rotating, stay clear of the rotating auger and other rotating/moving components of the drill rig, i.e. outriggers. Do not approach operator without making eye contact and getting approval. Watch for loose clothing (hooded sweatshirts, baggy clothing, loose shoelaces).	4
	4c. Exposure to contaminants causing injury or illness	8	4c. Position yourself upwind of the borehole whenever possible. Perform air monitoring using a PID as described in the HASP. **STOP WORK** if the action level is exceeded.	4
	4d. Noise-induced hearing loss from loud drilling operations	5	4d. Setup at least 30' away from noisy operations. Don't be near the rig when hammering. Measure dB levels with a noise meter. Wear hearing protection.	3
On-Site Edits:				

Task Name:	**Soil Sampling (Surface) with Trowel**	**Control #:**	**01-01-09-13**

Project Name:	**Study Area**	**Client:**	Corning Incorporated	**Date:**	3/13/2020
Permits Required? (list):		**Work Location:**	Corning, New York		

This THA must be fully reviewed with all staff members. All job steps, hazards, work practices, and PPE are clearly understood and have been implemented. All necessary revisions have been written on the THA.

Required PPE:	☒ Hard Hat ☒ Safety Glasses ☒ HiVis Vest ☒ Safety Toe Boots ☒ Gloves: Leather, nitrile, CR ☐ Hearing Protection ☐ Other:
Tools & Equipment:	Trowel Sampling kit

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Setup equipment	1a. Cuts or hand injuries from pinch points	3	1a. Inspect tools. If broken welds or cracks – **STOP WORK**. Wear cut resistant gloves when working with tools. Keep face, hands, fingers, and feet out of the line of fire of moving parts and tools	2
	1b. Back strain/ overexertion when unloading equipment	4	1b. Stretch before working. Bend and lift with legs and arms, not back. Team-lift any items that are awkward or over 50 pounds. If removing from the back of a truck, slide the case to the tailgate and lift from tailgate and not from the side of the truck bed	2
On-Site Edits:				
2. Collecting samples	3a. Contact with contaminated soil/water.	4	3a. Use clean sampler to touch soil. Wear nitrile gloves over the cut resistant gloves at all times. If nitrile tears, stop work and replace glove. For samples with high volatile organics content (PID in breathing zone is constantly above site limits stated in HASP (>5 ppm)) wear breathing protection as stated in HASP. Change Nitriles between samples to avoid cross contamination	2
	3b. Cut from handling auger, sampling tools, jars	6	3b. Inspect containers before and during filling. Do not use if chipped or cracked. Pack containers in coolers so that they will not shift (spacers/ packing materials as needed). Do not over pack coolers.	3
	3c. Muscle strain in back or legs from bending over or squatting	3	3c. Evaluate work surface height (see if chair/ table needed) and sample jar placement to eliminate ergonomic issues. Avoid squatting and bending	2
	3d. Falling into water/drowning	**10**	3d. Wear personal flotation device and have a buddy present when within 3 feet of water.	2

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!				
Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions To Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
On-Site Edits:				
3. Breakdown and decontaminate equipment.	5a. Contact with contaminants and cut hazards	6	5a. Inspect before handling for chips or cracks in glass containers. Wear nitrile gloves over cut resistant gloves. If nitrile tears, stop work and replace glove.	2
	5b. Breaking a sample container resulting in cut, or contact with contents/preservatives	6	5b. Handle containers with care and position over padded or soft surface in case it slips from hand. Place in packing materials that will protect against collisions.	2
	3e. Striking another person	4	3e. Before moving equipment, verify that no one is in the swing radius.	3
On-Site Edits:				
4.	4a.		4a.	
On-Site Edits:				
5.	5c.		5c.	
On-Site Edits:				
6.	6a.		6a.	

All Employees:

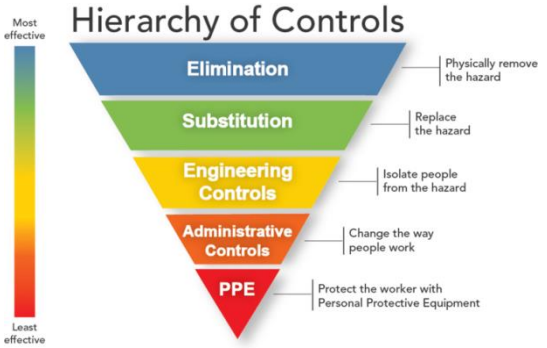
STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories



- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to DCSA.THA.Library@AECOM.com

AECOM

Americas

Daily Tailgate Meeting

S3AM-209-FM5

Instructions: Conduct meeting prior to sending crews to individual tasks. Require attendance of all AECOM employees and subcontractors. Invite personnel from simultaneous operations for coordination purposes. Review scope of work and briefly discuss required and applicable topics**. This meeting is a daily refresher, not a full orientation**. Task-specific discussions associated with Task Hazard Assessment (THA) follow this meeting at the task location immediately before individual task is started.

AECOM Supervisor Name:
Phone Number:
AECOM SH&E Rep. Name:
Phone Number:
Meeting Leader:

Date:	**Project Name/Location:**	**Project Number:**
Today's Scope of Work:		

Muster Point Location:	**First Aid Kit Location:**	**Fire Extinguisher Location:**	**Spill Kit Location:**

1. Required Topics

- ☐ Fitness for Duty requirements, all sign in / sign out
- ☐ Required training (incl. task specific) completed and current
- ☐ SH&E Plan onsite - understood, reviewed, signed by all (incl. scope, preplanning hazard assessments / risk registers, controls, procedures, requirements, etc.)
- ☐ Task Hazard Assessments (THAs) are to be reviewed and completed for each task immediately prior to conducting
- ☐ STOP WORK Right & Responsibility- all task changes/changed conditions re-assess with THA
- ☐ Requirement to report to supervisor any injury, illness, damage, near miss, unsafe act / condition
- ☐ Emergency Response Plan – including muster point, first aid kit, fire extinguisher, clinic/hospital location
- ☐ Personal Protective Equipment (PPE) - Required items per hazard assessments in good condition / in use by all
- ☐ Equipment/machinery inspected (documented as required) and in good condition - operators properly trained/certified
- ☐ Work area set up and demarcation/ barricades in place to protect workers, site staff, and the public
- ☐ Required checklists/records available, understood (describe):
- ☐ Lessons Learned / SH&E improvements (describe):

2. Discuss if Applicable to Today's Work

☑ ■ **Check ☑ as reviewed or mark ■ as not applicable**

- ☐ ☐ Biological/ Chemical / Electrical Hazards
- ☐ ☐ Ergonomics - Lifting, Body Position
- ☐ ☐ Lock Out/ Tag Out
- Short Service Employees - visual identifier and mentor/ oversight assignment
- ☐ ☐ Simultaneous/ Neighbouring Operations
- ☐ ☐ Slip/ Trip/ Fall Hazards
- ☐ ☐ Specialized PPE Needs
- ☐ ☐ Traffic Control
- ☐ ☐ Waste Management/ Decontamination
- ☐ ☐ Weather Hazards / Heat Stress / Cold Stress
- ☐ ☐ Subcontractor Requirements (e.g., JHAs, THAs, procedures, reporting, etc.)
- ☐ ☐ Work Permits / Plans required (e.g., Fall Protection, Confined Space, Hot Work, Critical Lifts, etc.); in place, understood (identify/attach):
- ☐ ☐ Other Topics (describe/attach):
- ☐ ☐ Client specific requirements (describe):

3. Daily Check Out by Site Supervisor

Describe incidents, near misses, observations or Stop Work interventions from today:	Describe Lessons Learned/ Improvement Areas from today:

The site is being left in a safe condition and work crew checked out as fit unless otherwise specified as above.

Site Supervisor Name	**Signature**	**Date** **Time** **(at end of day / shift)**

Worker Acknowledgement / Sign In Sign Out sheets applicable to this meeting are on reverse and, if applicable, attached.

All employees:

- **STOP WORK if concerned / uncertain about safety / hazard or additional precaution is not recorded on the THA.**
- **Be alert and communicate any changes in personnel or conditions at the worksite to the supervisor.**
- **Reassess task, hazards, & mitigations on an ongoing basis; amend the THA if needed.**

SITE WORKERS (including AECOM Contractors and Subcontractors): Your signature below means that you understand:

* The requirement to participate in creating, reviewing, & updating hazard assessments (THA) applicable to your task(s).
* The hazards & control measures associated with each task you are about to perform.
* The permit to work requirements applicable to the work you are about to perform (if it includes permitted activities).
* That no tasks or work is to be performed without a hazard assessment.
* Your authority & obligation to "Stop Work" intervene, speak up/ listen up.

Your initials (right columns) certify that you arrived & departed fit for duty, & have reported all incidents/near misses; meaning:

* You are physically and mentally fit for duty and have inspected your required PPE to ensure satisfactory condition.
* You are not under the influence of any type of medication, drugs, or alcohol that could affect your ability to work safely.
* You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or impairment/fatigue issue to the AECOM Supervisor.
* You signed out as fit / uninjured unless you have otherwise informed the AECOM Supervisor.

Print Name & Company	Signature	Initials & Sign In Time	Initials & Sign Out Time
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit
		In & Fit	Out & Fit

(Attach additional Site Worker sign-in/out sheets if needed) Identify number of attached sheets: _____

SITE VISITOR / SITE REPRESENTATIVE

Name	Company Name	Arrival Time	Departure Time	Signature

DCS Americas THA Review Guide

Task Hazard Assessment Instructions:

Each unique task or work group should have their own THAs. If workers have a THA for their task(s) in hand, they should simply review it and document the site specific edits in red pen in the appropriate section. If workers do ***not*** have a THA for all tasks to be performed, a THA must be obtained or drafted *prior to starting work* on that task. Use additional pages as needed.

- Identify the basic steps of the task that must be performed in order and their associated hazards. Identify controls or barriers to mitigate each identified hazard.
- Clearly identify any **STOP WORK** triggers
- Document stop work and change management if conditions/ scope changes.
- Use 4-Sight to identify and mitigate site-specific hazards throughout the day. Modify the THA as needed. Contact site supervisors or the PM for any significant scope changes or changes of expected conditions.
- All THAs shall be 3 pages (maximum) or less (preferred). If they are longer, the task is too broad
- All hazards will use standardized nomenclature (Hazard Wheel), should be specific, detail how someone could be hurt and what the outcome could be
- All actions to mitigate hazards must be specific, clearly aligned with its respective hazard and not generic. Avoid words such as "*proper", "correct*", or "*appropriate*"). Use specifics and numerical values (i.e. wear disposable nitrile gloves, stand back 6 feet/1.8 meters, take a 10 minute break every hour)
- PPE cannot be the only line of defense - PPE is always the last line of defense, so think through what other controls (engineering, administrative, etc.) could mitigate hazards

Discuss as Applicable and Modify THA as Needed

Check ☑ if reviewed or mark N/A

- ☐ *Biological/ Chemical/ Electrical Hazards*
- ☐ *Decontamination Procedures*
- ☐ *Ergonomics- Lifting, Body Position*
- ☐ *Lock Out/ Tag Out*
- ☐ *Short Service Employees- visual identifier and mentor/ oversight assignment*
- ☐ *Simultaneous/ Neighboring Operations*
- ☐ *Slip/ Trip/ Fall Hazards*
- ☐ *Specialized PPE Needs*
- ☐ *Traffic Control*
- ☐ *Waste Management/ Decontamination*
- ☐ *Weather Hazards/ Heat Stress/ Cold Stress*
- ☐ *Work Permit requirements (identify):*
- ☐ *Other (describe):*

Probability	Severity				
	5 - Catastrophic	4 – Critical	3 – Major	2 – Moderate	1 - Minor
5 – Frequent	25	20	15	10	5
4 – Probable	20	16	12	8	4
3 – Occasional	15	12	9	6	3
2 – Remote	10	8	6	4	2
1 - Improbable	5	4	3	2	1

Risk Rating (Probability x Severity)	Risk Acceptance Authority
1 to 4 (Low)	Risk is tolerable, manage at local level
5 to 9 (Medium)	Risk requires approval by Operations Lead/Supervisor & Safety Manager
10 to 25 (High)	Risk requires the approval of the Operations Manager & Safety Director

Severity – Potential Consequences				
	People	Property Damage	Environmental Impact	Public Image/Reputation
Catastrophic	Fatality, Multiple Major Incidents	>$1M USD, Structural collapse	Offsite impact requiring remediation	Government intervention
Critical	Permanent impairment, Long term injury/illness	>$250K to $1M USD	Onsite impact requiring remediation	Media intervention
Major	Lost/Restricted Work	> $10K to $250K USD	Release at/above reportable limit	Owner intervention
Moderate	Medical Treatment	> $1K to $10K USD	Release below reportable limit	Community or local attention
Minor	First Aid	</=$1K USD	Small chemical release contained onsite	Individual complaint

Probability		
Frequent	Expected to occur during task/activity	9/10
Probable	Likely to occur during task/activity	1/10
Occasional	May occur during the task/activity	1/100
Remote	Unlikely to occur during task/activity	1/1,000
Improbable	Highly unlikely to occur, but possible during task/activity	1/10,000

Using the Matrix:

1. Identify basic steps of the task and associated hazards.
2. Calculate the initial risk rating.
3. Identify control measure to eliminate or reduce the hazard's risk and calculate the residual risk rating.
4. If the risk rating (after controls are implemented) cannot be reduced to 4 or lower, additional approvals are needed before the activity can begin.

Attachment C

AECOM SH&E Procedures

Attachment C. AECOM SH&E Field Applicable Procedures

All AECOM SH&E Procedures, in their controlled copy version, are available on the internal SH&E Policy and Procedures ecosystem page.

Programmatic procedures referenced in this document (for example SH&E Training) DO NOT need to be printed for inclusion in this HASP. Only procedures that are needed for field activity reference and application MUST be printed in full and included in this section.

Copy the Field Procedure Checklist from the Physical Hazards Section 7.1 to become your table of contents for these attachments. Include only those procedures checked as applicable to this project.

	Hazard/ Activity *(note: text in this column links to procedure)*	Site Specific Description *[where, what phase of work, frequency, etc.]*	Applicable Procedure
☒	**Cold Stress**	Contingency in case of delay	S3AM-112-PR
☒	**Drilling, Boring & Direct Push Probing**	Soil sampling	S3AM-321-PR
☒	**Heat Stress**	Summer field work	S3AM-113-PR
☒	**Heavy Equipment**	Rig	S3AM-309-PR
☒	**Overhead Lines**		S3AM-322-PR
☒	**Underground Utilities**		S3AM-331-PR
☒	**Wildlife, Plants and Insects**		S3AM-313-PR

Cold Stress

1.0 Purpose and Scope

1.1 To protect employees from the severest effects of cold stress (hypothermia) and cold injury and to identify exposures to cold working conditions under which it is believed nearly all employees can be repeatedly exposed without adverse health effects.

1.2 This procedure applies to all AECOM Americas based employees and operations, and any other entity and its personnel contractually required to comply with this document's content, working outdoors in damp and cool (below 50 degrees Fahrenheit [°F] or 10 degrees Celsius [°C]) conditions or anytime temperatures are below 32°F or 0°C.

2.0 Terms and Definitions

2.1 **Cold Stress** – The production of physiological effects due to cold temperatures and\or wind chill.

2.2 **Equivalent Chill Temperature (ECT)** – Also known as Wind Chill (see below).

2.3 **Frostnip** – Superficial cooling of tissues without cellular destruction.

2.4 **Frostbite –** Freezing of tissue, resulting in tissue destruction.

2.5 **Hypothermia –** Condition of reduced core body temperature to 95ºF (35ºC) resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.

2.6 **Wind Chill –** The combined effect of air temperature and wind. Also expressed as "equivalent chill temperature" (ECT), wind chill is defined as heat loss resulting from the effects of air temperature and wind velocity upon exposed skin.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-128-PR1 Medical Screening & Surveillance Program

3.3 S3AM-208-PR1 Personal Protective Equipment

3.4 S3AM-314-PR1 Working Alone

3.5 S3AM-315-PR1 Working On or Near Water

3.6 S3AM-333-PR1 Marine Safety & Vessel Operations

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Ensuring the safety of employees on their project sites, consistent with regulatory standards.
- Implement cold stress prevention measures as applicable at each work site.
- Develop/coordinate a work-warning regimen, as applicable.
- Confirm cold stress hazard assessments/evaluations were completed for the planned activities.
- Assign employees physically capable of performing the assigned tasks. Consider acclimation to cold weather when evaluating employee capability.

- Confirm employees are properly trained to recognize the symptoms of cold stress.

4.1.2 **Safety, Health and Environment (SH&E) Manager**

- Conduct/support cold stress assessments/evaluations.
- Conduct/support incident investigations related to potential cold stress-related illnesses.
- Assist project teams develop appropriate work-warming regimens.
- Provide cold stress awareness training.

4.1.3 **Supervisor**

- Identify the tasks that may be most impacted by cold stress and communicate the hazard to the assigned employees.
- Confirm that employees have been trained on the recognition of cold stress-related illnesses.
- Confirm that adequate supplies of warm fluids/drinks are readily available to employees.
- Confirm that a warm/sheltered rest area is available, as applicable.
- Conduct cold stress monitoring, as applicable.
- Implement the work-warming regimen.
- Confirm that first aid measures are implemented once cold stress symptoms are identified.
- Confirm that employees are physically capable of performing the assigned tasks and are not in a physically compromised condition.

4.1.4 **Employee**

- Observe each other for the early symptoms of cold stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Report to work in a properly rested condition.
- Report all suspected cold stress-related illnesses.

4.2 Requirements

4.2.1 Carefully plan work anticipated to be performed in cool or cold conditions. If possible, heavy work should be scheduled during the warmer parts of the day or when the wind is most calm. Include costs in project budgets for specialized equipment and supplies needed to complete the field activities.

4.2.2 Staff working in extreme cold (wind chill or ECT below 10ºF or -12ºC) shall not work alone. The Buddy System shall be utilized to keep an eye on each other and to watch for signs of cold stress. Refer to *S3AM-314-PR1 Working Alone*. Watch for symptoms and signs of hypothermia

4.2.3 Monitor weather forecasts and weather conditions such as ambient temperature, wind speed, and precipitation. Use observations prior to entering and while in the field to ensure appropriate protections are in place:

- If possible, move the work to a warm location.
- If possible and as applicable, erect shelters or screens around the work area.
- If possible, heat the work area.
- If possible, adjust schedule according to the cold conditions, work level and worker acclimatization.
- Implement a work-warming regimen by taking breaks out of the cold. As applicable, consult *S3AM-112 ATT1 Temperature Thresholds* to determine wind chill and work-warming schedule.
- Take frequent short breaks in warm dry shelters to allow your body to warm up. Limit time of exposure to the cold. If shelter is not readily available, consider supplying temporary shelters.

- Provide assistance to prevent body heat loss, such as:
    - Providing appropriate sources of heat (e.g. warm packs, portable heaters, etc.).
    - Use of insulating materials on equipment handles when temperatures drop below 30°F (-1°C).

4.2.4 All staff working in extreme cold or snow conditions should understand the following guidelines for preventing and detecting hypothermia and frostbite; refer to *S3AM-112-ATT2 Symptoms & Treatment*:

- Ensure appropriate PPE requirements are established and adhered to.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Because prolonged exposure to cold air or to immersion in cold water at temperatures even well above freezing can lead to dangerous hypothermia, whole-body protection shall be used.
- Eat high calorie snacks to help maintain body metabolism.
- Confirm extra blankets or sleeping bags are on-site.
- Drink plenty of warm liquids. It is easy to become dehydrated in cold weather.
- Avoid caffeine and alcohol, which can act as diuretics. Alcohol consumption, depending upon quantity, can dilate blood vessels enhancing body heat loss or constrict blood vessels decreasing heat delivery to extremities.
- NEVER IGNORE SHIVERING. Persistent or violent shivering is a clear warning that you are on the verge of hypothermia.
- If you experience frost bite or hypothermia, find shelter and warmth and contact a medical practitioner if symptoms persist, refer to *S3AM-128-PR1 Medical Screening & Surveillance*.

4.3 Training

Before they begin work in a cold environment, employees that might be exposed to cold stress will be informed of the potential for cold stress and how to prevent cold stress. Employees that have not had the training within the twelve prior months shall repeat the training before exposure to cold stress, refer to *S3AM-003-PR1 SH&E Training*. Employees potentially exposed to cold stress will receive training including, but not limited to:

4.3.1 Sources of cold stress, the influence of protective clothing, and the importance of acclimatization.

4.3.2 How the body loses heat.

4.3.3 Recognition of cold-related illness symptoms.

4.3.4 Cold stress preventative/corrective measures including, but not limited to:

- Weather monitoring.
- Proper eating and drinking practices.
- Work-warming schedules and proper re-warming techniques.
- Buddy system.
- Safe cold work practices appropriate to the work that is to be performed.
- Proper use of cold environment personal protective clothing.

4.3.5 The harmful effects of excessive alcohol consumption in a cold stress environment.

4.3.6 The hazards associated with unstable snow or ice build ups.

4.3.7 First aid procedures for symptoms related to cold stress.

4.4 Personal Protective Equipment (PPE)

Wearing the right clothing is crucial to avoiding cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. Adequate insulating dry clothing will be required in air or wind chill temperatures below 40 °F (4.4°C)

All PPE will comply with the requirements of *S3AM-208-PR1 Personal Protective Equipment* and consider the following requirements:

4.4.1 Wear at least 3 layers of clothing to help prevent cold stress. It is important to preserve the air space between the body and the outer layer of clothing to retain body heat.

- Wear a middle layer of down, wool, or similar materials to provide insulation.
- Avoid cotton, especially blue jeans.
- Wear an outer layer to break the wind and allow some ventilation (e.g., Gortex® or nylon)
- Do not wear tight clothing. Loose clothing allows better ventilation.

4.4.2 Wear proper clothing, including head coverings and gloves or mittens for cold, wet, and windy conditions.

4.4.3 Wear a hat or hardhat liner. Up to 40 percent of body heat can be lost when the head is left exposed.

4.4.4 Use insulated footwear with adequate traction to prevent slips and falls.

4.4.5 Wear insulated boots or other insulated footwear, and insulated gloves to help reduce the chance of frostbite.

4.4.6 Keep a change of dry clothing available in case work clothes become wet.

4.4.7 Eye and face protection for employees employed outdoors in a snow and/or ice-covered terrain should be supplied.

- Sunglasses (with UVA and UVB protection) and sunscreen should be used when there is a persistent combination of snow and direct sun.
- Special safety goggles to protect against blowing ice crystals and ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.
- Ensure face guards are used to protect skin in cold, windy conditions, including riding on an unshielded vehicle.

4.5 General Cold Stress Prevention Measures

4.5.1 In order to prevent hypothermia:

- Wear appropriate clothing and PPE as determined by the weather conditions.
- When active, ventilate excess heat by opening or removing outer layers of clothing to avoid sweating.
    - Start with the mitten or gloves, unless protection from ice, snow, or cold metal surfaces is needed.
    - Next remove head gear and neck wrappings.
    - Then coats/parkas should be opened at the waist and sleeves.
    - Finally, layers of clothing should be taken off.
    - When resting or tired, or colder conditions are encountered, add additional layers of clothing/ close outer layers in the reverse of the above order, or get out of the cold. Have a sweet drink but do not indulge in heavy eating.

- Garments worn to keep out rain and spray should also allow water vapor to escape.
- Take advantage of heat from the sun and stay out of the wind as much as possible.
- Have available emergency shelter providing protection from wind and rain and insulation from the ground.
- Replace wet clothing. If wet clothing cannot be replaced, then cover it with a layer of non-breathing material to prevent evaporation. Place an insulation layer over this non-breathing material.
- Get adequate rest; conserve energy.
- Get adequate nutrition to replenish energy stores; rest after meals.
- Drink adequate fluids to avoid dehydration.
- If any project / location staff member shows signs of hypothermia, stop and treat him/her.

4.5.2 In order to prevent frost bite:

- Dress to prevent hypothermia and protect the feet and hands.
- Avoid obstruction of circulation by, for example, tight boots or tightly fitting clothing.
- Avoid nicotine (particularly cigarettes) and do not consume alcohol.
- Keep ears and nose covered and out of the wind.
- Frostbite of the corneas of the eyes can be prevented by protective goggles.
- Adopt a “buddy system” of constantly watching the faces of others in the party for white skin tissue, which is evidence of frostbite (frostnip).
- Practice constant personal vigilance for signs of trouble in one’s own fingers and toes; when in doubt, investigate thoroughly before it is too late.

4.5.3 Adequate, insulating dry clothing that will help maintain core temperatures above 96.8°F (37°C) shall be provided to employees if work is performed in air temperatures below 40°F (4.4°C). Wind chill cooling rate and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.

4.5.4 An Equivalent Chill Temperature (ECT) chart relating the actual dry bulb air temperature and the wind velocity is presented in *S3AM-112-ATT1 Temperature Thresholds*. Unless unusual or extenuating circumstances exist, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Superficial or deep local tissue freezing will occur only at temperatures below 32°F (0°C) regardless of wind speed. However, older employees, those with circulatory problems and those with previous cold injuries require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions that should be considered.

4.5.5 Continuous exposure of skin should not be permitted when the air speed and temperature results in an ECT of –25°F (-32°C) or below.

4.5.6 At air temperatures of 40°F (4.4°C) or less, it is imperative that employees who become immersed in water or whose clothing becomes wet be immediately removed from the cold environment, provided a change of clothing, and be treated for hypothermia.

4.5.7 If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.

4.5.8 Adequate protection, such as general ventilation, shall be incorporated into any warming shelter design to prevent carbon monoxide poisoning.

4.5.9 Operation of internal combustion or similar devices within warming shelters is prohibited.

4.5.10 If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

4.5.11 Walking and working surfaces shall be cleared of ice and snow to prevent slips and falls.

4.5.12 Confirm that employees carry fire starter materials if working in remote areas.

4.5.13 Supplies such as PPE, fuels, enclosures, de-icing, traction aids, warm drinks, and batteries will be specified by the SH&E Manager and/or the Manager and made available. These supplies will be inspected at least weekly during cold weather projects and replaced when necessary.

4.6 Cold Stress Prevention Measures for the Hands

4.6.1 Special protection of the hands is required to maintain manual dexterity for the prevention of accidents including, but not limited to the following:

- If fine work is to be performed with bare hands for more than 10 to 20 minutes in an environment below 60ºF (15ºC), special provisions should be established for keeping the employees' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below 30ºF (-1º C).
- If the air temperature falls below 60ºF (15ºC) for sedentary work, 40ºF (4.4º C) for light work, or 20ºF (-6ºC) for moderate work, and fine manual dexterity is not required, employees should use gloves.

4.6.2 To prevent contact frostbite, employees should wear anti-contact gloves:

- When cold surfaces below 20°F (-6°C) are within reach, each employee should be warned to prevent inadvertent contact by bare skin.
- If the air temperature is 0°F (-18°C) or less, employees should protect their hands with mittens or appropriate gloves. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens or gloves.
- Ensure an adequate supply of dry gloves is available to replace wet gloves.

4.6.3 Provisions for additional total body protection are required if work is performed in an environment at or below 40ºF (4.4ºC). The employees should wear cold protective clothing appropriate for the level of cold and physical activity.

4.6.4 Additional Cold Stress Prevention Measures:

For work practices at or below 10ºF (-12ºC) ECT, the following will apply:

- The employee should be under constant protective observation (buddy system or supervision).
- The work rate should not be so high as to cause heavy sweating that will result in wet clothing. If heavy work is being performed, rest periods should be taken in heated shelters and opportunities to change into dry clothing should be provided.
- New employees should not be required to work full time in the cold during the first days of employment until they become acclimated to the working conditions and required protective clothing. Refer to *S3AM-112-ATT1 Temperature Thresholds* for guidance.
- The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the employee.
- The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The employee should be protected from drafts to the greatest extent possible.

4.6.5 Employees handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 40ºF should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of “cryogenic fluids” or those liquids with a boiling point that is just above ambient temperature.

4.6.6 Trauma sustained in freezing or subzero conditions requires special attention, because an injured employee is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissue in addition to providing for first aid treatment.

4.7 Hypothermia in Water

4.7.1 Loss of body heat heat to the water is a major cause of deaths in boating and working near water incidents. Often the cause of death is listed as drowning; however, the primary cause is often hypothermia. It should also be noted that alcohol lowers the body temperature around 2 to 3 degrees by dilating the blood vessels. Do not drink alcohol around cold water. The following table shows the effects of hypothermia in water:

WATER TEMPERATURE		EXHAUSTION	SURVIVAL TIME
32.5°F	(0°C)	Under 15 minutes	Under 15 to 45 minutes
32.5 to 40°F	(0 to 4°C)	15 to 30 minutes	30 to 90 minutes
40 to 50°F	(4 to 10°C)	30 to 60 minutes	1 to 3 hours
50 to 60°F	(10 to 16°C)	1 to 2 hours	1 to 6 hours
60 to 70°F	(16 to 21°C)	2 to 7 hours	2 to 40 hours
70 to 80°F	(21 to 27°C)	3 to 12 hours	3 hours to indefinite
Over 80°F	(27°C)	Indefinite	Indefinite

4.7.2 Some points to remember when water is a potential hazard:

- Wear a personal flotation device when drowning is a potential hazard. Refer to *S3AM-315-PR1 Working On or Near Water*, and *S3AM-333-PR1 Marine Safety & Vessel Operations*.
- If the water is less than 50°F (10°C), wear a wet suit or dry suit for work in water (e.g., wading, or if a significant potential to fall in water exists).
- While in the water, do not attempt to swim unless to reach nearby safety. Unnecessary swimming increases the rate of body heat loss. Keep the head out of the water. This will increase survival time.
- Keep a positive attitude about rescue. This will increase chances of survival.
- If there is more than one person in the water, huddling is recommended to conserve body heat.

4.7.3 If an employee or equipment is to work on ice and the water beneath the ice is or may be more than 3¼ feet (1m) deep at any point:

- Test the ice prior to commencing to ensure it will support the load to be placed on it. Ongoing testing may be necessary.
- If there is any risk of falling through the ice employees must wear personal protective equipment that will ensure buoyancy and protect against hypothermia at all times while on the ice.

4.8 Work-Warming Regimen

4.8.1 If work is performed continuously in the cold at an equivalent chill temperature (ECT) at or below 19ºF (–7ºC), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The employees should be encouraged to use these shelters at regular intervals; the frequency will depend on the severity of the environmental exposure. Refer to *S3AM-112-ATT1 Temperature Thresholds* for guidance.

4.8.2 The onset of heavy shivering, minor frostbite (frostnip), the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter.

4.8.3 When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing should be loosened to permit sweat evaporation or a change of dry work clothing provided.

4.8.4 A change of dry work clothing should be provided as necessary to prevent employees from returning to the cold environment with wet clothing.

5.0 Records

5.1 Exposure assessments will be documented in the location's files.

6.0 Attachments

6.1 S3AM-112-ATT1 Temperature Thresholds

6.2 S3AM-112-ATT2 Symptoms & Treatment

Drilling, Boring & Direct Push Probing

1.0 Purpose and Scope

1.1 This document provides procedures designed to help prevent injuries to personnel working on the project and pedestrians, property damage, and adverse environmental impact as a result of potential hazards associated with drilling, boring and direct-push probing. These hazards include, but are not limited to, encountering underground utilities, subsurface installations, rotating equipment and potential overhead hazards.

1.2 This procedure provides the minimum requirements to be followed when drilling, boring, and probing work are performed.

1.3 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.4 The Manager is responsible for meeting all the requirements in this procedure.

1.5 AECOM's clients may have specific procedures which shall be followed to identify and map utility and subsurface structures on their properties or facilities. Provided the client's procedures meet or exceed those of AECOM, approval shall be obtained from the Manager and the SH&E Manager to follow the client's procedures.

2.0 Terms and Definitions

2.1 **Underground Utilities –** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling, and communications, etc.

2.2 **Ground Disturbance (GD) –** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

2.3 **Intrusive Activities –** Examples: Excavation of soil borings, installations of monitoring wells, installation of soil gas sampling probes, excavation of test pits / trenches or other man-made cuts, cavity, trench, or depression in an earth surface formed by earth removal.

2.4 **Subsurface Installations –** Examples: Subterranean tunnels, underground parking garages, and other structures beneath the surface.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-118-PR1 Hearing Conservation

3.3 S3AM-208-PR1 Personal Protection Equipment

3.4 S3AM-209-PR1 Risk Assessment & Management

3.5 S3AM-213-PR1 Subcontractor Management

3.6 S3AM-305-PR1 Hand & Power Tools

3.7 S3AM-306-PR1 Highway and Road Work

3.8 S3AM-322-PR1 Overhead Lines

3.9 S3AM-322-FM1 Overhead Electrical Lines Acknowledgement

3.10 S3AM-325-PR1 Lockout Tagout

3.11 S3AM-326-PR1 Machine Guarding

3.12 S3AM-331-PR1 Underground Utilities

3.13 S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Confirm the development of the project SH&E Plan and compliance with this procedure.
- Confirm the appropriate equipment and materials are available to conduct the drilling, boring or direct-push operations.
- Confirm compliance with *S3AM-331-PR1 Underground Utilities.*
- Review the *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* prior to authorizing work to proceed.
- Confirm that employees conducting drilling, boring or direct-push probing possess any required training, registrations or certifications.
- Confirm all employees involved and affected by the task review the SH&E Plan, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* and Task Hazard Assessment (THA) prior to work commencing.
- Confirm an equipment maintenance inventory is maintained, schedules adhered to and appropriate inspections of equipment are conducted.
- Provide authorization (with the concurrence of the Site Supervisor and SH&E Manager) for work to resume if interrupted due to unexpected conditions or events.

4.1.2 **Safety, Health & Environment (SH&E) Manager**

- Assist AECOM management as needed by providing guidance and clarification as to issues that may arise.
- Review the project SH&E Plan to confirm compliance with jurisdictional regulations**.** Provide technical guidance as needed when a variance is pursued related to this procedure. Confirm variance process meets requirements identified in *S2-001-SM1 Global SH&E Management System Manual*.

4.1.3 **Employees**

- Maintain training as appropriate to the work to be completed (e.g., ground disturbance, lockout tagout, equipment operation, etc.). Refer to *S3AM-003-PR1 SH&E Training.*
- Review the SH&E Plan, *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist* and Task Hazard Assessment (THA) prior to work commencing.
- As appropriate to the anticipated or encountered hazards and as addressed in the applicable planning documentation, utilize appropriate personal protective equipment (PPE) and applicable training, practices and operating procedures.
- Immediately notify the Manager of any unanticipated conditions or events. If assigned equipment, perform appropriate inspections and confirmations of maintenance and / or repairs.

4.2 Training

4.2.1 All on-site employees involved with drilling, boring, and direct-push probing shall be trained, at a minimum, in these procedures and in the procedures of *S3AM-331-PR1 Underground Utilities*.

4.2.2 All operators and assistants shall have the appropriate safety training based on the SH&E Training Matrix and any additional training assessments developed at the business group**,** and be versed in the equipment to be utilized.

- Refer to *S3AM-003-PR1 SH&E Training.*

- This training may include, but is not limited to, Excavation / Trenching (Ground Disturbance), HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.
- Only qualified personnel shall operate and inspect equipment.

4.2.3 All on-site Employees involved with drilling, boring, and direct-push probing activities shall be provided with on-site orientation of the drill rig and its operation.

4.2.4 All Employees involved with drilling, boring and direct-push probing activities at a client site shall receive the applicable client-required training**.**

4.3 Planning

4.3.1 SH&E Plan – At a minimum, a SH&E plan that includes a pre-job hazard assessment shall be prepared and communicated to all involved personnel prior to any drilling, boring, and direct-push probing activities. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

- Assessment shall include both overhead and subsurface utilities and installations. Refer to *S3AM-322-PR1 Overhead Lines* and *S3AM-331-PR1 Underground Utilities*.
- The SH&E Plan will address any required environmental monitoring including gas monitoring, dust, noise, metals, radiation or other monitoring as may be appropriate for site conditions.
- All SH&E Plan requirements will be followed by the project team.
- The location specific emergency response plan shall be in place, contain procedures applicable to the potential emergencies presented by the operations, and be reviewed with all personnel potentially affected.

4.3.2 A Task Hazard Assessment (THA) shall be completed before every assigned task at the work location. The focus of the analysis shall be on the specific assigned task and the evaluation of risks and assignment of control measures based on actual work conditions.

4.3.3 *S3AM-321- ATT2 Pre-Drilling, Boring & Direct-Push Probing Flow Chart* summarizes the key Pre-Drilling, Boring, and Direct-push probing requirements addressed in this procedure.

4.3.4 Procedures and documentation as detailed in *S3AM-322-PR1 Overhead Lines* and *S3AM-331-PR1 Underground Utilities* shall be completed prior to any intrusive subsurface work.

- The locations of subsurface and overhead utilities and subsurface installations will be investigated, documented, mapped on a site plan and evidenced with appropriate surface markings.
- A site walk shall be conducted by the project team / site Manager and any other appropriate personnel, with the objectives of reviewing all planned intrusive activity locations, the locations of subsurface and overhead utilities and the potential for subsurface installations, to determine the appropriate utility clearance activities, and to observe other physical hazards.
- All proposed subsurface activities will be reviewed in comparison to subsurface and overhead utilities and subsurface installations and adjustments made as necessary.
- Appropriate clearance activities shall confirm location(s) of identified underground utilities and subsurface structures. Review the applicable completed *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*
- Site Walks should be repeated as necessary following the clearance of subsurface utilities and installations to confirm hazards are clearly identified.

4.3.5 Confirm drilling location(s) and / or bore entry and bore exit points are adequately identified on the worksite to enable appropriate equipment positioning.

4.4 Permits, Notifications and Access Agreements

4.4.1 Any required notifications shall be provided within the appropriate timeframe to the applicable organization (e.g. owner, agency, governing body, etc.).

4.4.2 All applicable permits (e.g. client, government, working near rail road, etc.) will be identified, obtained, and adhered to.

4.4.3 Access agreements will be obtained and adhered to as necessary.

4.5 Pre-Qualifying and Re-Qualifying Drilling Subcontractors

4.5.1 All drilling subcontractors will be properly pre-qualified in accordance with *S3AM-213-PR1 Subcontractor Management*.

4.5.2 The qualifications of the drilling crew performing the work will be evaluated prior to each mobilization and each day by AECOM's on-site representative to assure that their safety performance, training, qualifications, equipment, processes, and approaches reflect AECOM standards for excellence.

4.5.3 All drilling subcontractor equipment will be properly maintained and properly equipped, and the drilling subcontractor will verify their equipment is fully functional as a normal part of their daily and pre-work routine. Refer to *S3AM-321-FM1 Daily Drilling, Boring & Direct Push Equipment Inspection.*

4.6 General Health and Safety

4.6.1 Personal Protective Equipment – Refer to the *S3AM-208-PR1 Personal Protection Equipment* for best practices. These requirements may be modified or expanded in the SH&E Plan. Clothing shall be close fitting and comfortable without loose ends, straps, draw strings, belts, or otherwise unfastened parts that might catch on some rotating or translating component of the rig.

- Depending upon the hazards present, additional PPE may be required such as fire retardant clothing, specific hearing protection, respiratory protective equipment and chemical protective clothing.
- If the location has potential for underground electrical utilities to be present, workers shall ensure footwear has additional protection of shock resistant soles required (white rectangle with omega symbol).

4.6.2 Hearing Conservation – Hearing conservation program requirements may apply when working around operating equipment. Refer to *S3AM-118-PR1 Hearing Conservation*.

- Each worker shall wear noise-reducing ear protectors around operating equipment or during elevated noise levels. Distance from the elevated noise level is the primary measure of control for non-essential drilling personnel.

4.7 Drilling, Boring and Direct Push Equipment Maintenance and Inspections

4.7.1 All equipment will be inspected prior to the initiation of operations and daily during operations using the *S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection*. This inspection is the responsibility of the operator who will provide written documentation of the inspection prior to the start of drilling each day.

- Equipment that is deemed defective will immediately be repaired by a qualified person, or, if repair is not practicable, tagged "Out of Service" and sent for repairs or discarded.

4.7.2 Managers shall confirm an accurate inventory of the equipment within their operation requiring scheduled maintenance is developed. Using applicable regulations, industry standards, best practices, and manufacturer's recommendations, a maintenance schedule shall be developed with defined responsibility, required actions, and frequency. Refer to *S3AM-321-FM2 Drilling, Boring, & Direct-Push Equipment Maintenance Inventory.*

4.7.3 The maintenance program for equipment shall:

- Adhere to applicable regulations, standards, and manufacturers' specifications;
- Provide for service by appropriately qualified maintenance personnel; and,
- Require maintenance schedules and records of maintenance.

4.7.4 Employees or operators who are assigned equipment are required to review maintenance schedules for that equipment and will confirm that required maintenance has occurred or see that it is undertaken.

4.8 General Requirements

4.8.1 Excluding geoprobe activities, set up any sample tables and general work areas for employees at a safe distance from the rig.

- The recommended safe distance is the height of the fully extended mast plus 5 feet (1.5 meters), and no less than 30 feet (9.1 meters) from the rig.
- An increase to this distance may be required due to noise exposure hazards. Refer to *S3AM-118-PR1Hearing Conservation.*

4.8.2 Operation of the drilling, boring or direct-push equipment shall be restricted to the designated operator except to activate the emergency shut-off as required.

- All rotary drilling equipment shall have an emergency shut off / kill switch. The location of the switch and operation should be reviewed with all involved Employees.

4.8.3 Sit-on direct push rigs are not permitted on AECOM worksites unless the rig has been modified (in accordance with manufacturer's requirements) to be operated by remote control or the rig has been manufactured with a rollover protection system and seat belt.

4.8.4 Consult jurisdictional regulations as use of J-hooks and cat-heads may be prohibited. Examples:

- 29 CFR 1926 requires derricks and cranes to use hooks with self-closing latches and permits the use of J-hooks only for a task unrelated to this procedure (setting trusses).
- British Columbia and Saskatchewan prohibit the use of friction cat-heads**.**

4.9 Identifying the Work Area

4.9.1 Ensure the work area is adequately identified:

- Including zone around the drilling, boring, or direct push equipment, as well as fluid equipment, entry point, exit point and any excavated areas.
- Utilize barricades, signage, pylons, snow fence, etc. as appropriate.
- Implement traffic control as necessary.
- Coordinate with concurrent operations to identify their associated hazards and controls, and communicate those associated with AECOM tasks.

4.9.2 When operating near public vehicular and pedestrian traffic, the on-site personnel shall take every precaution necessary to see that the work zone is properly established, identified, and isolated from both moving traffic and passer-by pedestrians (refer to *S3AM-306-PR1 Highway and Road Work*).

4.9.3 All traffic control devices shall be installed, placed, and maintained in accordance with a Traffic Control Plan, client specifications, and / or the Manual of Uniform Traffic Control Devices and Manual of Uniform Traffic Control Devices for Canada in Canada. Traffic control devices shall consist of and not be limited to

- Directional and informational signage;
- High visibility barricades, cones, or barrels;
- Lighting; and
- Other equipment and devices as required.

4.10 Clearing Work Areas

4.10.1 In addition to any minimum requirements the drilling subcontractor may have, prior to set up, adequate site clearing and leveling shall be performed to accommodate the rig and supplies and provide a safe working area.

4.10.2 Clearing the site includes clearing the intended drilling area obstacles and of underground utilities in accordance with *S3AM-331-PR1 Underground Utilities*.

4.10.3 Drilling or probing shall not commence when tree limbs, unstable ground, or site obstructions cause unsafe tool handling conditions.

- The cleared / levelled area should be large enough to accommodate the rig and supplies.
- If the rig is positioned on a steep grade and levelling of the ground is impossible or impractical, the wheel of the transport vehicle shall be blocked and other means employed of preventing the rig from moving or toppling over.

4.11 Drilling Activities

4.11.1 Federal / State / Provincial / Territorial regulations that govern drill rig operations and exposed moving parts shall be adhered to.

4.11.2 All applicable client on-site safety procedures shall be understood and adhered to.

4.11.3 Minimum approach distances (MAD) from subsurface and overhead utilities and subsurface installations will be established including 5 feet (1.5 meters) from any subsurface utility, 7 feet (2.1 meters) from the pad surrounding any underground storage tanks, and 10 feet (3 meters) from any overhead energized electrical line (or further depending on line voltage). These approach distances are a minimum; government regulations and utility requirements may dictate a greater set back distance and should be confirmed.

4.11.4 Verify that equipment / energy is isolated when lockout is required:

- Refer to operator's manual and *S3AM-325-PR1 Lockout Tagout*.
- Ensure stop switch is activated.
- Driller is out of the seat.
- Test controls to ensure they do not engage.

4.11.5 In addition to any identified minimum requirements (as applicable, client, drilling subcontractor), the following safety measures shall be taken during drilling, boring or probing operations on site:

- The operator and helper shall be present during all active rig operations.
- Site personnel shall remain within visual contact of the rig operator.
- Hard hats, approved safety boots, safety glasses, and hearing protection shall be worn in the work zone (minimum, the radius around the rig equal to the height of the drill rig mast) of a rig.
- Gas monitoring shall be conducted as appropriate.
- Hands, feet and other body parts shall be kept away from moving parts, (e.g. hoisted, rotating, pushing, etc.) including augers, drill rods and reamers.
- When observing drilling, stand upwind of the drill rig to prevent potential exposure to vapors that may be emitted from the borehole.
- The emergency shut-off switch on the rig shall be identified to site personnel and tested on a daily basis by the operator.
- Unauthorized personnel shall be kept outside of the established work zone.
- Rig crew and other worksite personnel shall not use a cell phone while operating the drill rig or other equipment or within the rig work zone.
- Do not drive the rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick) look up to check for overhead obstructions. Refer to *S3AM-322-PR1 Overhead Lines*.

- Before raising the mast (derrick), all rig personnel (with the exception of the operator) and visitors should be cleared from the areas immediately to the rear and the sides of the mast. All rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig shall be first levelled and stabilized with levelling jacks and / or solid cribbing.
    - The drill rig shall be releveled if it settles after initial set up.
    - Lower the mast (derrick) only when the levelling jacks are down, and do not raise the levelling jack pads until the mast (derrick) is lowered completely.
- After the rig has been positioned to begin drilling, all brakes and / or locks shall be set before drilling begins.
- The operator of a rig shall only operate a drill rig from the position of the controls. The rig shall not be in operation if the operator of the rig leaves the area of the controls.
- Throwing or dropping tools shall not be permitted. All tools shall be carefully passed by hand between personnel or a hoist line should be used.
- If it is necessary to operate the rig within an enclosed area, make certain that exhaust fumes are conducted out of the area.
    - Exhaust fumes can be toxic and some cannot be detected by smell.
    - Air monitoring and, as necessary, noise monitoring shall be conducted.
- Clean mud and grease from boots before mounting a rig platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- All unattended bore holes shall be adequately covered or otherwise protected to prevent rig personnel, site visitors, or animals from stepping or falling into the hole. All open bore holes shall be covered, protected, or backfilled adequately and according to Federal / State / Provincial / Territorial or local regulations on completion of the drilling project.
- When using a ladder on a rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending and descending. Always use adequate fall protection and a full body harness when climbing above 6 feet (1.8 meters) of the ground. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool “bucket” or a safety hook to raise or lower hand tools.

4.12 Drilling Fluid

4.12.1 Ensure drilling fluid is appropriate to the soil type and conditions to be encountered to enable smooth drilling.

4.12.2 Drilling fluid used in the boring process shall be contained at the entry and, as applicable, exit locations until recycled or removed from the site.

4.12.3 Confirm drilling fluid does not enter roadways, streams, municipal storm or sanitary sewer lines, and / or any other drainage system or body of water.

4.12.4 Monitor drilling equipment and fluid equipment for any leakage or spills. Confirm appropriate containment is in place and adequate spill response supplies are available.

4.12.5 It is important to monitor fluid flow and pressure gauges when drilling with any tooling, but it is essential when drilling with a mud motor (pump placed in the drill string to provide additional power to the bit while drilling).

4.13 Unanticipated Concrete / Debris or Void

4.13.1 The presence of subsurface installations and utilities requires special care when obstructions / refusal and voids are encountered and when unexpected absence of soil recovery occurs during

drilling operations. Other indicators of subsurface installations and utilities are the presence of warning tape, pea gravel, sand, non-indigenous material, bentonite, red concrete (indicative of electrical duct banks) and any departure from native soil or backfill.

4.13.2 If unanticipated concrete / debris is encountered and / or if a void is encountered, drilling will be immediately discontinued and the Manager notified. Drilling may only proceed with Manager or SH&E Manager approval.

4.14 Use of Manual Slide Hammer

4.14.1 The following health and safety procedures should be followed when using a manual slide hammer to install shallow injection points, drive point piezometers, and drill tools:

- Only use a manual slide hammer that either attaches directly to the point / piezometer being driven or that incorporates a cap on the point / piezometer / drill tool that prevents the slide hammer from slipping off the point / piezometer / drill tool.
- Always grasp the manual slide hammer (handles if equipped with handles) with both hands while driving the point / piezometer / drill tool.
- Never allow hands or feet to get between the manual slide hammer and the drive plate or anvil.

4.15 Use of Augers

4.15.1 The following general health and safety procedures should be followed when supervising borings with continuous flight hollow-stem augers:

- Never place hands or fingers under the bottom of an auger section when it is being hoisted over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When augers are rotating, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.
- Use a long-handled shovel to move auger cuttings away from a rotating auger. Never use hands or feet to move cuttings away from a rotating auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.
- Loud noises may occur while driving split spoons. At minimum hearing protection shall be worn when driving split spoons.
- When pulling / lifting augers, a clevis pin or other closed device shall be used. Use of J-hooks is prohibited.

4.16 Attaching and Breaking Rods

4.16.1 Do not use manual tools (e.g., pipe wrenches) in combination with rotation of the drill stem. Manual tools are not designed for the load, and may break.

- The use of such tools creates a significant impact hazard for those in the work area, because they rotate with the drill stem. Manual tool use in combination with a rotating drill stem to attach or break rods is therefore prohibited.
- Manual tools may be used if the drill stem is isolated / positively disengaged.
- Mechanical means of rod separation that are permitted include:
  - Opposing hydraulic controls.
  - Rod locking devices or machine's power vice.
  - Hydraulic breakout tools.
  - Hydraulic foot clamps.

4.16.2 Rod box changes present severe crushing hazards. Operators shall ensure all crew members are clear of the machine and hoisting equipment while they are changing rod boxes.

4.17 Rotary, Sonic and Core Drilling

4.17.1 In addition to the health and safety procedures identified above, the following general health and safety procedures should be followed when supervising borings with rotary, sonic and core drilling:

- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws. Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use hands to clean drilling fluids from drill rods.
- When drill rods are rotating, stay clear of the rotating components of the drill rig. Never reach behind or around a rotating drill rod for any reason.
- Use a long-handled shovel to move cuttings away from the top of the borehole. Never use hands or feet to move cuttings away from the borehole.
- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Keep away from area where drill rods are being moved or raised to the rig. Do not stand in the area where a drill rod will fall or slide if it should be dropped.
- Loud noises may occur during drilling. Hearing protection shall be worn.

4.18 Direct-push

4.18.1 The following general health and safety procedures should be followed when supervising drilling borings with direct-push drilling:

- Loud noise may occur during direct-push drilling. Appropriate hearing protection shall be worn.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a suitable rod wiper. Do not use hands to clean drilling fluids from drill rods.
- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

4.19 Horizontal Directional Drilling

4.19.1 During surface to surface operations a 16.4’ (5 meters) safe zone shall be established and identified at both the entry and exit locations; no personnel are permitted to be within this zone unless the drill is locked out and the operator is out of the seat.

4.19.2 Machine shall be locked out before entering an excavation, changing tools, adding or removing drill stem or doing any other work on tools or the drill stem at the exit end of the bore.

4.19.3 A tracking head shall be installed on the drill stem:

4.19.4 Assemble drill head using components appropriate to the soil conditions to be encountered (e.g. nozzle, bit, beacon housing, etc.).

4.19.5 Ensure all personnel are clear of the bore entry point (outside of identified work zone).

4.19.6 At all times two way communication will be maintained at entrance and exit points using two way radios or equally effective communication means. If at any time communication is lost, all work will be stopped until communication is re-established

4.19.7 Locate drill head with tracking device at least every half-length of pipe. Adjust direction as necessary to follow the intended bore path.

4.19.8 Any drilling fluid returning to the surface shall be cleaned up promptly.

4.19.9 Drill pipe should exit the bore at an angle of 5 to 10° from the ground surface.

4.19.10 Turn off fluid flow as soon as drill head emerges.

4.19.11 Lockout machine and remove drill head using appropriate breakout tools.

4.19.12 Select and attach a reamer that allows the return of drilling fluids and cuttings, to reduce frictional pullback forces, and to allow for bend radius of the pipe. Reamer shall be:

- The smaller of 1.5 times the outside diameter (O.D.) or 12 inches (300mm) larger than the diameter of the product pipe.
- A diameter less than 1.5 times the diameter of the product may be necessary in collapsing soil formations.
- Reamed diameter may need to be increased by up to 25% if substantial swelling of the soil is expected to occur.

4.19.13 All personnel shall clear the trench or the designated surface zone (16.4 feet [5 meters]) once the reamer is attached. Operator shall only reverse lockout and commence pullback when communication is received from personnel on exit hole side and operator has confirmed the message.

4.19.14 Personnel on exit hole side shall ensure reamer is pulled the entire way back to the exit hole.

- If rotation is started when drill rod and reamer are away from the exit hole, very fast sideways movement of the rod and reamer can occur.
- Larger reamers and longer lengths of exposed drill rod increase the speed and distance of this movement.

4.19.15 If working with trailing drill stem, swivels shall be verified as lubricated and rotating freely by hand prior to use:

- A freely moving swivel prevents trailing drill stem or product from rotating / whipping.
- If the swivel does not move freely by hand it shall be removed from service and repaired or replaced.
- Only use swivels with limited articulation to prevent whipping or cranking action between the reamer and trailing drill pipe or product.

4.19.16 It is important to clean and lubricate the tool and drill stem joint threads before each use.

4.19.17 Any individual drill pipes that are bent or damaged shall be immediately taken out of service.

4.19.18 Occasionally change the order of the lead drill pipe (i.e. move the lead pipe to the end of the stem, or other pipe rotation procedures) to extend drill stem life.

4.19.19 Operator should avoid stalling the pipe rotation to avoid stress damage from shock loading.

4.20 Drilling at Potential MEC / UXO Sites

4.20.1 If the project site is suspected of containing munitions and explosives of concern (MEC) or unexploded ordnance (UXO), the UXO team will conduct a reconnaissance and MEC / UXO avoidance to provide clear access routes to each site before drilling crews enter the area. The following procedures will be implemented:

- Drilling operations on an MEC / UXO site will not be conducted until a complete plan for the site is prepared and approved by the AECOM UXO Safety Officer. MEC / UXO avoidance shall be conducted during drilling operations on known or suspect MEC / UXO sites.
- The UXO team will identify and distinctly mark the boundaries of a clear approach path for the drilling crews, vehicles, and equipment to enter the site. This path will be, at a minimum, twice the width of the widest vehicle. No personnel will be allowed outside any marked boundary.
- If MEC / UXO is encountered on the ground surface, the UXO team will clearly mark the area where it is found, report it to the proper authorities, and divert the approach path around it.
- The UXO team will conduct an access survey using the appropriate geophysical instrument over the approach path for avoidance of MEC / UXO that may be in the subsurface. If a magnetic anomaly is encountered, it will be assumed to be MEC / UXO, and the approach path will be diverted around the anomaly. UXO personnel only will operate the appropriate geophysical instrument and identify MEC / UXO.
- An incremental geophysical survey of the drill-hole location(s) will be initially accomplished by the UXO team using a hand auger to install a pilot hole. If MEC / UXO is encountered or an anomaly cannot be positively identified as inert material, Hazardous, Toxic, and Radioactive Waste (HTRW) sampling personnel will select a new drill-hole location.
- Once the surface of a drilling site has been cleared and a pilot hole established as described above, the drilling contractor will be notified that the site is available for subsurface drilling.

4.21 Movement and Transport of Drilling, Boring or Direct-Push Equipment

4.21.1 Personnel transporting equipment shall be properly licensed and shall operate the vehicle according to Federal / State / Provincial / Territorial, and local regulations. Refer to *S3AM-005-PR1 Driving* and *S3AM-320-PR1 Commercial Motor Vehicles*.

4.21.2 Confirm the traveling height (overhead clearance), width, length and weight of the equipment with the carrier. Identify highway and bridge load, width and overhead limits, to confirm these limits are not exceeded and with adequate margin.

4.21.3 Allow for overhang of any drilling, boring or direct-push equipment when cornering or approaching other vehicles or structures.

4.21.4 Be aware that the canopies of service stations and motels are often too low for equipment loaded on a trailer to clear

4.21.5 Watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels, other commercial sites.

4.21.6 Never travel on a street, road, or highway with any part of the drilling, boring or direct-push equipment in a raised or partially raised position.

4.21.7 Remove all ignition keys if rig is left unattended unless client requirements specify that the keys remain in the ignition switch at all times.

4.21.8 Before moving a rig on location, the operator shall do the following:

- To the extent practical, walk the planned route of travel and inspect it for depressions, gullies, ruts, and other obstacles.
- Check the brakes of the truck / carrier, especially if the terrain along the route of travel is rough or sloped.
- Discharge all passengers before moving on rough or steep terrain.

4.21.9 Engage the front axle (on 4x4, 6x6, etc., vehicles) before traversing rough or steep terrain

4.21.10 Driving drill rigs along the sides of hills or embankments should be avoided; however, if side-hill travel becomes necessary, the operator shall conservatively evaluate the ability of the rig to remain upright while on the hill or embankment. The possibility shall be considered that the presence of

drilling tools on the rig may reduce the ability of the rig to remain upright (raises the center of mass of the rig).

4.21.11 Logs, ditches, road curbs, and other long and horizontal obstacles should be approached and driven over squarely, not at an angle.

4.21.12 When close lateral or overhead clearance is encountered, or when backing up, the driver of the rig shall be guided by another person on the ground.

4.21.13 Loads on the drill rig and truck shall be properly stored while the truck is moving, and the mast shall be in the fully lowered position.

4.22 Loading and Unloading

4.22.1 Consult applicable manufacturer's recommendations for loading and unloading of the equipment.

4.22.2 Use ramps of adequate design that are solid and substantial enough to bear the weight of the rig with carrier, including tools.

4.22.3 Load and unload on level ground.

4.22.4 Use the assistance of someone on the ground as a guide.

4.22.5 Check the brakes on the rig carrier before approaching loading ramps.

4.22.6 Distribute the weight of the rig, carrier, and tools on the trailer so that the center of weight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the height of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.

4.22.7 The rig and tools should be secured to the hauling vehicle with ties, chains, and / or load binders of adequate capacity.

5.0 Records

5.1 All employee training files shall be maintained in accordance with *S3AM-003PR1 SH&E Training*.

5.2 Completed inspections and maintenance inventories shall be maintained the site or project files.

6.0 Attachments

6.1 S3AM-321-ATT1 Core Drilling Machine

6.2 S3AM-321-ATT2 Pre-Drilling, Boring, & Direct-Push Probing Flow Chart

6.3 S3AM-321-FM1 Daily Drilling, Boring & Direct-Push Equipment Inspection

6.4 S3AM-321-FM2 Drilling, Boring & Direct-Push Equipment Maintenance Inventory

Heat Stress

1.0 Purpose and Scope

1.1 Establishes a Heat Illness Prevention Program to guide employees in preventing heat illness, recognition of the symptoms of heat stress-related illnesses and in taking the appropriate corrective action.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Acclimated –** Employees who have developed physiological adaptation to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures without stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.

2.2 **Chemical Protective Clothing (CPC)** – Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the Employee with potentially hazardous materials in the workplace. Such materials include Tyvek® coveralls (all types) and polyvinyl chloride coveralls and rain suits.

2.3 **Heat Cramps** – A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.

2.4 **Heat Exhaustion** – A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.

2.5 **Heat Rash** – A heat-induced condition characterized by a red, bumpy rash with severe itching.

2.6 **Heat Stress** – The combination of environmental and physical work factors that constitute the total heat load imposed on the body.

2.7 **Heat Stroke** – The most serious form of heat stress, which involves a profound disturbance of the body's heat-regulating mechanism.

2.8 **Sunburn** – Caused by unprotected exposure to ultraviolet radiation present in sunlight that is damaging to the skin (Refer to *S3AM-121-PR1 Non-Ionizing Radiation*). The injury is characterized by red painful skin, blisters, and/or peeling.

2.9 **Unacclimated** – Employees who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-010-PR1 Emergency Response Planning

3.4 S3AM-121-PR1 Non-Ionizing Radiation

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedures

4.1 Roles and Responsibilities

4.1.1 Managers

- Evaluate the need for heat illness prevention measures and incorporate as appropriate into the Safe Work Plan or Task Hazard Analysis.
- Allocate sufficient resources for the management of heat illness in the field including the provision of water, a shaded break area, and sufficient schedule to allow for breaks.

4.1.2 Safety, Health and Environment (SH&E) Manager

- Provide heat illness awareness training.
- Assist in developing appropriate work-rest schedules.
- Conduct/support incident investigations related to potential heat stress-related illnesses.

4.1.3 Supervisor

- Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned Employees.
- Confirm that Employees have been trained on the recognition of heat illness.
- Confirm that this procedure, along with any applicable Safe Work Plan and/or Task Hazard Analysis (and heat exposure control plan that may be contained therein) are made available to affected Employees.
- Confirm that adequate supplies of appropriate fluids are readily available to Employees.
- Confirm that a proper rest area is available.
- Conduct heat illness monitoring, as applicable.
- Implement the work-rest schedule.
- Confirm that first aid measures are implemented once heat stress symptoms are identified.
- Confirm personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.
- Report all suspected heat illnesses.

4.1.4 Employee

- Observe each other for the early symptoms of heat illnesses.
- Maintain an adequate intake of available fluids.
- Be familiar with heat stress hazards, predisposing factors, and preventative measures.
- Report to work in a properly vested and hydrated condition.
- Report all suspected heat stress-related illnesses.

4.2 Restrictions

4.2.1 The Buddy System is required when working in high heat conditions; Employees shall not work alone.

4.2.2 Employees shall not be exposed to levels exceeding those specified for the given work level and work-rest regimen as listed in *S3AM-113-ATT1 Temperature Thresholds*.

4.2.3 Clothing corrections shall be applied in accordance with the tables provided in *S3AM-113-ATT1 Temperature Thresholds*.

4.3 Exposure Controls

4.3.1 It shall be determined whether Employees are or may be exposed to hazardous heat levels. The Supervisor shall:

- Conduct a heat stress assessment to determine the potential for hazardous exposure of Employees. Assessment shall include, but not limited to:
  - Ambient temperature.
  - Amount of sunshine (cloudy, clear). Refer to *S3AM-121-PR1 Non-Ionizing Radiation* additional direction concerning ultraviolet radiation exposures.
  - Other radiant heat sources (e.g. motor, fire, etc.).
  - Humidity.
  - Air flow.
  - Amount or type of physical labor being performed,
  - Physical condition of the Employees (e.g., acclimated/not)
  - Protective clothing in use.
  - Referral to *S3AM-113-ATT1 Temperature Thresholds* to assist in determining whether hazardous heat exposures may exist.
- If potential for hazardous exposure is identified, the Supervisor shall develop and implement a heat stress exposure control plan within the Safe Work Plan and/or Task Hazard Analysis. Refer to *S3AM-209-PR1 Risk Assessment & Management.*

4.3.2 If Employees are or may be exposed, the Supervisor shall implement engineering controls (e.g., shelters, cooling devises, etc.) to reduce the exposure of Employees to levels below those specified for the given work level and work-rest regimen as listed in *S3AM-113-ATT1 Temperature Thresholds*.

4.3.3 If engineering controls are not practicable, the Supervisor shall reduce the exposure of Employees to levels below those listed in *S3AM-113-ATT1 Temperature Thresholds* by providing administrative controls, including a work-rest cycle or personal protective equipment, if the equipment provides protection equally effective as administrative controls.

4.3.4 If Employees are or may be exposed, the Supervisor shall provide and maintain an adequate supply of cool, fresh, potable water close to the work area for the use of a heat exposed Employee. Water shall be provided (paid) by the project or program; if Employees purchase their own drinking water because water is not otherwise available on site, they shall be reimbursed.

4.3.5 If an Employee shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant on site, if available, or by a physician, refer to *S3AM-113-ATT2 Symptoms & Treatment* for more specifics.

4.4 Heat Stress Planning

4.4.1 Heat stress can be a significant site hazard, especially for Employees wearing CPC. To prepare for emergency response planning, refer to *S3AM-010-PR1 Emergency Response Planning* procedure.

4.4.2 The project and site specific risks need to be planned using the SH&E Plan and the Task Hazard Assessments (THA). Refer to the *S3AM-209-PR1 Risk Assessment & Management* procedure.

4.4.3 The heat a worker is exposed to may be a combination of air temperature, radiant heat, and humidity. The WBGT (wet-bulb globe thermometer) is a useful index of the environmental contribution to heat stress. Because WBGT is only an index of the environment, the contributions of

work demands, clothing, and state of acclimatization shall also be accounted for, as described in the following steps.

- Monitor ambient temperatures and conduct heat stress monitoring in accordance with the location specific SH&E Plan. Revise the heat stress monitoring and controls if there are any reports of discomfort due to heat stress.
- Monitor temperatures in each unique environment in which workers perform work (e.g., take WBGT measurements inside truck cabs for truck drivers, and take separate WBGT measurements in the outdoor area where field employees work, etc.). Follow manufacturer's instructions on proper use of the WBGT.
- Determine if individual workers are acclimatized or un-acclimatized. Full heat acclimatization requires up to 3 weeks of continued physical activity under heat-stress conditions similar to those anticipated for the work. Its loss begins when the activity under those heat-stress conditions is discontinued, or when there is a sustained increase in temperatures of 10 °F (5.6 °C) or more, and a noticeable loss occurs after 4 days. A worker can be considered acclimatized for the purpose of this procedure when they have been exposed to the site conditions (including level of activity) for 5 of the last 7 days.
- Determine the approximate workload of each worker or group of workers. The following examples (Table 1) can be used for comparison:

Table 1
Examples of Activities within Workload Categories

Categories	Example Activities
Resting	Sitting quietly
	Sitting with moderate arm movements
Light	Sitting with moderate arm and leg movements
	Standing with light work at machine or bench while using mostly arms
	Using a table saw
	Standing with light or moderate work at machine or bench and some walking about
Moderate	Scrubbing in a standing position
	Walking about with moderate lifting or pushing
	Walking on level at 3.5 miles/hr (6 km/hr) while carrying 6.6 lbs (3kg) weight load
Heavy	Carpenter sawing by hand
	Shoveling dry sand
	Heavy assembly work on a non-continuous basis
	Intermittent heavy lifting with pushing or pulling (e.g., pick-and-shovel work)
Very Heavy	Shoveling wet sand

- Determine the approximate proportion of work within an hour during a typical shift. Typically, the initial work schedule will be 60 minutes of work per hour (100 percent work) with a small break in the morning and afternoon, as appropriate, and a 30-minute lunch break mid-day.
- For workers wearing cloth coveralls (e.g., Nomex fire resistant clothing), add 3 to the measured WBGT. For impermeable clothing, such as Tyvek or Saranex, the WBGT procedures cannot be used. For these situations, workers should begin physiological monitoring as soon as the temperature in the work area exceeds 70ºF (21°C).
- Use the collected information to develop appropriate work to rest schedules as detailed in *S3AM-113-ATT1 Temperature Threshold*.

4.4.4 Given the work demands (light, moderate, heavy or very heavy), heat of the work environment, and such aspects as PPE in use, workload will be adjusted appropriately to allow for proper acclimation.

- This is the process by which the body "gets used to" hot work environments. This is achieved by slowly increasing workloads.
- New and returning Employees (absent one week or more) who have not had time to acclimatize may be more susceptible to heat related illnesses, even in seemingly low risk heat exposures.
- All Employees shall be allowed time to acclimatize in the event of a heat wave. All Employees assigned to a new process with additional heat exposures shall be allowed to acclimatize.
- Minimize workload and gradually increase as tolerance is built up. Allow for more frequent breaks.
- While acclimatization normally takes approximately 5 to 7 days, heightened monitoring of these Employees will be maintained for the first 14 days.

4.4.5 Employees shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. Employees shall be encouraged to immediately report any heat stress that they may experience or observe in fellow Employees. Supervisors shall use such information to adjust the work-rest schedule to accommodate such problems.

4.4.6 Wherever possible, a designated break area should be established in an air conditioned space, or in shaded areas where air conditioning is impractical. The break area should be equipped to allow Employees to loosen or remove protective clothing, and sufficient seating should be available for all Employees. During breaks, Employees shall be encouraged to drink plenty of water or other liquids, even if not thirsty, to replace lost fluids and to help cool off. Cool water should be available at all times in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

4.5 Symptoms and Treatment

4.5.1 Refer to *S3AM-113-ATT2 Symptoms & Treatment*.

4.5.2 Employees who exhibit ANY signs of significant heat stress (e.g., profuse sweating, confusion and irritability, pale, clammy skin) shall be relieved of all duties at once, made to rest in a cool location, and provided with large amounts of cool water.

4.5.3 Anyone exhibiting symptoms of heat stroke (red dry skin, or unconsciousness) shall be taken immediately to the nearest medical facility. Steps shall be taken to cool the person during transportation (clothing removal, wet the skin, air conditioning, etc.).

4.5.4 Severe heat stress (heat stroke) is a life-threatening condition that shall be treated by a competent medical authority.

4.6 Prevention

4.6.1 Requirements for working in extreme heat may be triggered by a regulatory established criteria (e.g. CAL/OSHA requires high heat procedures when temperature equals or exceeds 95°F) or as a result of a hazard analysis assessing various contributory factors (refer to *S3AM-113-ATT1 Temperature Thresholds*). Employees working in extreme heat or sun should understand and apply the following guidelines for preventing and detecting heat exhaustion and heat stroke.

- When possible, begin hydrating at least three days prior to working in high heat conditions.
- Review the heat stress exposure control plan within the Safe Work Plan and/or Task Hazard Analysis.
- If the supervisor is not immediately available confirm a reliable method of communication is in place to allow for contact with supervision. In the absence of cellular reception a satellite phone or similar device may be required.

- Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently.
- Try to schedule work for the coolest part of the day, early morning and evening.
- Avoid strenuous physical activity outdoors during the hottest part of the day.
- Avoid sudden changes of temperature. Refer *to S3AM-113-ATT1 Temperature Thresholds*.
- Air out a hot vehicle before getting into it.
- Obtain medical direction if taking diuretics during hot weather (a lower dose may be necessary).
- When working in heat, drink 1 quart of water per hour of work.
- Avoid caffeine and alcohol as they increase dehydration.
- Monitor urine frequency and color to detect dehydration. Refer to the *S3AM-113-ATT3 Dehydration Chart.*
- The Buddy System is required when working in high heat conditions to enable effective communication and cross-observation for indications of heat stress.
- Initiate emergency response procedures when necessary, including contacting emergency medical services as appropriate and in accordance with the Emergency Response Plan.

4.6.2 Personal Protective Equipment

- Review the *S3AM-208-PR1 Personal Protective Equipment* procedure.
- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).
- Wear sunglasses with UV protection.
- Pack extra water to avoid dehydration (try freezing water in bottles overnight to help keep the water cooler for longer during the day).

4.7 Work-Rest Schedule Practices

4.7.1 Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid "fluid debt," which will not be made up as long as the individual is sweating.

- Two 8-ounce glasses of water should be taken prior to beginning work, then up to 32 ounces (1 quart) per hour during the work shift; fluid replacement at frequent intervals is most effective.
- The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration and may increase loss of water.
- If commercial electrolyte drinks (e.g., Gatorade) are used, the drink should be diluted with water, or 8 ounces of water should be taken with each 8 ounces of electrolyte beverage.

4.7.2 Additional salt is usually not needed and salt tablets should not be taken.

4.7.3 Replacement fluids should be cool and fresh, but not cold.

4.7.4 Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.

- A relatively cool, shaded area shall be provided for breaks when working in hot environments. For hazardous waste sites, the rest area should be located in the support zone adjacent to the contamination reduction zone, situated so that part of it is in the decontamination area so workers can take breaks without going through full decontamination.

- If shade is not available, shaded areas shall be constructed. This same type of canopy can be set up to shade personnel performing various types of work in hot weather.
- Cooling measures other than shade (e.g., misting, air conditioned break areas, air conditioned vehicles, etc.) can be used in lieu of shade provided it can be demonstrated that they are at least as effective in cooling employees.
- Employees should have access to these rest areas at break times and at any other time when suffering from heat illness or believing a preventive recovery period is needed.

4.7.5 Dry clothing or towels will be available to minimize chills when taking breaks.

4.7.6 Manual labor will not be performed during breaks, other than paperwork or similar light tasks.

4.7.7 Other controls that may be used include:

- Scheduling work at night or during the cooler parts of the day (6 am–10 am, 3 pm–7 pm).
- Erecting a cover or partition to shade the work area.
- Auxiliary cooling - wearing cooling devices beneath protective garments, but over any underclothing.
    - If cooling devices are worn, only physiological monitoring will be used to determine work activity.
    - These vests typically provide cooling via one of two methods: the use of ice or other frozen media, or the use of a vortex cooler. Each method has its advantages and disadvantages.
    - The frozen media vest requires a means for freezing the media, and the media (usually water or "blue ice") will melt, requiring replacement.
    - The vortex cooler tends to cool more uniformly. Instead of frozen media, this vest uses the expansion of compressed air to cool the wearer. The drawback is the compressed air requirement, but this is negated when the wearer is already using an airline respirator supplied by a compressor. A vortex cooler should not be supplied from air cylinders, as this will draw down the cylinders rapidly.
- Auxiliary cooling should be considered when the following conditions exist:
    - Ambient temperature over 80°F (26°C).
    - Workers are wearing impermeable garments (i.e., Tyvek, Saranex, Chemrel, etc.).
    - It is desirable to have long work shifts with minimum interruption.

4.8 Evaluating the Work-Rest Schedule's Effectiveness

4.8.1 Once a work-rest schedule is established, the Supervisor shall continually evaluate its effectiveness through observation of Employees for signs/symptoms of heat stress. Have workers assess themselves and their body's reaction to the heat and work conditions (self-assessment), and report any signs or symptoms of heat illness. These can include nausea or dizziness, heat cramps, extreme thirst, or very dark urine.

4.8.2 Measurement or physiological monitoring of each Employee's vitals (e.g., pulse, blood pressure, and temperature) can provide additional information in determining if the schedule is adequate. Refer to *S3AM-113-ATT1 Temperature Thresholds* for additional guidance on when physiological monitoring should be conducted.

4.8.3 Frequency of physiological monitoring is increased or decreased depending upon such factors as worker fitness, acclimatization, temperature of the work environment, type of PPE, etc.

Based on the results of the physiological monitoring and on the workers' self-assessments, the work period may be adjusted as follows:

- The work period may be increased (generally, by 5- to 10-minutes intervals, up to a maximum of 4 hours) if the results of the first 2 hours of the physiological monitoring and the workers' self-assessments indicate that workers are recovering adequately (see below), and on the judgment of the SH&E Manager.
- The work period shall be decreased if the results of the physiological monitoring and the workers' self-assessment indicate that workers are NOT recovering adequately (see below).

4.8.4 If physiological monitoring is conducted, the Employee and/or the SH&E Manager (or appropriate designate) shall measure and record body temperature and pulse rate as described below.

4.8.5 Monitor body temperature to determine if Employees are adequately dissipating heat build-up. Ear probe thermometers which are adjusted to oral temperature (aural temperature) are convenient and the preferred method of measurement. Determine work/rest regimen as follows:

- Measure oral body temperature at the end of the work period. Oral body temperatures are to be obtained prior to the employee drinking water or other fluids.
- If temperature exceeds 99.6°F (37.5°C), shorten the following work period by 1/3 without changing the rest period.
- If, at the next rest period, temperature still exceeds 99.6°F (37.5°C), the worker should not be allowed to continue work until repeated temperature measurements are in the acceptable range (i.e., less than 99.6°F). Do not leave the worker alone during the recovery time. Watch for signs of heat illness and be prepared to implement emergency response as necessary.
- Do not allow a worker to wear impermeable PPE when his/her oral temperature exceeds 100.6°F (38.1°C).

4.8.6 At the start of the workday each Employee's baseline pulse rate (in beats per minute [bpm]) is determined by taking a pulse count for 15 seconds and multiplying the result by four or by using an automated pulse count device. Pulse rates can then be measured at the beginning of each break period and two minutes thereafter to determine if the rest period allows for adequate recovery.

- Take the radial (wrist) pulse as early as possible in the rest period and determine the worker's heart rate in beats per minute. The heart rate is determined by counting the pulse for ten seconds and multiplying the number by 6 to get the beats per minute. Record this as P1.
- Wait 2 minutes and repeat the pulse measurement. Record this as P2.
- If P1 is greater than or equal to 110 beats per minute (bpm) and if (P1 – P2) is less than or equal to 10 bpm (indicating that workers are not recovering adequately), shorten the next work cycle by 1/3 without changing the rest period.
- At the next rest period, if P1 is still equal to or greater than 110 bpm, and if (P1 – P2) is still less than or equal to 10 bpm, shorten the following work cycle by 1/3 without changing the rest period.
- At the third rest period, if P1 is still equal to or greater than 110 bpm and (P1 – P2) is still less than or equal to 10 bpm, the worker should not be allowed to continue work until repeated pulse measurements are in the acceptable range (i.e., P1 is less than 110 bpm and (P1 – P2) is greater than 10 bpm). Do not leave the worker alone during the recovery time. Watch for signs of heat illness and be prepared to implement emergency response as necessary.

4.8.7 Use of an automated or similar blood pressure device will be used to assess each Employee's blood pressure at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- If the blood pressure of an Employee is outside of 90/60 to 150/90, then the Employee will not be allowed to begin or resume work; extend the break period by at least five minutes, at the end of which blood pressure rates will be re-measured and the end-of-break criteria again applied.

4.8.8 All physiological monitoring of heat stress will be documented using *S3AM-113-FM1 Heat Stress Monitoring Log.*

4.9 Training

4.9.1 Employees and their Supervisors that may be exposed to the hazard will be trained and oriented to the hazard and the controls prior to work commencing.

4.9.2 Those Employees, including Supervisors, potentially exposed to heat stress will receive training, refer to the *S3AM-003-PR1 SH&E Training* procedure. Training will include, but is not limited to:

- Sources of heat stress (environmental and personal), influence of protective clothing, and importance of acclimatization;
- How the body handles heat and acclimatization;
- Recognition of heat-related illness symptoms;
- Preventative/corrective measures including, but not limited to;
  - Employees will be informed of the harmful effects of excessive alcohol consumption in the prevention of heat stress.
  - All Employees will be informed of the importance of adequate rest and proper diet in the prevention of heat stress.
- First aid procedures for heat stress-related illnesses; and
- Immediate reporting of any heat-related incident (injury, illness, near-miss), refer to the *S3AM-004-PR1 Incident Reporting, Notifications & Investigation* procedure.

5.0 Records

5.1 None

6.0 Attachments

6.1 S3AM-113-ATT1 Temperature Thresholds

6.2 S3AM-113-ATT2 Symptoms & Treatment

6.3 S3AM-113-ATT3 Dehydration Chart

6.4 S3AM-113-FM1 Heat Stress Monitoring Log

Heavy Equipment

1.0 Purpose and Scope

1.1 Outline the safe working requirements for working with and near heavy equipment and heavy equipment operation.

1.2 Military related vehicles and equipment (e.g. tanks) are not covered under this standard.

1.3 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Heavy equipment** –All excavating equipment (e.g. scrapers, loaders, crawler or wheel tractors, excavators, backhoes, bulldozers, graders, agricultural and industrial tractors, etc.), cranes, lift trucks, drills, etc. This may include off-highway trucks (e.g. dump truck, heavy haul truck, etc.). For requirements related to crew trucks refer to *S3AM-005-PR1 Driving*.

2.2 **Operator** – Any person who operates the controls while the heavy equipment is in motion or the engine is running.

2.3 **Ground personnel/workers** – Personnel performing work on the ground around heavy equipment (note: operators are considered ground personnel when outside of the equipment cab).

3.0 References

3.1 S3AM-005-PR1 Driving

3.2 S3AM-202-PR1 Competent Person Designation

3.3 S3AM-213-PR1 Subcontractor Management

3.4 S3AM-303-PR1 Excavation

3.5 S3AM-322-PR1 Overhead Lines

3.6 S3AM-325-PR1 Lockout Tagout

3.7 S3AM-331-PR1 Underground Utilities & Subsurface Installation Clearance

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers / Supervisors**

- Responsible for confirming all equipment is in good working order and all equipment operators are verified as qualified on the piece of machinery they are assigned.
- As applicable, review as-built drawings.
- Maintain operation manuals at the site for each piece of equipment that is present on the site and in use.
- Maintain a list of operators for the project, and the specific equipment that they are authorized to operate.
- Prohibit equipment from being operated by any personnel who have not been specifically authorized to operate it.

- Confirm an equipment maintenance inventory is maintained, schedules adhered to and appropriate inspections of equipment are conducted.
- Confirm subcontractors are properly pre-qualified in accordance with *S3AM-213-PR1 Subcontractor Management.*
- Require that subcontractor employees follow established safety procedures in operation, inspection, and maintenance of vehicles and equipment.
- Inform AECOM and subcontractor machinery operators about applicable local regulations restricting the consecutive minutes of engine idling time allowed.
- Confirm subcontractor machinery and mechanized equipment is approved for use in accordance with the requirements of *S3AM-309-FM1 Approval of Machinery & Mechanized Equipment*.
- Confirm that all rented equipment bears any required current certification marks and arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.
- Confirm that AECOM and subcontractor machinery and mechanized equipment is certified, as applicable, in accordance with manufacturer specifications and/or regulatory requirements.
- Visually observe the subcontractors' vehicles and equipment, for any unsafe conditions or practices. Equipment or operation not in compliance with applicable safety standards is prohibited.

4.1.2 **Employees / Ground Personnel**

- Confirm that all rented equipment arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.
- Ground personnel when working in the vicinity of heavy equipment shall have received training, and comply with the applicable rules of engagement.

4.1.3 **Operators (of heavy equipment)**

- Operate the equipment safely, maintain full control of the equipment, and comply with manufacturer's operation manual and the laws governing the operation of the equipment.
- Inspect equipment and immediately report defects and conditions affecting the safe operation of the equipment to the appropriate Supervisor.
- Trainees may operate equipment in accordance with jurisdictional requirements and under the direct supervision of a trainer.

4.2 Communication

4.2.1 Communication between site Managers / Supervisors, heavy equipment Operators, and site Employees / Ground Personnel is a key method of preventing serious injury or death during heavy equipment operations.

4.2.2 Managers shall confirm the Industrial site or project specific SH&E Plan is developed and communicated to all affected and involved employees. Refer to *S3AM-209-PR1 Risk Assessment & Management*.

4.2.3 Task Hazard Assessments and Daily Tailgate meetings shall be conducted in accordance with *S3AM-209-PR1 Risk Assessment & Management.*

4.2.4 Concerning worksites in which other employers control concurrent operations and SH&E issues related to the worksite, the manager shall coordinate with those conducting concurrent operations to confirm appropriate control measures are in place to protect employees from the hazards associated with activities to be performed.

- Coordination shall occur prior to work commencing, periodically thereafter, and as necessary given changes in scope and/or working conditions.
- Affected employees (including managers and supervisors) shall seek to participate in all site SH&E meetings related to concurrent operations.

4.2.5 The following points outline the communication requirements during heavy equipment operations:

- Site Supervisors/t Managers shall confirm that all operators are notified/informed of when, where, and how many ground personnel will be working on site.
- Site Supervisors/ Managers shall inform all ground personnel before changes are made in the locations of designated work areas.
- Prior to work initiating on site, the Site Supervisor/ Manager is to confirm all operators and ground personnel are trained on the hand signals that will be used to communicate between operators and ground personnel.
- Ground Personnel working around heavy equipment operations are to maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.
- All heavy equipment whose backup view can be obstructed shall be equipped with reverse warning devices (e.g., backup alarms) that can be significantly heard over equipment and other background noise. Reverse signaling lights shall be in working order.
- When feasible, two-way radios shall be used to verify the location of nearby ground personnel.
- When an operator cannot adequately survey the working or traveling zone, a signal person shall use a standard set of hand signals to provide directions. Flags or other high visibility devices may be used to highlight these signals.

4.3 Ground Personnel

4.3.1 Ground clearance around heavy equipment may significantly reduce hazards posed during heavy equipment operations.

4.3.2 The following points outline the clearance requirements during heavy equipment operations:

- Ground Personnel shall always yield to heavy equipment.
- Ground Personnel shall maintain a suitable “buffer” area of clearance from all active heavy equipment.
- A task hazard assessment that identifies any special precautions shall be completed and communicated to all AECOM personnel associated with or affected by the activity.
- Site Supervisors/ Managers shall designate areas of heavy equipment operation and confirm that all ground personnel are aware of designated areas.
    - Designated areas shall include work zone boundaries and travel routes for heavy equipment.
    - Travel routes shall be set up to reduce crossing of heavy equipment paths and to keep heavy equipment away from ground personnel.
    - Work zone boundaries shall consider line of fire hazards related to the equipment and associated activities. Refer also to *S3AM-309-ATT2 Operator Line of Sight.*
    - If working near heavy equipment, Ground Personnel shall stay clear of loads to be lifted or suspended loads, and out of the travel and swing areas (excavators, all-terrain forklifts, hoists, etc.) of all heavy equipment.
    - During winch use, all swampers or other personnel will remain outside the “whip area” of the winch line or tow cable.

- At a minimum, employees shall maintain a distance of at least two pile lengths from where piles are being cut and dropped, other than in situations where cut piles are being guided to the ground utilizing mechanical means (e.g., pile driver and shackle) to control the direction and speed of fall of the cut pile.

- When feasible, Site Supervisors/ Managers shall set up physical barriers (e.g., caution tape, orange cones, concrete jersey barriers) around designated areas and confirm that unauthorized ground personnel do not enter such areas.
- Operators shall stop work whenever unauthorized personnel or equipment enter the designated area and only resume when the area has been cleared.
- Operators shall only move equipment when aware of the location of all workers and when the travel path is clear.
- Ground Personnel shall never stand between two pieces of operating heavy equipment or other objects (e.g., steel support beams, trees, buildings, etc.).
- Ground Personnel shall never stand directly below heavy equipment located on higher ground unless it can be verified ground stability is not a factor and grade of slope is such that it would not contribute to equipment tip-over.
- Ground Personnel may only enter the swing area, work area or path of travel of any operating equipment when:
  - They have attracted the operator's attention and established eye contact, and
  - The operator has idled the equipment down, placed it in neutral, grounded engaging tools, set brakes and communicated entry is permitted.
- Employees shall keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment.
- Employees shall not talk, text, or otherwise use a cell phone while standing or walking on a roadway or other heavy equipment path.

4.3.3 At a minimum, all Ground Personnel and Operators outside of heavy equipment shall wear the following:

- High visibility safety vest (fluorescent background material and retro-reflective striping) meeting jurisdictional requirements that is visible from all angles.
  - Background material: should be fluorescent yellow-green, fluorescent orange-red or fluorescent red.
  - Combined-performance retro-reflective material (e.g. the stripes): should be fluorescent yellow-green, fluorescent orange-red or fluorescent red - and shall be in contrast (that is, have a distinct color difference) to the background material.
  - Hazards may require high visibility garments that cover torso, legs and arms.
  - Confirm that vest is not faded or covered with outer garments, dirt, etc.
- American National Standards Institute/Canadian Standards Association- (ANSI/CSA-) approved hard hat
- ANSI/CSA-approved safety glasses with side shields
- At a minimum, CSA or ASTM approved, high-cut (min. 6"), puncture, impact and compression resistant footwear.
- ANSI/CSA-approved hearing protection as needed
- Appropriate work clothes (e.g., full-length jeans/trousers and a sleeved shirt; no tank, crew tops or other loose clothing permitted).

4.4 Prior to work commencing

4.4.1 All heavy equipment will be inspected pre-shift and then regularly as required with the details of the inspection recorded in a log book.

- Roll-over protection systems (ROPS) and appropriate overhead protection (Fall Object Protection FOP) shall be in place given the specific equipment requirements. Utilize equipment with enclosed cabs where feasible or accessible.
    - Where use of equipment with enclosed cabs is not feasible or said equipment is not accessible, operators shall use any additional personal protective equipment determined as necessary (e.g. goggles, additional hearing protection, etc.).
- Equipment operated in hazardous atmosphere environments shall be equipped with the proper safety equipment (e.g., spark arrestors, positive air shut off, etc.).
- Operation of equipment that has or had cab glass (per the manufacturer's specifications) that is cracked/broken (obstructing the operator's view) or missing is prohibited.
- A locking device shall be provided that will prevent the accidental separation of towed and towing vehicles on every fifth-wheel mechanism and two-bar arrangement.
- Trip handles for tailgates of dump trucks and heavy equipment shall be arranged so that when dumping, the operator will be in the clear.
- The Operator will report defects and conditions affecting the safe operation of the equipment to the Site Supervisor or employer. Any repair or adjustment necessary for the safe operation of the equipment will be made before the equipment is used.
- Exposed moving parts on heavy equipment (belts, gears, shafts, pulleys, sprockets, spindles, drums, fan belts, flywheels, chains, or other reciprocating, rotating or moving parts) which are a hazard to the operator or to other workers will be guarded.
    - If a part will be exposed for proper function it will be guarded as much as is practicable consistent with the intended function of the component.

4.4.2 An approved 4A40BC fire extinguisher shall be present on all heavy equipment. An approved 4A40BC fire extinguisher of appropriate rating shall be present and readily accessible on all heavy equipment.

- Fire extinguishers shall be inspected by the operator prior to heavy equipment operation each shift. Monthly and annual inspections shall be documented.

4.4.3 All Operators shall inspect the area adjacent to the machine prior to starting.

- Evaluate ground conditions, concurrent operations and obstructions to identify approved routes of travel and work areas.
- As applicable, check that there is sufficient swing room and that the outriggers are adequately supported on solid and stable ground

4.4.4 Managers / Supervisors shall inform the operators of the equipment that AECOM employees are in the area and inquire if there are any restricted areas or specific rules or requirements. In some industrial facilities, heavy equipment has the 'right of way'.

4.4.5 Where the Operator will not have a full view of the path of travel, a signal person will be used on the ground that has a full view of the load, the operator, and the path.

4.4.6 All heavy equipment with limited visibility (operator cannot directly or by mirror or other effective device see immediately behind the machine) operated around workers or on a construction site:

- Shall have an audible back-up alarm installed that functions automatically when the vehicle or equipment is put into rear motion.

- All bi-directional equipment shall be equipped with a horn, distinguishable from the surrounding noise level, which shall be operated as needed when the machine is moving in either direction.
- Backing up or movement in both directions for bidirectional equipment shall occur only when a signal person communicates that it is safe to do so if alarms or horns are not feasible.

4.5 Operation

4.5.1 The Operator of heavy equipment is the only worker permitted to ride the equipment unless the equipment is equipped by the manufacturer for passengers. Manufacturer operator's manual shall be complied with.

4.5.2 A person will not operate heavy equipment unless the person has received adequate instruction and training in the safe use of the equipment, and has demonstrated to a qualified supervisor or instructor competency in operating the equipment.

- Oilers, apprentices, and other operators will not be allowed to operate equipment unless authorized by the Manager.

4.5.3 The Operator of heavy equipment will operate the equipment safely, maintain full control of the equipment, and comply with the manufacturer's operator manual and the laws governing the operation of the equipment.

- Operation of company-owned, leased, or rented vehicles or equipment while under the influence of alcohol or illegal drugs or otherwise impaired is prohibited.
- Do not operate any equipment beyond its safe load or operational limits.
- Operator shall not talk on, text, or otherwise use mobile phones while operating heavy equipment.
- Never use bucket teeth or boom for lifting or moving heavy objects.

4.5.4 When heavy equipment is used for lifting or hoisting or similar operations there shall be a permanently affixed notation stating the safe working load capacity of the equipment and the notation shall be kept legible and clearly visible to the operator.

4.5.5 A Supervisor or Manager will not knowingly operate or permit a worker to operate heavy equipment which is, or could create, an undue hazard to the health or safety of any person. Where compliance is refused, the Manager or his or her designate should be notified immediately.

4.5.6 The Operator of heavy equipment will not leave the controls unattended unless the equipment has been secured against inadvertent movement.

- The Operator is not to leave suspended load, machine or part or extension unattended, unless it has been immobilized and secured against inadvertent movement.
- Turn off heavy equipment, place gear in neutral and set parking brake prior to leaving vehicle unattended.
- Buckets and blades are to be placed on the ground and with hydraulic gears in neutral when not in use.
- Brakes shall be set and, as necessary, wheels chocked or equivalent (as applicable) when not in use.

4.5.7 The Operator will maintain the cab, floor and deck of heavy equipment free of material, tools or other objects which could create a tripping hazard, interfere with the operation of controls, or be a hazard to the operator or other occupants in the event of an accident.

4.5.8 If heavy equipment has seat belts required by law or manufacturer's specifications, the Operator and passengers will use the belts whenever the equipment is in motion, or engaged in an operation which could cause the equipment to become unstable.

- Seat belts shall be maintained in functional condition, and replaced when necessary to ensure proper performance.

4.5.9 All vehicles transporting material or equipment on public roads shall comply with local laws pertaining to weight, height, length, and width. Obtain any permits required for these loads.

4.5.10 Never jump on to or off of a piece of heavy equipment, always maintain 3-points of contact at a minimum.

4.5.11 Never exit heavy equipment while it is in motion.

4.5.12 Do not ride with arms or legs outside of the truck body of equipment cab.

- Never ride on the outside of a piece of heavy equipment (e.g. in a standing position on the body, on running boards, or seated on side fenders, cabs, cab shields, rear of truck bed, on the load, bucket, etc.).

4.5.13 Have vehicle headlights on at all times when driving in the area.

4.5.14 Park motor vehicles off the haul roads, or away from the work areas.

4.5.15 Do not wear loose clothing or jewelry where there is a danger of entanglement in rotating equipment.

4.5.16 Do not enter the swing area of machines such as cranes, heavy drill rigs, or excavators, without first making eye contact with the operator, and receiving permission to do so. Refer to *S3AM-309-ATT2 Operator Line of Sight.*

4.5.17 Stay out of the blind areas around heavy equipment and never assume that the equipment operators have seen you or are aware of your presence.

4.5.18 Maintain a distance of at least 2 feet (60 centimeters) between the counterweight of swing machines and the nearest obstacle. If this distance cannot be maintained, a spotter shall observe and be in constant communication with the operator to prevent contact.

4.5.19 Vibrations from moving traffic or heavy equipment can cause excavations or spoil piles to become unstable.

- Excavation activity shall be conducted according to *SOP S3AM-303-PR1 Excavation*.
- Equipment not involved in the excavating activity or not required to be in the vicinity shall keep clear. Equipment that shall operate in the vicinity shall maintain appropriate setback distances from edges of excavations or spoil piles.

4.5.20 All heavy equipment shall be operated in a safe manner that will not endanger persons or property.

- When ascending or descending grades in excess of 5 percent, loaded equipment shall be driven with the load upgrade.
- When operating an electric-powered, remote controlled, hydraulic device used for demolishing concrete structures and refractory linings as well as excavating, refer to the *S3AM-309-ATT1 Brokk 180* for more specifics.

4.5.21 All heavy equipment shall be operated at safe speeds. Do not drive any vehicle at a speed greater than is reasonable and safe for weather conditions, traffic, intersections, width, and character of the roadway, type of motor vehicles, and any other existing condition.

4.5.22 Always move heavy equipment up and down the face of a slope. Never move equipment across the face of a slope.

4.5.23 Slow down and stay as far away as possible while operating near steep slopes, shoulders, ditches, cuts, or excavations.

4.5.24 When feasible, Operators shall travel with the “load trailing”, if the load obstructs the forward view of the operator.

4.5.25 Slow down and sound horn when approaching a blind curve or intersection. Signal people equipped with 2-way radio communications may be required to adequately control traffic.

4.5.26 All haulage equipment / trucks, whose payload is loaded by means of cranes, power shovels, loaders, or similar equipment, shall have a cable shield and/or canopy adequate to protect the operator from shifting or falling material. If protection is not available for the operator, the operator shall leave the vehicle and wait in a designated safe location until it is loaded..

4.5.27 Equipment shall be shut down prior to and during fueling.

- Confirm proper grounding/ bonding between equipment and fuel vehicle prior to fueling operations.
- During fuel operations confirm fuel nozzle remains in contact with the tank.
- Do not smoke, use electrical devices or have an open flame present while fueling.
- Fuel shall not be carried in or on heavy equipment, except in permanent fuel tanks or approved safety cans.

4.5.28 Site vehicles will be parked in a designated parking location away from heavy equipment.

4.5.29 Operators shall never push/pull “stuck” or “broken-down” equipment unless a spotter determines that the area is cleared of all personnel around and underneath the equipment.

4.5.30 If designated for work in contaminated areas/zones, equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.

4.5.31 Equipment left unattended at night adjacent to travelled roadways shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of that equipment, and shall not be closer than 6 feet (1.8m) (or the regulatory requirement for the work location) to the active roadway.

4.5.32 Rubber / pneumatic-tired earthmoving haulage equipment shall be equipped with fenders on all wheels. Mud flaps may be used in lieu of fenders whenever motor vehicle equipment is not designed for fenders.

4.5.33 Lift trucks shall have the rated capacity clearly posted on the vehicle, and the ratings are not to be exceeded.

4.5.34 Steering or spinner knobs shall not be attached to steering wheels.

4.5.35 High-lift rider industrial trucks shall be equipped with overhead guards.

4.5.36 All hot surfaces of equipment, including exhaust pipes or other lines, that present a possible injury or fire hazard, shall be guarded or insulated.

4.5.37 All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.

4.5.38 Platforms, foot walks, steps, handholds, guardrails, and toeboards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.

4.5.39 Substantial overhead protection shall be provided for the operators of fork lifts and similar equipment.

4.5.40 In an effort to reduce air emissions, fuel costs, and run-time hours (that can impact equipment warranty), operators shall limit heavy equipment engine idling to not more than five consecutive minutes. Local regulations at the location of the vehicle operation could require less than five consecutive minutes idling time. The idling limit does not apply to:

- Idling when queuing.
- Idling to verify that the vehicle is in safe operating condition.

- Idling for testing, servicing, repairing or diagnostic purposes.
- Idling necessary to accomplish work for which the vehicle was designed (cranes, man-lifts, forklifts, etc.)
- Idling required to bring equipment/vehicle to operating temperature, as specified by the manufacturer. Engine heaters shall be used for cold weather starting to avoid engine idling where feasible.
- Idling necessary to ensure safe operation of the vehicle.
- Idling to keep equipment (including windows) clear of ice and snow.
- Idling to provide air conditioning or heat to ensure the health and safety of the operator, but only when seated inside the equipment or vehicle.

4.6 Utilities

4.6.1 When contacted by heavy equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc. Refer to the *S3AM-322-PR1 Overhead Lines* procedure for more specifics.

4.6.2 The following outline the requirements while performing heavy equipment operations that may lead to contact with aboveground or underground utilities:

- Always be aware of surrounding utilities.
- Confirm all equipment (e.g., dump trailers, loaders, excavators, etc.) is lowered prior to moving underneath aboveground utilities.
- Confirm utilities are cleared and identified prior to beginning any earthmoving operation. Contact the local utility service providers for clearance prior to performing work. Confirm documentation of the contact is made; date, number; contact name, organization, etc. Refer to *SOP S3AM-303-PR1 Excavation* and *S3AM-331-PR1 Underground Utilities & Subsurface Installation Clearance.*

4.7 Training

4.7.1 The Operator or other qualified supervisor will provide all on-site personnel with an orientation to the heavy equipment and its associated hazards and controls.

4.7.2 Only designated, qualified personnel shall operate heavy equipment.

4.7.3 Operators shall have all appropriate jurisdictional licenses or training to operate a designated piece of heavy equipment.

4.7.4 Operators shall be evaluated through documented experience and routine monitoring of activities unless the equipment is operated by an AECOM operator in which case a practical evaluation is required. Operators shall be knowledgeable and competent in the operation of a designated piece of heavy equipment.

4.8 Inspection and Maintenance

4.8.1 Maintenance records for any service, repair or modification which affects the safe performance of the equipment will be maintained and be reasonably available to the operator and maintenance personnel regulatory agencies upon request during work hours.

4.8.2 Maintenance records will be maintained on the site or project for heavy equipment.

4.8.3 Conduct maintenance as prescribed by the manufacturer in the Operation Manual for each piece of equipment.

4.8.4 Servicing, maintenance and repair of heavy equipment will not be done when the equipment is operating.

- Lockout and tagout safety procedures are followed. Refer to *S3AM-325-PR1 Lockout Tagout*.

- Motors are turned off, unless required for performing maintenance or repair.
- All ground-engaging tools are grounded or securely blocked.
- Controls are set in a neutral position and brakes are set.
- Electrically driven equipment is installed with provision for tagging and locking out the controls while under repair.
- Manufacturer's requirements for maintenance and repair are followed.
- If continued operation is essential to the process, a safe means of protection shall be provided.
- Provide and use a safety tire rack, cage, or equivalent protection when inflating, mounting, or dismounting tires installed on split rims, or rims equipped with locking rings or similar devices.

4.8.5 All heavy equipment shall have a documented inspection and if necessary, repaired prior to use.

- Operators shall not operate heavy equipment that has not been cleared for use.
- All machinery and mechanized equipment will be verified to be in safe operating condition (refer to *S3AM-309-FM1 Approval of Machinery & Mechanized Equipment*) by a competent person (refer to *S3AM-202-PR1 Competent Person Designation*) within seven days prior to operation on a new site or project. Clearance is valid for up to one year for the given site or project.
- As applicable, all machinery and mechanized equipment shall be inspected / certified and tested at appropriate intervals as required by the manufacturer and/or regulatory requirements.

4.8.6 All heavy equipment shall be inspected at a minimum to the manufacturer's recommendations prior to each work shift. All defects shall be reported to the Supervisor/ Manager immediately.

- Defective heavy equipment shall be immediately tagged and taken out of service until repaired.
- Inspection, maintenance, service and repair records shall be maintained at the site. If a manufacturer's or company-specific inspection checklist is not provided, use *S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist*.
- Records shall be made available for review upon request. Note: Documents may be electronically stored in the project files.

4.9 Fueling and batteries

4.9.1 A well-ventilated area shall be used for refueling.

4.9.2 Only the type and quality of fuel recommended by the engine manufacturer shall be used.

4.9.3 Fuel tanks shall not be filled while the engine is running. All electrical switches shall be turned off.

4.9.4 If there is potential to spill fuel on hot surfaces, the surfaces shall be permitted to cool down prior to fueling. Any spillage shall be cleaned before starting engine.

4.9.5 Spilled fuel shall be cleaned with cotton rags or cloths and disposed of in the proper receptacle; do not use wool or metallic cloth.

4.9.6 Open flames, lighted smoking materials, sparking equipment or any other type of ignition source shall remain a minimum of 35' (10.7m) from the fueling area and/or fuel source. This clearance shall be increased if required or conditions warrant.

4.9.7 Heaters in carrier cabs shall be turned off when refueling the carrier or the drill rig.

4.9.8 Portable containers to be filled shall be placed directly on the ground or be properly grounded prior to filling to prevent creation of a static charge. Portable fuel containers shall not be filled completely to allow expansion of the fuel during temperature changes.

4.9.9 Control electrostatic hazards.

- Before activating fuel pump, touch some part of vehicle / equipment to de-energize any static electricity that may be present.
- The fuel nozzle shall be kept in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Fuel containers and transfer hoses shall be kept in contact with a metal surface during travel to prevent build-up of a static charge.

4.9.10 Portable fuel containers shall not travel in the vehicle or carrier cab with personnel.

4.9.11 Batteries shall be serviced in a ventilated area while wearing appropriate Personal Protective Equipment.

4.9.12 When a battery is removed from a vehicle or service unit, the battery shall be disconnected ground post first. Consult the SDS applicable to the battery and/or contents for additional information including; handling, precautions, and first aid measures.

- Spilled battery acid shall be immediately flushed off the skin with a continuous supply of water. Battery storage or maintenance areas shall have readily accessible eye wash stations.
- Should battery acid get into the eyes, the eyes shall be flushed immediately with copious amounts of water and medical attention shall be sought immediately.

4.9.13 When installing a battery, the battery shall be connected ground post last.

4.9.14 When charging a battery, cell caps shall be loosened prior to charging to permit gas to escape.

4.9.15 When charging a battery, the power source shall be turned off to the battery before either connecting or disconnecting charger loads to the battery posts.

4.9.16 To avoid battery explosions, the cells shall be filled with electrolytes. A flashlight (not an open flame) shall be used to check water electrolyte levels. Avoid creating sparks around batteries by shorting across a battery terminal. Lighted smoking materials and flames shall be kept at least a minimum of 35 feet (10.7 meters) away from battery-charging stations.

5.0 Records

5.1 Inspection, maintenance, service and repair records shall be maintained with the equipment.

6.0 Attachments

6.1 S3AM-309-ATT1 Brokk180 Safety Card

6.2 S3AM-309-ATT2 Operator Line of Sight

6.3 S3AM-309-FM1 Approval of Machinery & Mechanized Equipment

6.4 S3AM-309-FM2 Heavy Machinery Pre-Operation Checklist

6.5 S3AM-309-FM3 Rubber Tire Backhoe Operator Skill Evaluation

6.6 S3AM-309-FM4 Scraper Operator Skill Evaluation

6.7 S3AM-309-FM5 Bull Dozer Operator Skill Evaluation

6.8 S3AM-309-FM6 Dump Truck Operator Skill Evaluation

6.9 S3AM-309-FM7 Roller Compactor Operator Skill Evaluation

6.10 S3AM-309-FM8 Front End Loader Operator Skill Evaluation

6.11 S3AM-309-FM9 Grader Operator Skill Evaluation

6.12 S3AM-309-FM 10 Excavator Operator Skill Evaluation

6.13 S3AM-309-FM11 Water Truck Operator Skill Evaluation

6.14 S3AM-309-FM12 Heavy Equipment Maintenance Inventory

6.15 S3AM-309-FM13 Heavy Equipment Inspection Report

Overhead Lines & Obstructions

1.0 Purpose and Scope

1.1 Provides the safe work requirements to be observed where overhead obstructions (e.g., cable trays, pipe racks, etc.), overhead utilities, or other lines are present at a work location, including, but not limited to electric power lines, electrical apparatus, or any energized (exposed or insulted) parts, communication wires, or any other overhead wire or cable.

1.2 This procedure applies to all AECOM Americas**-**based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

2.0 Terms and Definitions

2.1 **Arc Flash Hazard** – A dangerous condition associated with the possible release of energy caused by and electric arc. Arc flash is the light and heat produced from an electric arc supplied with sufficient electrical energy to cause substantial damage, harm, fire, or injury.

2.2 **Electrical Hazard** – A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

2.3 **Minimum Approach Distance (MAD)** – The MAD is the closest distance any employee or any part of the operating equipment is permitted to approach an energized or a grounded object.

2.4 **Qualified Person (Electrical Transmission and Distribution) –** A person trained and knowledgeable in the construction and operation of electrical transmission and distribution equipment or a specific work method, and has been trained to recognize and avoid electrical hazards that might be present with respect to that equipment or work method.

2.5 **Types of Overhead Lines / Obstructions (examples)**:

- Overhead electric power lines
- Structural cable supports
- Guy wires
- Cable television / communication lines
- Cable Trays
- Pipe Racks
- Low Clearance Overpasses

3.0 References

3.1 S3AM-004 PR1 Incident Reporting, Notifications & Investigation

3.2 S3AM-010-PR1 Emergency Response Planning

3.3 S3AM-209-PR1 Risk Assessment & Management

3.4 S3AM-302-PR1 Electrical Safety

3.5 S3AM-303-PR1 Excavation

4.0 Procedure

4.1 Roles & Responsibilities

4.1.1 **Manager**

- Identify conditions where overhead electric power lines and other overhead obstructions may be present and outline what is required in the SH&E Plan and Task Hazard Assessments. Refer to the *S3AM-209-PR1 Risk Assessment & Management*.
- Confirm electrical and communication lines, and as appropriate other overhead obstructions, are identified on all site and project drawings.
- Coordinate and communicate with overhead electrical line owner or operator to identify and implement appropriate control measures.
    - Provide adequate advance notification to the Overhead Electrical Line Owner / Operator to allow for insulation or isolation and grounding of the line(s) if required.
    - Confirm the Overhead Electrical Line Owner / Operator(s) are fully informed as to when the operations are to begin, end and when any location changes are planned if applicable.
- Confirm Employees are trained as required for the scope of work and associated hazards.
- Coordinate and communicate with subcontractors or employees working around overhead electric power lines and as applicable, other overhead obstructions.
- Confirm the *S3AM-322-FM1 Overhead Electric power lines Acknowledgement* is completed by concurrent operations working around overhead electric power lines on the worksite.

4.1.2 **Safety Health & Environment (SH&E) Manager**

- Assist and support the Manager in planning and responding to concerns regarding the exposure to overhead electric power lines.

4.1.3 **Employees**

- Maintain current training required for the scope of work and associated hazards.
- Inform the Manager of location conditions that may expose risks to overhead electric power lines.
- Comply with established minimum approach distances.

4.2 Training

4.2.1 The Manager shall confirm all Employees are oriented to the SH&E Plan and Task Hazard Assessment (THA) process, in accordance with *S3AM-209-PR1 Risk Assessment & Management*.

4.2.2 Confirm training requirements were met prior to work starting.

-
- Employee orientation shall include the Location Specific Emergency Response Plan.
- Proof of training and orientation shall be documented and retained in the project files.

4.2.3 Managers shall confirm that each Employee has received training required for the scope of work and associated hazards in accordance with *S3AM-003-PR1 SH&E Training*.

4.2.4 Additional training requirements may include, but are not limited to:

- The limitations of an insulating link / device, proximity alarm, and range control (and similar) device, if used.

- Grounding and bonding procedures.
- Client specific requirements

4.3 General Requirements

4.3.1 The AECOM Manager or supervisor and employees shall perform a walk-thru of the work site and / or review of the work area / travel route to identify the overhead electric power lines and any other overhead obstructions that could be impacted by the work. Consider high profile equipment, equipment in transport, swing radius of equipment, potential for shifting loads, etc. AECOM personnel may be accompanied by other applicable personnel (e.g. client representatives, contractors operating concurrently, etc.).

4.3.2 The location or project specific SH&E Plan shall identify all overhead line hazards and provide suitable methods of elimination or control. All involved or affected workers shall review the SH&E Plan to confirm proper communication of the overhead line hazards and awareness of the control measures associated with their work.

4.3.3 Assess applicable factors such as, but not limited to:

- Scope of work (e.g. hoisting materials, excavation, grubbing, etc.).
- Transportation route.
- Hoisting, excavating, or other equipment to be operated.
- Height, placement, and reach of equipment.
- Equipment or material loading / unloading.
- Location(s) of electric power lines, communication lines, guy wires, etc.
- Worker training and experience.
- Soil or ground condition and environmental conditions.
- Interruptions to electrical services.
- Hazard to public.
- Use of ladders.
- Pipe and other conducting materials.
- Notification of electric utility owner.
- Changing conditions.
- Communication of all hazards to all workers including contractors, sub-contractors, and concurrent operations.

4.3.4 Task Hazards Assessments (THAs) shall be completed to record the hazards and control measures specific to the task, including those related to overhead line and obstructions hazards, prior to undertaking assigned tasks. THAs shall be reviewed and signed by all workers involved in the specific task.

4.3.5 Should adverse weather conditions cause the work associated with overhead lines to be unsafe, the activities shall be discontinued.

4.3.6 Managers or designated employees shall formally notify all concurrent operations, or any others who may not have had reason to review and sign the related SH&E Plan or THAs, of work that is to be done in the vicinity of overhead lines at distances less than 50 feet (15.25 meters), and for non-electrical obstructions, at distances less than 10 feet (3.05 meters) if appropriate to the obstruction’s potential hazards, and obtain the operator's assistance in protecting workers involved.

- Formal notification may be accomplished through a review of the SH&E Plan or THAs by the concurrent operator and associated personnel, as evidenced by signing the respective document's acknowledgement.
- Alternately, the concurrent operations may acknowledge having reviewed AECOM's procedures with a separate acknowledgment form. *S3AM-322-FM1 Overhead Electric Power Lines Acknowledgement Form* or equivalent may be used.
- Prior to equipment operation within 10 feet (3.05 meters) of non-electrical obstructions, as appropriate to potential hazards associated with the obstruction, the Owner/Operator should be contacted to obtain specific details regarding the obstruction such as piping or tray contents,

4.3.7 Overhead lines are presumed to be energized unless the Overhead Electrical Line Owner / Operator confirms that the overhead line has been, and continues to be de-energized and visibly grounded at the worksite.

4.3.8 Overhead lines are presumed to be uninsulated unless the Overhead Electrical Line Owner / Operator or a registered Professional Engineer who is a Qualified Person with respect to electrical power transmission and distribution confirms that a line is insulated.

4.3.9 Confirm accurate measurement of load heights, maximum equipment radius and height or reach of any other equipment that could potentially encroach on the safe limit of approach for the overhead electrical line,guy wires, or other applicable overhead obstructions.

- The height of all applicable overhead lines and obstructions that pose contact or encroachment potential shall be determined prior to work commencing.
- The height of electric power lines may only be determined by the client, utility company professional, or by using an approved electronic measuring device.
- Awareness shall be maintained for any elements that could affect clearance (e.g. snow pack, ice or snow weighing down lines, excessive heat causing sag, etc.).
- Caution shall be exercised when working or travelling near overhead lines having long spans, since they tend to be more prone to lateral swing in response to the wind and can present a contact hazard.
- All low hanging communication lines in close proximity to energized lines shall be clearly identified as *Encroaching on Energized Lines**.***

4.3.10 Managers shall contact the overhead owner/operator (i.e. local utility company) if work is to be done or before equipment is operated within 50 feet (15.25 meters) of an energized overhead line, to determine the voltage of the overhead line and establish the appropriate MAD.

- All inquiries regarding electric utilities shall be made in writing and a written confirmation of the outage / isolation shall be received by the appropriate AECOM Manager prior to the start of the task that may impact the utility.

4.3.11 Until the voltage of the overhead electrical line is known and the MAD established, an exclusion zone shall be created at ground level beneath and 50 feet (15 meters) perpendicular to the overhead electric power lines on each side.

- The exclusion zone shall be demarcated with visual indicators (e.g., signage, flagging, paint, cones). No equipment shall enter the exclusion zone without approval from AECOM management.
- Unqualified employees shall maintain a safe clearance distance in accordance with the established MAD when working in an elevated position near energized overhead lines. For additional information associated with Qualified Employees refer to *S3AM-302-PR1 Electrical Safety*.

4.3.12 The Minimum Approach Distance (MAD) as it relates to Voltage varies from jurisdiction to jurisdiction. The MAD or the regulatory minimum distance requirements, whichever is more stringent, shall be maintained. The below chart shows the Phase-to-Phase voltage rating voltages in kilovolts and the MADs applicable to all AECOM operations:

Minimum Approach Distances (MAD)

Voltage Range (Kilovolts) (Phase-to-Phase)	Minimum Approach Distance (MAD) in Feet (Meters)
Personnel shall allow for equipment movement and electrical line swaying when establishing a M.A.D.	
0 – 50 KV	10 (3)
Over 50 – 200 KV	15 (5)
Over 200 – 350 KV	20 (6)
Over 350 – 500 KV	25 (8)
Over 500 – 750 KV	35 (11)
Over 750 – 1,000 KV	45 (14)
Note: This requirement shall apply except where client, local, or governmental regulations are more stringent.	

Source: American National Standards Institute, Publication B30.5.

4.3.13 An appropriate distance shall be kept between equipment, its occupants, their tools and energized overhead lines, electrical apparatus, or any energized parts.

4.3.14 These minimum approach distances do not apply to a load, equipment, or building that is transported under energized overhead power lines if the total height, including equipment transporting it, is less than 13.5 feet (4.15 meters).

- If the travelling equipment, including load, is over 4.15m (13.62ft) a transportation permit shall be acquired from the appropriate jurisdiction to travel on any public road or highway.
    - Consult local jurisdiction as some US states may use heights of up to 4.45m (14.6ft).
    - Notification of appropriate utility companies may be required in conjunction with the transportation permit. Jurisdictional requirements shall be verified prior to transport.
    - Route shall be checked for clearance of overhead electrical and communication lines prior to transport.
    - A designated signaler will be utilized when the height of the equipment, buildings, tractor / trailers or any other transport equipment travelling under an overhead electrical line is greater than 4.15m (13.62ft).

4.3.15 Employees shall not place earth or other material under or beside an electrical overhead line if doing so reduces the safe clearance to less than 50 feet (15.25 meters) or, if appropriate to potential hazards associated with other types of overhead obstruction, less than 10 feet (3.05 meters). To maintain a safe distance:

- Install warning devices and signs (hang a sign from and mark all guy wires to warn traffic of low clearance; provide warning signage for all overhead services).
- Install telescopic, nonconductive posts and flagging across right-of-way at the minimum allowable clearance as allowed by regulations for the line voltage.
- Position signs or other devices to determine the “Danger Zone”.

- Inform all job site personnel of the danger zone and the safe distances required.
- Beware of atmospheric conditions, such as temperature, humidity, and wind that may dictate more stringent safety procedures.

4.3.16 If employees are to climb or perform work on poles or towers, the structures shall be confirmed as capable of withstanding the weight and activity without failure.

4.3.17 If holes are dug for poles or foundations for structures, appropriate measures shall be taken to prevent inadvertent entry by personnel or equipment. Refer to *S3AM-303-PR1 Excavation*.

4.3.18 Operation of heavy equipment and cranes in areas with overhead lines represents a significant arc flash and electrical hazard to all personnel on the job site.

- Accidental contact with an energized overhead line or arcing between a high power line and grounded equipment, can cause harm to nearby equipment operators or ground personnel and damage to power transmission systems and / or operating equipment.
- Equipment will be repositioned and blocked so that no part, including cables, can come within the established minimum clearances.

4.3.19 Gravel trucks, cranes, boom trucks, etc. shall retract, stow and lower boxes, outriggers, booms, etc. to the travel position prior to entering municipal and client owned roads (e.g. leaving plant sites, work over rig sites, battery sites, and storage yards) and any time travel may put the equipment within the MAD of an electrical line.

4.3.20 When a signal person is required, the individual shall wear reflective striping (coveralls or vest) and carry an air horn or other appropriate means of emergency communication.

4.3.21 The signal person shall be aware of the potential electrical line hazards, be verified as competent by their supervisor and not have any other duties while acting as the signal person.

4.3.22 The signal person shall remain outside the MAD and in a position that allows for monitoring of equipment or loads to prevent encroachment on the MAD.

4.3.23 Signs, pylons, high visibility tape and / or signalers shall not be removed until the last piece of AECOM equipment has traveled under the overhead electrical line.

4.4 Minimum Approach Distance (MAD) Reduction

4.4.1 Where any work task will not allow the MAD to be maintained, an alternate means of protection shall be implemented by the Manager and approved by the SH&E Manager. In order of preference, acceptable procedures are:

- De-energize the overhead line(s) / lockout by local utility authorities; or
- Implement alternative procedures as identified by the Overhead Electrical Line Owner / Operator or a registered professional engineer.

4.4.2 De-energize Overhead Lines

- Elimination of electrical power provides the most acceptable means of ensuring safety of personnel. While temporary site overhead lines are often under the control of the site manager (and can be de-energized locally), electrical distribution and transmission lines can be de-energized only by the Overhead Electrical Line Owner / Operator. De-energizing of an overhead line often requires advance coordination with the Overhead Electrical Line Owner / Operator. At least one week advance notice should be provided.
- Managers shall confirm with the utility Overhead Electrical Line Owner / Operator that the overhead line has been de-energized and visibly grounded at the job site.

4.4.3 Alternative Procedures

- Managers may implement alternative procedures to prevent arc flash and electrical contact. These procedures shall be identified by the Overhead Electrical Line Owner / Operator or a registered Professional Engineer who is a Qualified Person with respect to electrical power transmission and distribution.
- A planning meeting with the Manager, SH&E Manager and the Overhead Electrical Line Owner / Operator (or registered Professional Engineer) shall be held to determine the most effective alternative procedures.
- Alternative procedures shall meet all client, local and governmental regulatory requirements.
- The work will be conducted by qualified and competent individuals, following the alternative written safe work procedures. All others are restricted from entering the MAD.
- Insulating Barriers shall be rated for the voltage line being guarded. These barriers may not be part of or attached to the equipment. The MAD shall only be reduced within the designed working dimensions of the insulating barrier. This determination shall be made by a Qualified Person in accordance with local or governmental requirements for work practices near energized equipment.
- Consult *S3AM-302-PR1 Electrical Safety* procedures to properly ground equipment and for limitations of grounding.
- Dedicated Line Spotters shall be trained to enable them to effectively perform their task, including training on the applicable local and governmental regulations.
- No work that encroaches on an energized power line will be completed outside of daylight hours.

4.5 Additional Safety Measures.

4.5.1 When equipment shall repeatedly travel beneath electric power lines, a route shall be plainly marked and “rider poles” of non-conductive material shall be erected on each side to confirm equipment structures are lowered into a safe position.

- 20” X 28” (50.8cm X 71.12cm) Danger Overhead Power Lines signs, which are highly visible, shall be erected at a height of 1.8 meters (6ft) on each side of the electrical line. A combination of pylons and high visibility tape shall be placed underneath the electrical line.
- These signs shall be in plain view of equipment traveling in either direction, but no closer than the MAD.
- If physical guards (i.e. goal posts, rider poles) are used, the guards shall be of non-conductive material and consist of a pole on each side of the approach connected by a rope.
- The poles will be placed at the MAD from and on each side of the electrical line. The ropes will be set at a height, which will maintain the MAD from the electrical line.

4.5.2 Watch for uneven ground that may cause vehicles and equipment to weave, bob, or bounce.

4.5.3 The following additional safety measures shall be implemented as needed when working around energized power lines:

- Provide equipment with proximity warning devices. These provide an audible alarm if any part of the equipment gets too close to a line.
- Install ground safety stops. These prevent vehicles from accidentally entering hazardous areas.
- Equip cranes with a boom-cage guard. This prevents the boom from becoming energized if an electrical line is contacted.

- Utilize insulated links and polypropylene tag lines. These prevent the transmission of electricity to loads or tag line handlers if an electrical line is contacted.

  NOTE: These additional safeguards are intended as supplemental protection. Use of these measures is not permissible as a substitute for maintaining the safe working distance or implementation of the procedures outlined in this document.

4.6 Emergency Planning

4.6.1 Managers shall complete a location specific emergency response plan as part of their location or project specific SH&E Plan for all operations during which equipment is operated within 50 feet (15.25 meters) of an energized overhead electrical line or conductor. Refer to *S3AM-010-PR1 Emergency Response Planning*. This plan shall identify the following information:

- The importance to the operator's safety of remaining inside the cab except where there is an imminent danger of fire, explosion, or other emergency that necessitates leaving the cab.
- The safest means of evacuating from equipment that may be energized.
- The potentially energized zone around the equipment.
- The need for crew in the area to avoid approaching or touching the equipment and the load.
- The means to de-energize the electrical line or live conductor.
- The contact information for the utility Overhead Electrical Line Owner / Operator and emergency services.

4.6.2 In the event of an incident, the Employee shall report it in accordance with *S3AM-004 PR1 Incident Reporting, Notifications & Investigation.*

4.6.3 All damaged utilities shall be repaired by a qualified and / or licensed professional.

5.0 Records

5.1 Retain the Overhead Electric power lines Acknowledgement forms and any document related to requests of and confirmation from the Overhead Electrical Line Owner / Operator in the project files. Documentation of employee training completed shall be retained in accordance with *S3AM-003-PR1 SH&E Training*.

6.0 Attachments

6.1 S3AM-322-FM1 Overhead Electric Power Lines Acknowledgement Form

Underground Utilities

1.0 Purpose and Scope

1.1 Provides procedures designed to help prevent injuries to personnel working on the location and pedestrians, property damage, and adverse environmental impact as a result of potential hazards associated with encountering underground utilities, subsurface installations, and potential overhead hazards.

1.2 Provides the minimum requirements to be followed for underground work (e.g., excavations, drilling, boring, and probing work) to ensure that underground installations, and subsurface structures, are identified properly before work commences.

1.3 This procedure applies to all Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document's content.

1.4 The Manager is responsible for meeting all the requirements in this procedure.

1.5 AECOM's clients may have specific procedures which shall be followed to identify and map utility and subsurface structures on their properties or facilities. Provided the client's procedures meet or exceed those of AECOM, approval shall be obtained from the Manager and the SH&E Manager to follow the client's procedures.

2.0 Terms and Definitions

2.1 **Underground Utilities –** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling and communications, etc.

2.2 **Clearance** – includes the following:

- The positive locating of underground utilities or subsurface installations in or near the work area.
- A signed statement by an appropriate representative attesting to the location of underground utilities and/or the positive de-energizing (including lockout) and testing of electrical utilities.

2.3 **Ground Disturbance (GD) –** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

2.4 **Hand Clearance Zone –** The area on either side of the locate marks of a utility that shall be maintained in order to expose the utility through the use of non-destructive ground disturbance techniques acceptable to the owner of the buried utility. Visual exposure is required before mechanical excavation equipment may be used.

2.5 **Intrusive Activities –** Examples: Excavation of soil borings, installations of monitoring wells, installation of soil gas sampling probes, excavation of test pits/trenches or other man-made cuts, cavity, trench or depression in an earth surface formed by earth removal.

2.6 **Non-Destructive Ground Disturbance Technique –** A safe and acceptable excavation method that is used to visually expose an underground utility without causing damage. Non-destructive ground disturbance techniques may include, but are not limited to:

- Hand digging.
- Use of non-conductive tools.
- Hydro-vacuum.

2.7 **Subsurface Installation –** Examples: Subterranean tunnels, underground parking garages and other structures beneath the surface.

2.8 **Utility Strikes –** Unplanned contact with utilities resulting in damage to the utility or its protective coating.

3.0 References

3.1 S3AM-003-PR1 SH&E Training

3.2 S3AM-303-PR1 Excavation

3.3 S3AM-321-PR1 Drilling, Boring & Direct-Push Probing

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Manager**

- Administer this procedure and the development of the SH&E Plan.
- Confirm the appropriate equipment and materials are available to conduct the underground utility and/or subsurface installation clearance.
- Confirm all employees involved and affected by the task review the SH&E Plan and Task Hazard Assessment (THA) prior to work commencing
- Authorize work to proceed using the *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist*.
- Confirm that employees conducting underground utilities and subsurface clearance processes possess all required training, registrations or certifications.
- Provide authorization (with the concurrence of the Site Supervisor and SH&E Manager) for work to resume if interrupted due to unexpected conditions or events.

4.1.2 **Safety, Health & Environment (SH&E) Manager**

- Assist AECOM management as needed by providing guidance and clarification as to issues that may arise.
- Review the SH&E Plan to confirm compliance with jurisdictional regulations. Provide technical guidance as needed when a variance is pursued related to this procedure.

4.1.3 **Employees**

- Maintain training as appropriate to the work to be completed (e.g. ground disturbance, lockout tagout, equipment operation, etc.). Refer to *S3AM-003-PR1 SH&E Training*.
- Review the SH&E Plan and Task Hazard Assessment (THA) prior to work commencing.
- As appropriate to the anticipated or encountered hazards and as addressed in the applicable planning documentation, utilize appropriate personal protective equipment (PPE) and applicable training, practices and operating procedures.
- Immediately notify the Manager of any unanticipated conditions or events. If assigned equipment, perform appropriate inspections and confirmations of maintenance and/or repairs.

4.2 Training

4.2.1 All on-site employees involved with the underground utility and subsurface identification and associated clearance process shall be trained, at a minimum, in these procedures.

4.2.2 Employees shall complete all required training associated with their tasks in accordance with the SH&E Training Matrix and any training assessments developed at the business group.

- Refer to *S3AM-003-PR1 SH&E Training.*
- This training may include, but is not limited to, Excavation / Trenching (Ground Disturbance), HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.

4.2.3 As applicable, employees shall receive client-required training.

4.3 Planning

4.3.1 Health and Safety Plan – At a minimum, a SH&E Plan and task hazard assessments (THAs) shall be prepared prior to any underground utilities and subsurface installations clearance activities.

- The SH&E Plan will address any required environmental monitoring including gas monitoring, dust, noise, metals, radiation or other monitoring as may be appropriate for site conditions.
- Employees shall comply with all SH&E Plan requirements.
- The location specific emergency response plan shall be in place, contain procedures applicable to the potential emergencies presented by the operations, and be reviewed with all personnel potentially affected.

4.3.2 *S3AM-331-ATT2 Underground Utilities & Subsurface Installation Clearance Flow Chart* provides a summary of the key requirements addressed in this procedure.

4.3.3 Underground utilities and subsurface installations shall be investigated as being present, including the following, but not limited to:

- Steam, gas and electric.
- Sewer and water.
- Subterranean tunnels.
- Fibre optics (note: routine geophysical surveys will not identify fibre optic cables).
- Traffic control cables.

4.3.4 Location of underground utilities and subsurface installations will be confirmed by cross-referencing available information:

- Maps, as-built drawings and issued for construction (IFC) drawings.
- Plot plans, permits, crossing/encroachment agreements.
- One-Call information, locator and provided surveys.
- Private utility information, locator and provided surveys (e.g. ground penetrating radar (GPR), electromagnetic, etc.).
- Owner supplied documentation.
- Site walks.

4.3.5 As applicable, emergency shut-off locations of utilities shall be verified before work activities commence.

4.3.6 Jurisdictional, land owner, client and utility owner requirements shall be consulted to determine the minimum search zone dimensions and appropriate clearance distances.

4.3.7 As necessary and if possible, adjust locations of excavations or intrusive subsurface work away from subsurface utilities and installations

4.3.8 Prior to any excavation or intrusive subsurface work, the *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist* shall be completed. The form shall be reviewed and signed by the Manager.

- If the answer to any question in Part 1 of the checklist is “No” or “N/A”, no ground disturbance may take place without review by the Manager, in consultation with SH&E Manager, of the circumstances related to the particular item. The Manager shall initial beside each “No” or “N/A” item to indicate review and authorization.

4.4 Permits, Notifications and Access Agreements

4.4.1 Any required notifications shall be provided within the appropriate timeframe to the applicable organization (e.g. owner, utility company, agency, governing body, etc.).

4.4.2 All applicable permits (e.g. client, government, working near rail road, etc.) will be identified, obtained, and adhered to.

4.4.3 All access agreements will be obtained and adhered to.

4.5 Locating Underground Utilities and Subsurface Installations

4.5.1 Utilize the appropriate call/click-before-you-dig provider. Refer to *S3AM-331-ATT1 One-Call System*.

4.5.2 Federal/State/Provincial/Territorial and other “One Call” providers shall be contacted at least two working days and no more than ten working days prior to commencing the ground disturbance. Jurisdictional requirements shall be consulted to verify the appropriate advance notice. (e.g. 24 hours, two full working days, three to ten business days, etc.).

4.5.3 If the location of proposed excavation or intrusive subsurface work cannot be clearly and adequately identified, the route and/or area of the proposed ground disturbance shall be identified using white flags, paint or stakes prior to the arrival of the locator. Consult jurisdictional requirements as white-lining may be a mandatory requirement on all ground disturbances.

4.5.4 One Call providers shall appropriately identify and mark the subsurface utilities or installations, or otherwise provide written notification they do not have any facilities near the proposed subsurface/intrusive locations.

4.5.5 Confirm all circuits were on during subsurface checks if the checks were for identifying energized lines (e.g. circuits on timers or light sensing switches).

4.5.6 Areas that have a high density of sub-surface facilities may require a secondary locate by another independent locator to verify locations identified by the first locator.

4.6 Private Utility Locating

4.6.1 One Call services may not be available in various non-urban locations. Private utility locating companies shall be utilized to identify and located any underground utilities or subsurface installations.

4.6.2 Be aware urban areas (e.g. city or town) may have subsurface installations (e.g. underground garages) and utilities (e.g. public water, sewer, and gas pipelines) that are not covered by one-call systems.

- These subsurface installations and utilities require additional investigation and diligence beyond the one-call system.
- Additional investigation and diligence beyond the one-call system is also recommended for non-urban areas.

4.6.3 In urban areas, private utility locating companies shall be called to identify and locate, through geophysical surveys and other means, the presence of private utilities installed by the property owner (e.g. irrigation systems) and to verify the presence of public utilities on the properties.

- Hand clearing is required in urban areas.

4.6.4 Hand clearing is also recommended for non-urban areas and may be required by the given jurisdiction.

4.6.5 Warning tape, pea gravel, sand, non-indigenous material, bentonite, red concrete (indicative of electrical duct banks) and any departure from native soil or backfill may be evidence of the presence of subsurface installations and utilities.

4.7 Surface Markings

4.7.1 Once the underground installation has been identified, proper surface markings shall be made in accordance with the guidelines from the One-Call System (refer to S3AM-331-ATT1), guidance contained in this procedure or as contract-specified.

4.7.2 Color-coded surface marks (paints or similar coatings) shall be used to indicate the type, location, and route of buried installations. Additionally, to increase visibility, color-coded vertical markers (temporary stakes or flags) shall supplement surface marks.

4.7.3 All marks and markers shall indicate the name, initials, or logo of the company that owns or operates the installation and the width of the installation if it is greater than 2 inches.

4.7.4 If the surface over the buried installation is to be removed, supplemental offset marking shall be used. Offset markings shall be on a uniform alignment and shall clearly indicate that the actual installation is a specific distance away.

4.7.5 Locate marks shall be re-verified as per jurisdictional requirements or no later than 14 days after the previous locate was completed, whichever interval is shorter. These locate time intervals shall be maintained for the duration of the ground disturbance.

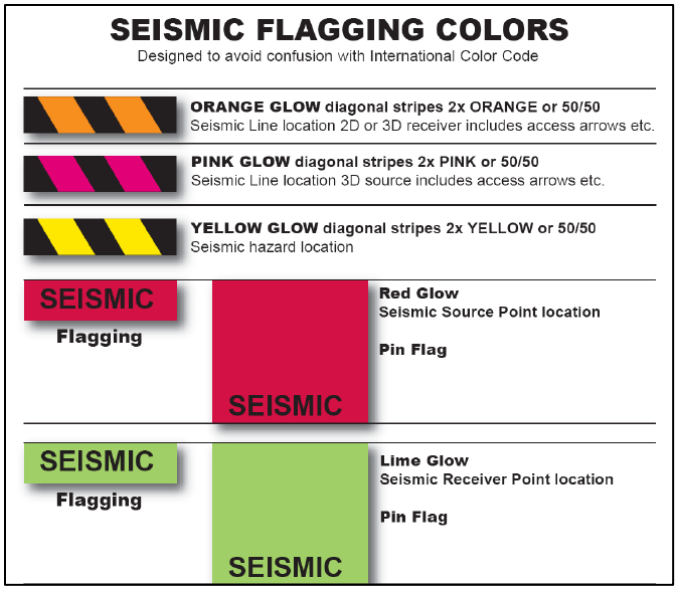
- If the work is interrupted during the determined lifespan or work does not commence during the applicable lifespan, a new locate shall be performed.
- Jurisdictional provisions may allow for an extension to the lifespan of the locate marks, however certain conditions may need to be met. (e.g. activities uninterrupted)
- If locate marks are moved or destroyed the location of the buried facilities shall be re-established.

4.8 Uniform Color Coding

4.8.1 The colors and corresponding installation type are as follows unless otherwise contract-specified:

AMERICAN PUBLIC WORKS ASSOCIATION – APWA
Color Coding for Marking of Buried Facilities

White	Proposed Ground Disturbance Area
Pink	Temporary Survey Markings
Red	Electric Power Lines, Cables, Conduit and Lighting Cables
Yellow	Gas, Oil, Steam, Petroleum Lines or Gaseous Materials
Orange	Conduit, Cable, Communication, Alarm or Signal Lines
Blue	Potable Water
Green	Sewer, Storm Sewer and Drain Lines
Purple	Reclaimed Water, Irrigation and Slurry Lines (non-potable)



4.9 Identification and Mapping of Utility and Subsurface Structures

4.9.1 The locations of subsurface utilities and subsurface installations shall be investigated, documented, and shown on a site plan (a scaled site plan shall be used when feasible). Refer to *S3AM-331-FM1 Underground Utilities & Subsurface Installation Clearance Checklist.*

4.9.2 Documentation of utility and subsurface installation identification (calling one call, responses from utilities) along with the scaled site plan shall be available on the worksite at all times of intrusive activities.

4.10 Site Walk

4.10.1 A site walk shall be conducted by the AECOM Manager and any other appropriate personnel with the objectives of reviewing all planned intrusive activity locations, the locations of subsurface and overhead utilities, overhead obstructions, and the potential for subsurface installations, to determine the appropriate utility clearance activities, and to observe other physical hazards.

- Walk the area at least 50 feet (15.2 meters) from perimeter of the site to observe physical hazards.
- Walk the area of at least 50 feet (15.2 meters) radius from each proposed subsurface intrusion location.
- If possible, particularly at urban and industrial sites, the client/property owner or an individual knowledgeable about the site and site utilities will attend the site walk.
- Add discovered items/issues to map for use in location confirmation.

4.10.2 The Site Walk further supplements the Identification and Mapping of Utility and Subsurface Structures procedure. Site Walks should be repeated as necessary following the Identification and Mapping of Utility and Subsurface Structures as visual verification of the hazards. Examples include:

- Proposed location(s) does not lie on a line connecting two similar manhole covers (e.g. sanitary sewer or storm drain).
- Proposed subsurface location(s) has not subsided, been excavated and patched, nor gives the appearance it may be covering a former trench (e.g. linear cracks, sagging curbs, linear re-pavements, etc.).
- Proposed subsurface location(s) does not lie on a line with any water, gas, electrical meters, utility cleanouts, or other utility boxes in the surrounding areas.

4.11 Proposed Subsurface Investigation Locations

4.11.1 All proposed subsurface locations will be reviewed in comparison to subsurface and overhead utilities and subsurface installations and adjustments made as necessary.

4.11.2 Minimum set back distances from subsurface and overhead utilities and subsurface installations will be established including 5 feet (1.5 meters) from any subsurface utility, 7 feet (2.1 meters) from the pad surrounding any underground storage tanks, and 10 feet (3 meters) from any overhead energized electrical line (or further depending on line voltage). These set back distances are a minimum; government regulations and utility requirements may dictate a greater set back distance.

4.12 Utility Clearance Investigation Location Confirmation

4.12.1 As applicable, all client on-site safety procedures shall be understood and adhered to.

4.12.2 Hand exposure or non-destructive ground disturbance techniques to expose an underground utility or subsurface installation are necessary to accurately determine size, location and alignment prior to mechanical excavation or intrusive subsurface work in the vicinity of that utility or installation.

4.12.3 Non-destructive ground disturbance techniques shall be acceptable to the owner of the buried utility (i.e. hydro-vacuum temperature or pressure).

4.12.4 Hydro-vacuum or air-knife require proper grounding equipment at sites where the subsurface may contain flammable gases, liquids, or vapors

4.12.5 Jurisdictional, land owner, client and utility owner requirements shall be consulted to determine the distance of the hand exposure zone, and what requirements, when met, may allow mechanical excavation within these zones.

4.12.6 At a minimum, all underground utilities and subsurface installations within a 5 feet (1.5 meter) radius of the work site shall be identified and physically located (seen) before use of mechanical excavation equipment is permitted. Jurisdictional, client, land owner and utility owner requirements shall be consulted as the required hand exposure radius may be larger.

4.12.7 In urban areas, proposed subsurface locations will be hand cleared to 5 feet (1.5 meters) (soil borings and wells) or 12 inches (30 centimeters) (soil gas sampling probes) using non-mechanical methods.

- In non-urban areas, hand clearing should be conducted if possible and shall be conducted as required by the given jurisdiction.
- Hand clearance should be extended if locations of deep utilities and structures are not known.
- Hand exposure or non-destructive ground disturbance techniques should extend a minimum of 24 inches (60 centimeters) below the intended ground disturbance depth to minimize the hazard of mechanical equipment contact with any utility or installation.

4.12.8 Mechanical equipment and attachment dimensions shall be considered when establishing the zone in which all underground utilities and subsurface installations are physically located (seen) prior to the use of that equipment. The radius may require expanding to maintain safe distances when using large equipment.

4.13 Utility Strikes

4.13.1 Utility strikes shall be reported in accordance with *S3AM-004-PR1 Incident Reporting, Notifications & Investigation*.

4.13.2 All damaged utilities shall be repaired by a qualified and/or licensed professional.

5.0 Records

5.1 Retain completed *S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist* and documents related the clearance process (e.g. Utility Owner communication, etc.) in the site or project files.

5.2 Documentation of employee training completed shall be retained in accordance with *S3AM-003-PR1 SH&E Training*.

6.0 Attachments

6.1 S3AM-331-ATT1 One-Call System

6.2 S3AM-331-ATT2 Underground Utilities & Subsurface Installation Flow Chart

6.3 S3AM-331-FM1 Underground Utility & Subsurface Installation Clearance Checklist

1.0 Purpose and Scope

1.1 Communicates the requirements and precautions to be taken by AECOM employees to protect against the biological hazards associated with insects, arachnids, snakes, poisonous plants, and other animals referred to herein collectively as “biological hazards”.

1.2 This procedure applies to all AECOM Americas-based employees and operations and any other entity and its personnel contractually required to comply with this document’s content.

2.0 Terms and Definitions

2.1 **Field Work –** Any activity conducted at a site that contains brush, overgrown grass, leaf litter, poisonous plants, or is located near mosquito breeding areas and includes work in structures where animals might exist that harbor fleas or ticks or where spiders and mites could be present. Field work includes, but is not limited to, Phase I, Phase II, Operations Monitoring & Maintenance, biological surveys, and other work that meets the definition of field work.

2.2 **Poisonous** – Capable of harming or killing by or as if by poison; toxic or venomous.

2.3 **Phase I Environmental Site Assessment –** Investigation of real property to determine the possibility of contamination, based on visual observation and property history, but no physical testing. Under new Environmental Protection Agency regulations that went into effect on November 1, 2006, a Phase I, as it is called for short, will be mandatory for all investors who wish to take advantage of Comprehensive Environmental Response, Compensation, and Liability Act defenses that will shield them from liability for future cleanup, should that prove necessary. The new Phase I rules, called “All Appropriate Inquiry” or AAI, also require more investigation than previously mandated. Investors can expect to see dramatic price increases over prior experiences.

2.4 **Phase II Environmental Site Assessment** – Investigation of real property through physical samplings and analyses to determine the nature and extent of contamination and, if indicated, a description of the recommended remediation method.

3.0 References

3.1 RS2-001-PR1 Firearms Standard

3.2 S3AM-004-PR1 Incident Reporting, Notifications & Investigation

3.3 S3AM-008-PR1 Fitness for Duty

3.4 S3AM-113-PR1 Heat Stress

3.5 S3AM-208-PR1 Personal Protective Equipment

3.6 S3AM-209-PR1 Risk Assessment & Management

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers / Supervisors**

- Responsible for managing field work.

- Work with employees to see that a Task Hazard Analysis (THA) for the work to be conducted has been performed prior to the beginning of the field work and that it includes an assessment of potential biological hazards.
- Implement control measures at the location to reduce the potential for employees to be exposed to injuries and illnesses from biological hazards while working.
- If the exposures cannot be eliminated or managed with engineering controls, approve the use and cost of Personal Protective Equipment (PPE) and protective repellents and lotions and confirm that exposed employees have and use these products.

4.1.2 **SH&E Manager**

- Confirm training and guidance is provided to employees consistent with this procedure.
- During the performance of site visits, assess the precautions being taken against biological hazards for compliance with this procedure.
- Assist AECOM personnel in identifying hazards and selecting appropriate control measures.
- As applicable, review and approve relevant SH&E Plans for locations that have biological hazards.

4.1.3 **Employees**

- Participate in required training related this procedure.
- Participate in the development of THAs for the task, identify control measures to limit exposure and request PPE, repellents, and protective lotions identified by this procedure.
- Update the applicable THA when a new, unaccounted for biological hazard is identified. Employee shall stop work to identify appropriate elimination or control measures (and obtain any necessary guidance) before continuing work.
- Obtain approval from Managers and/or Supervisors to purchase selected PPE prior to purchasing.
- Implement the precautions appropriate to prevent exposure to the hazardous wildlife, insects and plants.
- Observe requirements for reporting (e.g. tick bites, skin irritations, etc.) as detailed within the procedure and attachments.

4.2 Training

4.2.1 Employees shall be trained to recognize organisms that represent a threat in the regions in which they work – experienced field staff shall provide on the job training to assist staff with hazard recognition.

4.2.2 Employees shall be properly trained to the anticipated tasks and the associated required PPE.

4.3 Overview

4.3.1 The procedures discussed below are detailed because these hazards have historically posed the most significant risk to AECOM employees. Note that this discussion is not a fully encompassing list of hazards. As part of the SH&E Plan and THA developed by the AECOM personnel, in accordance with *S3AM-209-PR1 Risk Assessment & Management*, additional consideration shall be given to other biological hazards.

4.3.2 Departments of Public Health local to the worksite, as well as the Centers for Disease Control (CDC) can serve as a resource for identifying biological hazards not discussed in this procedure.

4.3.3 If additional biological hazards are identified, employees should stop work and contact the SH&E Manager to discuss the hazards and identify effective control measures. Those control measures shall be implemented at the location prior to restarting work.

4.4 Employee Sensitivity

4.4.1 Sensitivity to toxins generated by plants, insects and animals varies according to dosage and the ability of the victim to process the toxin; therefore, it is difficult to predict whether a reaction will occur, or how severe the reaction will be. Employees should be aware that there are a large number of organisms capable of causing serious irritations and allergic reactions. Some reactions will only erupt if a secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can be severe scarring, blindness or even death.

4.4.2 Employees also need to consider whether they are sensitive to the use of insect repellents.

4.5 Planning and Hazard Assessment

4.5.1 AECOM personnel shall confirm that the potential for exposure to specific biological hazards are assessed prior to the commencement of work and that the procedures specified by this procedure are integrated into the THA planning process and conveyed to employees conducting the field work. This information shall be communicated in the location-specific SH&E plan, the THA, pre-project kickoff meetings, and tailgate meetings at the location.

4.5.2 It is important to note that the precautions to be taken by employees to decrease the risk of exposure to biological hazards can directly increase the risk of heat-related illness due to thermal stresses. Therefore, heat stress monitoring and precautions shall be included as a critical component of the task-specific THA in accordance with *S3AM-511-PR1 Heat Stress**.***

4.5.3 During the preparation of the location-specific SH&E plan and task specific THA, Managers, Supervisors, and employees shall determine what biological hazards might be encountered during the task or operations and shall prescribe the precautions to be taken to reduce the potential for exposure and the severity of resulting illnesses. Consideration will be given to conditions such as weather, proximity to breeding areas, host animals, and published information discussing the presence of the hazards.

4.5.4 It should be assumed that at least one of the biological hazards exists whenever working on undeveloped property. This can include insect activity any time that local temperatures exceed 40 degrees Fahrenheit (4.5 degrees Celsius) for a period of more than 24 hours. The stubble and roots of poisonous plants can be a hazard any time of year, including when some plants are dormant or mown.

4.5.5 The hazard assessments shall also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with poison ivy, oak or sumac and hazards associated with the use of tools and equipment to remove vegetation.

4.5.6 Employees in the field where biological hazards exist shall not enter the hazard areas unless they are wearing the appropriate protective clothing, repellents, and barrier creams specified below. If the hazard is recognized in the field but was not adequately assessed during the THA, the field staff shall stop work and not proceed until the THA has been amended and approved and protective measures implemented.

4.5.7 Employees who have severe allergic reactions are strongly recommended to notify their Manager, field Supervisor and co-workers of the potential for a reaction and demonstrate what medication they might need, where they keep it and how it is administered.

4.5.8 A decision flow chart and table for determining the potential for biological hazards in the Americas has been provided in *S3AM-313-ATT1 Biological Hazard Assessment Flow Chart.*

4.5.9 Restrictions:

- No firearms or weapons are allowed to be used without express permission by the Region Executive and Chief Resilience Officer, refer to the *RS2-001-PR1 Firearms Standard*.
- No weapons related work shall occur without an assessment that includes appropriate hazard control measures and training.

- Staff with life-threatening reactions shall not undertake work in areas infested with the allergen (e.g., wasps, poison ivy), unless precautions are met which satisfy a medical practitioner's requirements. Refer to *S3AM-008-PR1 Fitness for Duty*.

4.5.10 Precautions

- Be aware of the potential irritants in your area and know how to recognize them.
- Modify activities to avoid encounters (diurnal rhythms, seasonal rhythms).
- Avoid wearing perfume and cologne and strong smelling deodorants, lotions, soaps, and shampoos.
- When working in areas where there may be small insects that "hitchhike" (e.g., ticks, spiders, scorpions), it is recommended that clothes are turned inside out and shaken at the end of day; do not wear same clothes two days in a row.
- Staff should always be aware of where they are placing their hands, or where they are sitting in order to avoid contact with potential toxins. Avoid reaching into areas where visibility is limited.

4.6 Wildlife Hazards (Wild Animals, Reptiles and Birds)

4.6.1 Employees shall not work alone in areas where the risk of an encounter with dangerous wildlife is high. Wildlife handling shall only be completed under direct supervision of an experienced individual. Refer to the following work instructions for more specifics:

- *S3AM-313-ATT13 Alligators*
- *S3AM-313-ATT9 Large Carnivores & Ungulates*
- *S3AM-313-ATT10 Bear Safety*
- *S3AM-313-ATT11 Small Mammals*
- *S3AM-313-ATT12 Snakes & Scorpions*

4.7 Ticks, Spiders and other Insects

4.7.1 Insects for which precautionary measures should be taken include but are not limited to: mosquitoes (potential carriers of disease aside from dermatitis), black flies, wasps, bees, ticks, fire ants and European fire ants.

4.7.2 Employees with known allergies to insect stings should consult their personal physician for advice on any immediate medications that they should carry with them. Epi-pens[1] shall be carried at all times in the field by employees who are aware that anaphylactic shock is a possibility for them AECOM highly recommends that employees with known allergies inform their co-workers of the allergy and the location of the medications they might carry for the allergy.

4.7.3 Habitat Avoidance, Elimination and/or Control

- The most effective method to manage worker safety and health is to eliminate, avoid and/or control hazards. Clearing the location of brush, high grass and foliage reduces the potential for exposure to biological hazards. Clearing will not eliminate the exposure to flying insects and there might be an increased exposure to ticks and spiders during the clearing process.
- Projects such as subsurface environmental assessment or remediation are often candidates for brush and overgrown grass to be cleared. In these instances, the Manager shall either request that the client eliminate vegetation, or request approval from the client to have vegetation clearing added to the scope of work.
    - It should be noted that vegetation clearance may unintentionally serve to spread noxious and poisonous plant materials around the site.

[1] Epi-pens must be prescribed by a personal physician. Renew epi-pens on a regular schedule to ensure effectiveness and make sure your field companions know where it is and how to use it if you cannot self-administer the dose.

- As applicable, measures should be taken to prevent spread, such as but not limited to, confirming equipment and materials are not placed on affected areas, and equipment is decontaminated after use and before removal from site.

- When work shall be conducted in areas that cannot or may not be cleared of foliage, personal precautions and protective measures shall be prescribed.
- Mosquitoes breed in stagnant water and typically only travel a quarter mile (less than half a kilometer) from their breeding site. Whenever possible, stagnant water should be drained to eliminate breeding areas. Managers and client site managers should be contacted to determine whether water can be drained and the most appropriate method for draining containers, containment areas, and other objects of standing water.
- If water cannot be drained, products similar to Mosquito Dunks® can be placed in the water to control mosquitoes. Once wet, the Mosquito Dunks® kill the immature, aquatic stage of the mosquito. The active ingredient is a beneficial organism that is lethal to mosquito larvae, but harmless to fish, humans, and other animals. Mosquito Dunks® provide long-term protection for 30 days or more.

4.7.4 Ticks

- Ticks can be encountered when walking in tall grass or shrubs. They crawl up clothing searching for exposed skin where they will attach themselves. The most serious concern is a possibility of contracting a disease.
- Data from the CDC indicates that tick-borne diseases have become increasingly prevalent. At the same time, tick repellents have become both safe and effective so it is possible to prevent the vast majority of bites and, therefore, most related illnesses. The use of permethrin is strongly advised.
- The most common and severe tick-borne illnesses in the U.S. are Lyme disease, Ehrlichiosis, and Rocky Mountain spotted fever. A summary table listing CDC informational resources for these diseases is provided in *S3AM-313-ATT2 Ticks* along with a listing of CDC information resources and maps showing the distribution of common tick-borne diseases in the U.S.
- When working in areas where ticks may occur, it is recommended that clothes are turned inside out and shaken at the end of day; do not wear the same clothes two days in a row.
- Employees should conduct a thorough full body tick check upon exiting the field. Shower within two hours of coming indoors to help wash away loose ticks. Clothes should be laundered in hot water or tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks.
- To remove ticks that are embedded in skin, utilize a tick key. Alternatively use tweezers or fingers to carefully grasp the tick as close to the skin as possible and pull slowly upward, avoiding twisting or crushing the tick. Do not try to burn or smother the tick. Cleanse the bite area with soap and water, alcohol, or household antiseptic. Note the date and location of the bite and save the tick in a secure container such as an empty pill vial or film canister. A bit of moistened paper towel placed inside the container will keep ticks from drying out. Follow AECOM incident reporting guidelines to report the tick bite within 4 hours and notify the Manager or Supervisor.
- Familiarize yourself with the characteristic bulls-eye pattern of Lyme disease infection surrounding the bite. If you notice this type of pattern or rash resulting from a tick bite, immediately report the issue to your supervisor and follow the incident reporting requirements for your business group.
- If you experience symptoms such as fever, headache, fatigue, and a skin rash, you should immediately visit a medical practitioner as Lyme disease is treated easily with antibiotics in the early stages, but can spread to the heart, joints, and nervous system if left untreated.

4.7.5 Chiggers

- Chiggers are mite larvae, approximately ½ millimeter in size, and typically invisible to the naked eye. While chiggers are not known to carry infectious diseases, their bites and resulting rashes and itching can lead to dermatitis and a secondary infection.
- Chiggers are typically active from the last hard freeze in the winter or spring to the first hard freeze. They are active all year in the Gulf Coast and tropical areas.

4.7.6 Spiders

- Spiders can be found in derelict buildings, sheltered areas, basements, storage areas, well heads and even on open ground. Spiders can be found year round in sheltered areas and are often present in well heads and valve boxes.
- Most spider bites produce wounds with localized inflammation and swelling. The Black Widow and Brown Recluse spiders in the U.S. and others outside the U.S. inject a toxin that causes extensive tissue damage and intense pain.
- Additional information on spider identification can be found in attachment *S3AM-313-ATT3 Poisonous Spider Identification*.

4.7.7 Mosquitoes

- When a mosquito bites, it injects an enzyme that breaks down blood capillaries and acts as an anticoagulant. The enzymes induce an immune response in the host that results in itching and local inflammation. The tendency to scratch the bite sites can lead to secondary infections.
- CDC data indicates that mosquito-borne illnesses, including the strains of encephalitis, are a health risk. At least one of the Encephalitis strains listed below is known to exist in every area of the U.S. and in many other countries as well:
    - Eastern Equine encephalitis
    - Western Equine encephalitis
    - West Nile Virus
    - St. Louis encephalitis
    - La Crosse encephalitis
- Mosquitoes can transmit the West Nile Virus and other forms of encephalitis after becoming infected by feeding on the blood of birds which carry the virus.
- Most people infected with the virus experience no symptoms or they have flu-like symptoms. Sometimes though, the virus can cause severe illness, resulting in hospitalization and even death, so proper precautions should be taken. Consult a medical practitioner if you suspect you have West Nile Virus. Other diseases including Dengue Fever and Malaria are spread by mosquitoes in the sub-tropic and tropical parts of the world. See *S3AM-313-ATT4 Mosquito Borne Diseases* for information on the locations where mosquito borne diseases are known to be present.

4.7.8 Bees, Wasps and Hornets

- Wasps and bees will cause a painful sting to anyone if they are harassed. They are of most concern for individuals with allergic reactions who can go into anaphylactic shock. Also, instances where an individual is exposed to multiple stings can cause a serious health concern for anyone. These insects are most likely to sting when their hive or nest is threatened.
- Bees, hornets, and wasps may be found in derelict buildings, sheltered areas, behind covers or lids and even on open ground. Other protective measures are not normally effective against aggressive, flying insects. Be aware of the potential areas for these types of insects, approach these locations cautiously. Avoid reaching into areas where visibility is limited.
- If you see a nest in the area you are working in stop work. Contact the Manager or Site Supervisor for procedures to have the nest removed.

- If stung by a wasp, bee or hornet, notify a co-worker or someone who can help should you have an allergic reaction. Stay calm and treat the area with ice or cold water. Follow AECOM incident reporting guidelines to report the sting within 4 hours and notify the Manager or Supervisor immediately. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or sting, or any swelling or numbness beyond the site of the bite or sting.

4.7.9 Fire Ants

- The fire ant (southern and western U.S.) and the European fire ant (northeastern U.S. and eastern Canada) is often very abundant where it is established. It is very aggressive and commonly climbs up clothing and stings unprovoked when it comes into contact with skin. Painful irritations will persist for an hour or more.

4.7.10 Personal Protective Equipment (PPE)

- Chemically-treated field clothing, full-length clothing, or Tyvek® coveralls.
- Gloves shall also be worn consistent with the recommendations of the site-specific SWP and/or THA to minimize hand exposure.
- Where ticks, chiggers, and spiders are presumed to exist, the Tyvek® or chemically treated clothing will be taped to the work boots.
- See *S3AM-313-ATT2 Ticks* for configuration of clothing for protection against ticks and insects.
- Application of insect repellent to clothing and/or exposed skin. Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the CDC for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, employees can use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work. If permethrin is unavailable employees can apply DEET to their skin and let dry prior to putting FRC on.
    - Oil of Lemon Eucalyptus is a plant-based insect repellent on the market as Repel Lemon Eucalyptus. The products have been proven to be effective against mosquitoes, deer ticks, and no-see-ums for up to six hours. Derived from Oil of Lemon Eucalyptus, this non-greasy lotion or spray has a pleasant scent and is not known to be toxic to humans. The spray or lotions will be effective for approximately two to six hours and should be reapplied every two hours to sustain protection. Lemon Eucalyptus products cannot be applied to fire retardant clothing.
    - Permethrin is an insecticide with repellent properties registered with the Environmental Protection Agency and recommended by the CDC.
        - Permethrin is highly effective in preventing tick bites when applied to clothing, but is not effective when applied directly to the skin. Two options are available for Permethrin treatment of clothing worn during field work: 1) pre-treatment of fabric by the clothing manufacturer; or 2) manual treatment of their personal clothing using Permethrin spray in accordance with recommendations manufacturers recommendations. This will likely require treatment at home or the office prior to field mobilization. Caution should be used when applying Permethrin as it is highly toxic to fish and house cats. AECOM strongly recommends the first option (employees obtaining pre-treated clothing) to avoid the time required, potential risk, and housekeeping issues involved with manually treating the clothing with spray. Purchase pre-treated clothing in accordance with *S3AM-208-PR1 Personal Protective Equipment* and with the approval of your Supervisor or Manager.
        - The Permethrin pre-treatment is odorless and retains its effectiveness for approximately 25 washings. After 25 washings, the pre-treated clothing will be

considered no longer effective and removed from service. Clothing that has been manually treated by employees will be considered effective for five wash cycles.

- Also, use of clothing that has been pre-treated with Permethrin offers a reduction in the use and application of other insect repellents that shall be applied directly to the skin. Supervisor or Manager approval is required prior to purchase.
- If the employee opts not to utilize chemically pre-treated clothing while potentially exposed to insects, spiders and/or ticks, they shall either: 1) wear Tyvek® coveralls taped to the boots, or 2) wear full-length clothing consisting of long-legged pants and long-sleeved shirts treated with an insect repellent containing Permethrin, DEET, or an oil of lemon eucalyptus to their work clothing.

- Safety Data Sheets (SDS) for the repellents, lotions, and cleansers discussed in this Procedure are not required because the repellents, lotion, and clothing are consumer products used in the manner intended for the general public. Although not required, a SDS should be obtained for the products used and placed into the office SDS library and site-specific safety plan.

4.8 Poisonous Plants

4.8.1 Habitat Avoidance, Elimination and/or Control

- If poisonous plants are identified in the work area, employees will mark the plants using either flags or marking paint, and discuss what the specific indicator will be to signal to other employees to avoid the designated area. If employees decide to use ground-marking paint to identify poisonous plants, they should discuss this tactic with the Manager (and Client as appropriate) for approval.
- If removal of the plants is considered, it should be subcontracted to a professional landscaping service that is capable and experienced in removing the plant. If herbicides are considered for use, a discussion shall need to occur with the Manager (and Client as appropriate) to determine whether it is acceptable to apply herbicides at the work site. Application of herbicides may require a license.
- Employees shall not attempt to physically remove poisonous plants from the work area unless a clearing procedure, including PPE, is prepared in advance and approved by the SH&E Manager. The clearing procedure should be included in the SH&E Plan and THA and the required PPE specified.

4.8.2 Poisonous plants that employees should recognize and take precautions to avoid include: poison sumac, poison ivy (terrestrial and climbing), poison oak, giant hogweed[2] (or giant cow parsnip), wild parsnip, devil's club and stinging nettle. Many others are extremely poisonous to eat (e.g., poison hemlock; water parsnip) – do not eat anything that has not been identified. Refer to *S3AM-313-ATT5 Plants of Concern* for information on locations where some of these poisonous plants are found in the U.S.

- Of the toxic plants in the cashew family, poison ivy (*Rhus radicans*) is most widespread. It grows in a variety of forms such as a low sprawling shrub, dense ground cover, or a thick woody vine that grows high into the tree canopy. Poison oak (*Rhus diversiloba*) is typically a low shrub in drier soils. Both of these plants have leaves of three and white berries. Poison sumac (*Rhus vernix*) is a tall shrub that is less prolific in distribution. It grows in wet areas, has a compound leaf with a red leaf stem (rachis), and white berries. All of these plants possess urushiol oils in all parts of the plant. Touching the plant causes an itchy skin rash that can show up within 4-72 hours following contact. People have a wide range of reactions including swelling, itching, rash and bumps, patches or blisters.
- Uroshiol oil can also transfer onto clothing and equipment. The oil can remain active on surfaces for up to 5 years and can be transferred to your skin.

[2] Phytodermatisi producer: keep skin covered and wash well after exposure

- Wild parsnip is found throughout the U.S. and contains a poison that produces a rash similar to poison oak and ivy. Unlike poison oak and ivy, the active oil will not be present on unbroken leaves. See *S3AM-313-ATT6 Wild Parsnip Identification* for additional information and photos of wild parsnip.
- Several plants in the carrot family contain toxic sap that causes severe dermatitis if it comes into contact with skin that is then exposed to sunlight. The most serious reaction is caused by the giant hogweed (*Heracleum mantegazzianum*), a plant that is spreading in southern Ontario and is also present in southwestern British Columbia. The plant is enormous, attaining up to 16 feet (5 meters) in height, which it does in one growing season. Contact causes painful blistering that can cause permanent disfigurement. It is to be avoided. Similar but less serious reactions can be caused by meadow parsnip (*Pastinaca sativa*) and cow parsnip (*Heracleum lanatum*). Meadow parsnip can be very abundant on disturbed sites.
- Nettles, particularly stinging nettle (*Urtica dioica*) and wood nettle (*Laportea canadensis*) contain urticating hairs on the leaves and stems that cause sharp pain or itchiness on contact with skin. The irritation is immediate and normally lasts no more than an hour and there are no lasting consequences.
- Some plants contain abundant stiff spines that can present a safety hazard, particularly if one is to fall into them. These include the cactus (*Opuntia spp.*), devils club (*Oplopanax horridum*), and prickly-ash (*Zanthoxylon americanum*).

4.8.3 A large number of plants are not harmful to touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. It goes without saying to not eat any berries or plants if you are unsure of their identity.

- Remember that in the fall and winter the hazard still exists in the form of stubble and roots.

4.8.4 Personal Protective Equipment (PPE)

- Employees conducting clearing, grubbing, or similarly disturbing work activities in areas where poisonous plants exist shall wear long-sleeve clothing or Tyvek® coveralls, and disposable cotton, leather or synthetic gloves. Employees shall not touch exposed skin (neck and face) with potentially contaminated gloves. Tyvek® and gloves worn to protect from exposure to poisonous plants shall be treated as contaminated, removed from the body in a manner that the contamination is not spread, and placed in plastic bags for disposal.
- Personal clothing that has been exposed to poisonous plants shall be decontaminated with a poisonous plant cleanser such as Tecnu® or removed in a careful manner, bagged and washed separately from other clothing to remove urushiol.
- Work boots will be decontaminated with either soap and water or a cleansing agent such as Tecnu® cleanser.
- If foliage is being cleared and includes poisonous plants, exposed skin shall be treated with a dermal barrier cream such as Tecnu®'s Oak 'n Ivy Armor or Enviroderm's Ivy Block and either a full-face respirator or a half-face respirator (with goggles) fitted with a P-100 (HEPA) dust filter.

4.9 Bird Droppings and Biological Soil Hazards

4.9.1 Work in any area where pigeons or other flying animals (e.g. bats) may nest requires a written statement from the client which states the potential for, and extent of, accumulation of excrement on/in the structure from pigeons or other winged animals.

4.9.2 Substantial accumulations of droppings can pose physical and health risks as slippery surfaces (if wet) and if the material is disturbed and becomes airborne, it can be inhaled or ingested if personal hygiene practices are not implemented. Inhalation of airborne droppings can cause diseases such as histoplasmosis. Exposure to surfaces with bird droppings shall be safeguarded by implementing proper work practices, training employees for awareness and using PPE. See *S3AM-313-ATT8 Bird Droppings*.

4.9.3 Tularemia is a problem with contaminated soil in some locations. Tularemia is a disease of animals and humans caused by the bacterium *Francisella tularensis*. Rabbits, hares, and rodents are especially susceptible and often die in large numbers during outbreaks. Workers can contract Tularemia through tick and deer fly bites, but also through inhalation of contaminated aerosols or agricultural dusts. Check work areas for carcasses before disturbing the ground (e.g. mowing, brushing, grubbing, excavation, etc.).

4.10 Personal Hygiene and Body Checks

4.10.1 Tick-borne diseases typically require that the tick be imbedded for four hours to begin disease transfer. The oils from poisonous plants can take up to 4 hours after exposure to penetrate the skin and react with the live proteins under the skin.

4.10.2 It is recommended that exposed skin be checked frequently for the presence of ticks, insects, rashes, or discolorations. External clothing should also be checked for the presence of ticks and insects; these should be retained for identification and to determine if medical treatment is needed.

4.10.3 Employees shall shower as soon as practical after working in the field and examine their bodies for the presence of ticks, insect bites, rashes, or swollen areas. If imbedded ticks are found, they should be removed using the technique described in *S3AM-313-ATT2 Ticks*.

4.11 Employees shall immediately notify their Manager or Supervisor of the presence of an imbedded tick, bee, wasp or hornet sting, other insect bite, rash, or any abnormal reaction. Reporting shall occur within 4 hours for a significant incident and 24 hours for all other SH&E incidents, and in accordance with *S3AM-004-PR Incident Reporting, Notifications & Investigation.*

4.12 The Manager or Supervisor shall forward the report to the SH&E Manager for follow up.

5.0 Records

None

6.0 Attachments

6.1 S3AM-313-ATT1 Biological Hazard Assessment Flow Chart

6.2 S3AM-313-ATT2 Ticks

6.3 S3AM-313-ATT3 Poisonous Spider Identification

6.4 S3AM-313-ATT4 Mosquito Borne Diseases

6.5 S3AM-313-ATT5 Plants of Concern

6.6 S3AM-313-ATT6 Wild Parsnip Identification

6.7 S3AM-313-ATT7 Alligators

6.8 S3AM-313-ATT8 Bird Droppings

6.9 S3AM-313-ATT9 Large Carnivores & Ungulates

6.10 S3AM-313-ATT10 Bear Safety

6.11 S3AM-313-ATT11 Small Mammals

6.12 S3AM-313-ATT12 Snakes & Scorpions

Attachment D

Stretch/Flex Poster

Stretch & Flex

HAMSTRING STRETCH

HIP FLEXOR STRETCH

ADDUCTOR STRETCH

GASTROC STRETCH

SOLEUS STRETCH

NECK STRETCH

PEC/BICEP STRETCH

TRAPEZIUS STRETCH

RHOMBOID STRETCH

TRICEP STRETCH

HANDS AND WRISTS

HOLD EACH STRETCH 20-30 SECONDS
REPEAT EACH STRETCH TWO TIMES

SHIP Safety & Health Investment Projects

integrity safety services

Attachment E

Safety Data Sheets (SDSs)

1 Identification of the substance/mixture and of the supplier

1.1 Product identifier

Trade Name: Alconox
Synonyms:
Product number: 1104-1, 1104, 1125, 1150, 1101, 1103, 1112-1, 1112

1.2 Application of the substance / the mixture : Cleaning material/Detergent

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer **Supplier**
Alconox, Inc.
30 Glenn Street
White Plains, NY 10603
1-914-948-4040

Emergency telephone number:
ChemTel Inc
North America: 1-800-255-3924
International: 01-813-248-0585

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Skin irritation, category 2.
Eye irritation, category 2A.

Hazard pictograms:

Signal word: Warning

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Additional information: None.

Hazard description
Hazards Not Otherwise Classified (HNOC): None

Information concerning particular hazards for humans and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization : None

3.2 Description : None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	2-16

3.4 Additional Information : None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:

Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:

Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:

Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:

Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents : None

5.2 Special hazards arising from the substance or mixture :

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information :

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures :

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions :

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up :

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections : None

7 Handling and storage

7.1 Precautions for safe handling :

Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities :

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

8 Exposure controls/personal protection

8.1 Control parameters :

a) 7722-88-5, Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3

b) Dusts, non-specific OEL, Irish Code of Practice

(i) Total inhalable 10 mg/m3 (8hr)

(ii) Respirible 4mg/m3 (8hr)

(iii) Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3, (8hr)

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal use conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance or preparation. Protective gloves recommended to comply with EN 374. Take note of break through times, permeability, and special workplace conditions, such as mechanical strain, duration of contact, etc. Protective gloves should be replaced at the first sign of wear.

Eye protection:

Safety goggles or glasses, or appropriate eye protection. Recommended to comply with ANSI Z87.1 and/or EN 166.

General hygienic measures:

Wash hands before breaks and at the end of work.

Avoid contact with skin, eyes and clothing.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower:** **Explosion limit upper:**	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C:**	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density:**	Not determined or not available.
pH-value:	9.5 (aqueous solution)	**Relative density:**	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities:**	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water):**	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature:**	Not determined or not available.
Evaporation rate:	Not determined or not available.	**Decompositio n**	Not determined or not available.

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity : None

10.2 Chemical stability : None

10.3 Possibility hazardous reactions : None

10.4 Conditions to avoid : None

10.5 Incompatible materials : None

10.6 Hazardous decomposition products : None

11 Toxicological information

11.1 Information on toxicological effects :

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product .

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation. .

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye irritation .

Tetrasodium Pyrophosphate: Rabbit - Risk of serious damage to eyes .

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.4 mg/l, 48 hours. Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: ADR, ADN, DOT, IMDG, IATA	None
14.2 UN Proper shipping name: ADR, ADN, DOT, IMDG, IATA	None
14.3 Transport hazard classes: ADR, ADN, DOT, IMDG, IATA	**Class:** None **Label:** None **LTD.QTY:** None

US DOT

Limited Quantity Exception: None

Bulk:	**Non Bulk:**
RQ (if applicable): None	**RQ (if applicable):** None
Proper shipping Name: None	**Proper shipping Name:** None
Hazard Class: None	**Hazard Class:** None
Packing Group: None	**Packing Group:** None
Marine Pollutant (if applicable): No additional information.	**Marine Pollutant (if applicable):** No additional information.

	Comments: None	**Comments:** None
14.4	**Packing group:** ADR, ADN, DOT, IMDG, IATA	None
14.5	**Environmental hazards** :	None
14.6	**Special precautions for user:**	None
	Danger code (Kemler):	None
	EMS number:	None
	Segregation groups:	None

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.

14.8 Transport/Additional information:

Transport category:	None
Tunnel restriction code:	None
UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable

Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.
EC 648/2004 – This is an industrial detergent. Contains >30% phosphate, 15-30% anionic surfactant, <5% EDTA salts
EC 551/2009 – This is not a laundry or dishwasher detergent
EC 907/2006 – Contains no enzymes, optical brighteners, perfumes, allergenic fragrances, or preservative agents

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

NFPA: 1-0-0
HMIS: 1-0-0

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Attachment F

Site Orientation

Attachment F. Site Orientation

AECOM will conduct a site safety briefing for a person's initial visit to the site. The briefing will be conducted:

- Prior to the start of work;
- For any new AECOM or subconsultant personnel; and
- At each mobilization, or whenever there is a change in task or significant change in task location.

All personnel working on the project who have received the site briefing (including the HASP review) will sign the Personal Acknowledgement located at the end of the HASP. Visitors may receive a shortened version to address the hazards specific to their visit.

The following items, at minimum, will be discussed during the site safety briefing:

- Contents of this HASP;
- The Emergency Response Plan;
- Contractor SH&E Management expectations;
- Injury management, including notification and hospital and occupational clinic locations;
- The AECOM 4-Sight program;
- Stop Work authority;
- The THAs (**Attachment B**) for the tasks that will be performed on a given project;
- Types of hazards at the site and means for minimizing exposure to them;
- Instructions for new operations to be conducted, and safe work practices;
- PPE that must be used;
- Lone worker check-in procedures;
- Emergency evacuation routes, muster points, and tornado/storm shelters; and
- Location and use of emergency equipment.

These meetings must be documented and maintained in the project files.

Attachment G

Coronavirus Control Information

AECOM

Coronavirus Control Information

The Coronavirus pandemic is evolving rapidly, and AECOM's resilience team is working diligently to stay on top of the latest guidance to help protect the health and safety of our employees, minimize the spread of the virus, and continue to serve our clients. We have been requested to provide specific guidance to AECOM employees who are continuing to perform field work during this time. Check CDC website, https://wwwnc.cdc.gov/travel for ongoing updated guidance.

This guidance should be incorporated as part of existing project Health & Safety Plans (HASPs), read and understood by project staff, and discussed as part of daily project tailgate safety meetings.

Symptoms -- Mild to severe respiratory illness with fever, cough, and difficulty breathing. People are at higher risk of getting very sick from this illness including older adults, and people who have serious chronic medical conditions like heart disease, diabetes, and lung disease.

Controls:

- Clean your hands often with soap and water for at least 20 seconds after using the restroom, after you have been in a public place, before and after eating or after blowing your nose, coughing, or sneezing. If soap and water are not readily available, use a hand sanitizer that contains at least 60% alcohol. Cover all surfaces of your hands and rub them together until they feel dry.
- Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw used tissues in the trash. Immediately wash or sanitize your hands.
- If using water coolers to provide drinking water, wear clean gloves to operate the spigot and verify that a clean source of disposable cups are available. Verify that the cooler is cleaned and sanitized. If using bottled water sources, have employees take measures such as labeling bottles to avoid drinking out of someone else's bottle.
- Avoid close contact with people who are sick.
- Practice social distancing at tailgate meetings and in break rooms and job trailers. Put at least 6 feet of distance between yourself and other people. Limit the amount of people in job trailers and other confined areas at any one time so that this distance can be maintained. This is especially important for people who are at higher risk of getting very sick.
- Wear PPE. COVID 19 can be contacted via the eyes, nose, mouth, and respiratory tract from people who are ill via sneezing/coughing. You can also contact it from direct contact with surfaces that have been contaminated with these fluids. Employees should wear face coverings and gloves to prevent contact and avoid touching your face, eyes, nose, and mouth whenever possible.
- Assign someone to clean AND disinfect frequently touched surfaces daily. This includes tables, doorknobs, light switches, countertops, handles, shared desk spaces, desk phones, computer keyboards and mice, toilets, faucets, and sinks. If surfaces are dirty, clean them: use detergent or soap and water prior to disinfection.
- Avoid handling common use items such as desk pens, staplers, paper cutters, etc. If it is necessary to have common use items, include these in the cleaning and disinfecting cycle outlined above.
- If using outside toilet facilities (i.e. Porta Johns), wear nitrile gloves prior to using the toilet and doff and dispose of in a trash receptacle when finished. Use hand sanitizer after you dispose of the gloves.
- If you experience signs/symptoms of illness, notify the site supervisor and the project manager, and go home and/or stay home. Contact the AECOM Incident Reporting Hotline (**1-800-348-5046)** and/or the AECOM Nurse Line (**1-512-419-5016)**.

Working on Client Projects Sites – AECOM will follow clients' directives and protocols in addition to this

policy. If construction or field projects remain active, it is our intention to continue to support these projects.

Public Interaction, Meetings, and Gatherings – Where possible, we will limit public interaction to email, phone or virtual meetings. Public events or meetings will be cancelled or postponed or held via telepresence, if practical

Subcontractors, Vendors, and Suppliers to AECOM facilities – We have implemented an enhanced entrance procedure at our facilities which requires subcontractors, vendors, and suppliers to disclose if they are exhibiting any symptoms of the Coronavirus, or if they or anyone in their household have travelled through high-risk countries as defined by CDC travel advisories in the last 14 days. If they answer positively to any of the questions, they will not be permitted to enter our facility.

AECOM Pandemic Policy – AECOM's Pandemic Procedure provides additional information and guidelines on various Coronavirus scenarios.

AECOM Global

Pandemic Procedure

SR1-003-PR2

1. Purpose and Scope

Providing the requirements for preparation and planning for potential pandemic emergencies that may occur while AECOM staff are working.

Applies to all AECOM staff working inside and outside an AECOM office, including location and project environments as well as business related travel.

2. Background

2.1 Pandemic

A pandemic virus emerges because of a process called antigenic shift, which causes an abrupt or sudden and major change in flu-like viruses. Public health officials closely monitor the movement of flu-like viruses through avian and swine populations. The public health fear is that the virus may obtain the ability to shift and incorporate the ability to infect humans directly through human-to-human contact. At that point, the threat of a regional epidemic, or a global pandemic may be realized.

Flu-like viruses can weaken the immune system, making the person more vulnerable to serious infections such as pneumonia, or can worsen chronic medical conditions. Public health officials watch both avian and swine flu outbreaks closely to monitor potential for an antigen shift and progression to a human transmissible disease.

Government health agencies continually monitor flu-like viruses and other diseases worldwide. Human cases are reported and updated by the World Health Organization (WHO) and U.S. Centers for Disease Control (CDC). This information is used by responsible government agencies for planning and response actions as required to minimize the spread and effects of disease outbreaks. It is important that information provided by CDC or WHO is made available to employees when there is potential for impact on work conditions or local community health.

2.1.1 Swine Influenza

Influenza A (H1N1) is a flu virus of swine origin that first caused illness in March and April, 2009. Influenza A (H1N1) flu spreads in the same way that regular seasonal influenza viruses spread, mainly through the coughs and sneezes of people who are sick with the virus, but it may also be spread by touching infected objects and then touching your nose or mouth. Influenza A (H1N1) is now established in human populations as a seasonal influenza virus. There is an Influenza A vaccine available for humans.

2.1.2 Avian Influenza

Avian influenza (bird flu) occurs mainly in wild birds but can spread to domestic birds and can cause outbreaks. Human cases are rare but have occurred from direct close contact with infected birds and poultry or contaminated materials. There is no vaccine available for humans related to this virus at this time.

2.1.3 Coronavirus

Coronavirus (COVID-19) is the result of a virus identified as SARS-CoV-2. Coronaviruses are large family of viruses found in both animals and humans. Some infect people and are known to cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) with symptoms such as fever, cough and shortness of breath. There currently is no human vaccine available for this virus.

2.2 Flu-Like Contingency Planning

2.2.1 Roles & Responsibilities of Governing Agencies

2.2.1.1 Global Health Monitoring

The WHO coordinates health issues for the United Nations and provides leadership on global health matters. The WHO assists member nations with recommendations regarding global pandemics and declares global pandemic phases to help organizations to plan for the impacts. The major phases are:

a. Phase 1:	No viruses circulating among animals have been reported to cause infections in humans.
b. Phase 2:	An animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans and is therefore considered a potential pandemic threat.
c. Phase 3:	An animal or human-animal flu-like reassortment virus (the process by which viruses swap gene segments) has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, for example, when there is close contact between an infected person and an unprotected caregiver.
d. Phase 4:	There is verified human-to-human transmission of an animal or human-animal flu-like reassortment virus able to cause “community-level outbreaks.” The ability to cause sustained disease outbreaks in a community marks a significant upwards shift in the risk for a pandemic. Any country that suspects or has verified such an event should urgently consult with WHO so that the situation can be jointly assessed, and a decision made by the affected country if implementation of a rapid pandemic containment operation is warranted. Phase 4 indicates a significant increase in risk of a pandemic but does not necessarily mean that a pandemic is a forgone conclusion.
e. Phase 5:	There is human-to-human spread of the virus into at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.
f. Phase 6:	The pandemic phase is characterized by community level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way.
g. Post-peak period:	During the post-peak period, pandemic disease levels in most countries with adequate surveillance will have dropped below peak observed levels. The post-peak period signifies that pandemic activity appears to be decreasing; however, it is uncertain if additional waves will occur and countries will need to be prepared for a second wave.
h. Post-pandemic period:	Flu-like disease activity will have returned to levels normally seen for seasonal flu-like illness. At this stage, it is important to maintain surveillance and update pandemic preparedness and response plans accordingly. An intensive phase of recovery and evaluation may be required.

2.2.1.2 Country Specific Pandemic Plans

Most nations have developed pandemic plans that include monitoring the regional spread of disease, the recommended medical practices, and related guidance. AECOM operations outside the US must keep abreast of country specific requirements and recommendations.

2.2.1.3 United States

The federal government is responsible for coordinating a nationwide flu-like pandemic response.

a. The U.S. Department of Homeland Security coordinates all non-medical support and response actions.

b. The Department of Health and Human Services (HHS) coordinates overall public health and medical emergency response. Under Executive Order 13295 (revised April 1, 2005), the Secretary of Health and Human Services has the authority for apprehension, detention and conditional release of individuals to prevent the spread of a flu-like illness caused by a novel or re-emergent flu-like virus that causes or has the potential to cause a pandemic. Under HHS, the CDC is responsible for controlling the introduction and spread of infectious diseases and provides information to help health care providers, public health officials and the public. CDC's Division of the Strategic National Stockpile (SNS) distributes antiviral drugs, personal protective equipment, and respiratory protection devices to all 50 states and U.S. territories to help them respond to outbreaks.

c. Under the Department of Defence (DOD) Directive 6200.3, military facilities require identification of a Public Health Emergency Officer who coordinates Military Treatment Facilities emergency response plans with local emergency planning.

2.2.1.4 State and Local Governments

Each state has authority to manage and respond to pandemic conditions. It is important that projects and offices contact their local and state governments for emergency contact information.

3. Procedure and Responsibilities

AECOM Managers, HR (Human Resources), SH&E (Safety, Health and Environment) including Occupational Health, Legal Counsel, and Resilience Coordinators will collaborate and drive efforts to plan for, respond to, manage and recover from pandemic disruption to the business. This collaboration may also require input and cooperation from various other support functions who should be consulted in a timely fashion in order to expedite a return to normal business operations or to provide alternate solutions such as remote work. In the event of a declared Stage 5 or Stage 6 of a Pandemic event, the AECOM Managers, HR, SH&E, Occupational Health, Legal Counsel and Resilience Coordinators will make decisions and take necessary steps to protect the business from the pandemic, up to, and including, travel bans to/from certain areas, telecommuting, and other decisions as needed for business continuity with a focus on the health and welfare of the employee. Local Resilience Teams will take the lead in responding to pandemic-related business disruptions with overarching guidance provided by Global Resilience.

3.1 Corporate Roles and Responsibilities

AECOM offices will be prepared to respond to either a global, national or regional pandemic condition in accordance with the Organizational Resilience Standard - AECOM Global. The standard provides the common platform to organize mission-critical, Resilience Teams to prepare for, actively navigate and / or recover from significant business disruptions. It also provides the context for plans and procedures to minimize any impact on AECOM's business in terms of severity and duration.

3.1.1 Prevention and Containment

a. If a pandemic condition exists or is imminent within a local office or field location, consult the location specific Emergency Response Plan (ERP) or Business Continuity Plan for immediate response guidelines.

b. Upon notification from State Emergency Planning agency that a national or regional pandemic condition exists or is reasonably expected to occur, the facilities and administration teams working with the SH&E Department will provide sufficient and accessible infection control supplies in all local affected business locations.

c. Face masks may be supplied, if recommended by WHO/CDC. Supplies of anti-viral medications will not be stockpiled, distributed, or administered unless specified by community health administrators.

d. Annual influenza vaccinations are encouraged.

e. As applicable, communications through email or intranet, training programs, or work place postings may be utilized to provide information concerning prevention and containment. Information may include, but is not limited to:

   i. Initial symptoms of the disease, disease prevention techniques, how to respond if an individual suspects infection and when return to work is appropriate after the illness.

   ii. Personal practices and habits for minimizing exposure, such as: frequent hand washing, avoiding exposing other employees when sick, annual flu vaccinations if appropriate, and consulting a personal physician to determine personal risk.

   iii. Social distancing techniques such as minimizing large group gatherings, reducing employee face-to-face meetings through the use of video / phone conferencing/ Microsoft Teams, and eliminating unnecessary travel during severe outbreaks.

   iv. Flexible worksite and flexible work hours options should be implemented as appropriate.

   v. Employees shall notify their supervisor if they are going to miss work because of illness. Information concerning sick leave and health benefits can be obtained through the employee's HR representative, by consulting applicable policies and procedures.

   vi. As applicable, business and meeting travel may be limited to "business essential" only.

   vii. Management will notify any applicable clients or suppliers of potential business impacts that may be experienced as a result of a pandemic. Management will update clients/suppliers once operations are restored to full capacity.

3.1.2 Anti-Viral Medication

a. Media coverage of flu-like outbreaks has focused on the availability of oral anti-viral medications (not vaccines). These prescription medications are known to help with treating uncomplicated flu-like virus effects in limited applications. There are potential side effects of the drugs, and some viruses have shown resistance to the drug.

b. Based on this information, unless legally mandated by a country's government, AECOM will not attempt to stockpile sources of anti-viral drugs to be used for employees in the event of a pandemic. Resources of these drugs may be maintained by a country's National Strategic Stockpile.

c. Employees should contact their personal health care provider regarding recommendations for support medications that may be necessary in the event of a flu pandemic.

3.2 General AECOM Employee Guidelines

3.2.1 Employee Illness

a. Employees should report the illness to your Supervisor immediately.

b. Employees who are ill with flu-like symptoms (Fever >100.4 F/38 C, cough, shortness of breath should stay home. If they have a fever, they should stay home until at least 72 hours after they are free of fever without the use of fever reducing medications.

c. Employees should not travel if they are ill.

d. Employees who become sick during work hours should immediately go home.

e. Employees at higher risk of complications, or who become seriously ill, should contact their health care provider immediately.

3.2.2 Employee Family Member Illness

a. Employees who are well but who have a family member at home with the flu or flu-like illness such as coronavirus may choose to stay home or can go to work as usual. Employees with ill family members should monitor their health daily before coming to work, unless directed to quarantine by a health agency, and stay home if they become ill.

b. Employees who choose to stay home to care for ill family members should contact their supervisor or HR representative to discuss flu-related issues such as using sick time/paid time off or if telecommuting is an option.

c. Employees should not bring an ill family member with them to the office, even for brief periods.

3.2.3 Supervisors

a. If an employee calls in sick because of the flu or a flu-like illness, the supervisor is to require them to stay home. Expect employees to be out of work for 3-5 days (in most cases). Additional quarantine may be required based on the recommendations of CDC / WHO.

b. Should the supervisor be informed by the employee that he/she has the flu or flu-like symptoms, the supervisor should report the employee illness to HR and SH&E representative only, maintaining the employee's privacy.

c. Because symptoms may not appear until after an incubation period, (24 hours prior to symptoms), the supervisor should try to account for any close contacts (<6ft/2m) the affected employee might have had in order to evaluate if co-workers may have been exposed. Report the potential exposure of co-workers to your HR or SH&E representative and to the Corning Incorporated Project Manager.

d. Do not allow employees with the flu or flu-like symptoms to remain at work. In-office quarantine (isolation) of an employee with flu-like symptoms (e.g., work in a secluded office area) is not permitted.

Important Reminder: The names of employees who are ill with the flu are CONFIDENTIAL and can only be discussed with HR representatives or company nurses.

3.2.4 HR or SH&E Representatives

a. During Phase 5 and 6 of a potential / actual Pandemic, the SH&E representative will track cases of flu illness at your location using the Coronavirus Affected Employee Form obtained from the AECOM Occupational Health Nurse upon identification of employee/s who are confirmed positive for the virus, exhibiting symptoms of the virus or on self-quarantine and provide updates at least weekly. These numbers also to be reported to your Local Resilience Coordinator (LRC) to allow Resilience Teams (RT) to assess appropriate responses. Notification will also be provided to the Corning Incorporated Project Manager.

b. Inform fellow employees if a co-worker possibly exposed them to a flu-like illness, while maintaining strict confidentially regarding the identity of the co-worker, so that employees can self-monitor for symptoms and stay home if they become sick. (Sample notification: We have been notified that there has been a potential exposure to the coronavirus in this office/building. As a precaution, it is recommended that all employees potentially affected begin self-monitoring for symptoms and to stay home if you become ill. Ensure that you follow the office procedure for notification of management of unexpected absences). For additional information, refer to the AECOM Global update through the Ecosystem

c. A medical release of a clearance to return to work (following an extended absence) may not be available because of a busy health care system. Requiring a physician's release to return to work should be considered in cases of hospitalization or medical leave of absence in line with local HR protocols.

d. Address staff rumors immediately through investigation and follow-up, then inform management of communication with employee and onward reporting to the Local Resilience Coordinator.

3.2.5 HR Representative

a. Advise employees and supervisors regarding sick time or paid time off options.

b. Discuss with supervisors if telecommuting is an option for the employee.

3.2.6 Managers/SH&E Representative

a. Provide information to staff regarding good hygiene, including cough and sneeze etiquette and proper hand washing. Hold periodic meetings to refresh awareness of prevention measures.

b. Remind employees to check with their health care provider to determine if flu inoculations are recommended.

c. Follow-up with facilities and office managers to provide tissues, disinfectant wipes, hand sanitizers and no-touch receptacles for disposal.

d. Coordinate with facilities managers to arrange for commonly touched surfaces such as doorknobs and countertops to be cleaned frequently.

3.3 Travel Worldwide to Areas Affected by a Pandemic

AECOM's Global Security & Resilience (GSR) shall be consulted to obtain advice, approvals or restrictions, and support, for employees traveling worldwide to and returning from areas affected by a pandemic or potential pandemic.

Persons visiting areas with reports of outbreaks of concern can reduce their risk of infection by observing the following measures:

3.3.1 Before Traveling to an Affected Area

a. Educate yourself and others who may be traveling with you through consultation with AECOM's GSR Travel Security Portal and AECOM's policies and procedures.

b. Confirm applicable and routine vaccinations are current. See your doctor or health-care provider. When traveling from the US, contact our travel resource, WorkCare Travel Consultant directly at 800-455-6155 and outside the US, contact iSOS (International SOS) at +1 215 942 8226 (Membership # 11BMMS000147), ideally 4-6 weeks before travel, to get any additional vaccination medications or information you may need. In many cases, a medical examination may be required prior to travel.

c. Assemble a travel health kit containing basic first aid and medical supplies. Be sure to include a thermometer and alcohol-based hand gel or wipes for hand hygiene.

d. Identify in-country health-care resources in advance of your trip. Employees may contact iSOS, HR or WorkCare for assistance in identifying available resources.

3.3.2 During Travel to an Affected Area

a. As with other infectious illnesses, one of the most important preventive practices is careful and frequent hand washing for at least 20 seconds. Cleaning hands often with soap and water removes potentially infectious material from skin and helps prevent disease transmission. Waterless alcohol-based hand gels or wipes may be used when soap is not available, and hands are not visibly soiled.

b. If an employee becomes sick with symptoms such as a fever accompanied by cough and sore throat, or difficulty breathing or if they develop any illness that requires prompt medical attention, a consular officer (refer to the country's representatives on the GSR Travel Portal-Drum Cussac) or iSOS can assist you in locating approved medical services and informing your family or friends. The employee should defer any further travel until they are free of symptoms, unless traveling locally for medical care or instructed to evacuate by your project management, security, or upon advice of occupational health nurses. AECOM employees on foreign travel should notify their HR representative of any serious illness. Local employees should contact their supervisor according to their specified reporting policy.

c. In the event of a flu outbreak, avoid all direct contact with birds or swine and avoid farms and markets. There is the possibility that other animal groups may become reservoirs of the infection in the future so current information from WHO/CDC should be checked for updated guidance.

3.3.3 After Return from Travel

a. Monitor your health for 14 days after return for any fever or breathing difficulties.

b. If you become ill with a fever, a cough and sore throat, or trouble breathing during this 14-day period, consult your primary care physician. Do not come into work until advised by your primary care physician that it is safe to do so. Communicate the following:

   i. your symptoms;

   ii. where you travelled; and

   iii. if you have had direct contact with animals, birds, or severely ill persons.

c. Do not travel while ill, unless you are seeking medical care. Limiting close physical contact (<6ft/2 meters) with others as much as possible can help prevent the spread of an infectious illness.

4. Terms and Definitions

a.	Local Resilience Coordinator	A manager designated as the Office or Worksite lead for local level organizational resilience who may or may not be the emergency response coordinator. The LRC is the point of contact with the Region Resilience Team in determining further action, including notifications, following an initial emergency response.
b.	Pandemic	An epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people as declared by the World Health Organization

c.	Resilience Team (RT)	Interdependent networks of necessary and essential business functions collaborating at the enterprise, region and/or local levels to achieve organizational resiliency. Functions include but are not limited to communications, facilities, finance, human resources (HR), information technology, legal, procurement, safety, health, and environment, and security.

5. Appendices

The following appendices are designed to assist business leads, people managers, HR partners, SH&E representatives and Resilience Coordinators assess processes to follow when presented with potentially symptomatic employees, visitors, locations and provide useful resources for communicating prevention methods in the workplace.

a. Appendix 1 – Manager Resilience Checklist.

b. Appendix 2 – Virus Prevention Posters and Flyers

6. Change Log

Rev #	Change Date	Description of Change	Location of Change
0	March 11, 2020	Initial Release as SR1-003-PR2	

Appendix 1 – Manager Resilience Checklist

AECOM Managers Guideline on 2019-nCoV Scenarios					
	CASE	**SUB-CASE**	**What Business Leader must ask the "Case" Employee to do**	**What Business Leader should ask other employees potentially affected by "Case" Employee**	**Notice and Announcement** (To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal)
1	Employee confirmed to have contracted COVID-19.		Employee to stay away from the work sites and seek medical treatment. Employee may not return to work without medical clearance.	Without disclosing the identity of the infected employee, persons with workstations within 2m/ 6 ft of the "Case" Employee are to observe 14-day quarantine or as recommended by the governing health agency.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
2A	Employee having close contacts (2) with a person of a clinically diagnosed/confirmed case.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to not attend work and seek medical attention and observe any quarantine as instructed by governing health agency.	Persons with workstations within 2m/ 6 ft of the "Case" Employee to observe 14-day quarantine in accordance with governing health agency recommendations or provide medical clearance to return to work prior to the end of the quarantine period.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
2B		Feeling Well/ not exhibiting any signs/symptoms.	Employee to observe 14-day quarantine or as instructed by governing health agency.	Persons with close contact with the "Case" employee to self-monitor. If begin having any symptoms see 2A.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.

AECOM Managers Guideline on 2019-nCoV Scenarios					
	CASE	**SUB-CASE**	**What Business Leader must ask the "Case" Employee to do**	**What Business Leader should ask other employees potentially affected by "Case" Employee**	**Notice and Announcement (To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal)**
3	Employee being a suspected case (1).		Employee to seek medical attention and observe 14-day quarantine. If at work they should obtain a suitable face-mask as available, notify their supervisor and leave straight away.	Persons with close contact with the "Case" Employee are to observe 14-day quarantine in accordance with governing health agency recommendations or provide medical clearance to return to work prior to the end of the quarantine period.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
4A	Employee visited a location (3) of a confirmed case but had no contact with the confirmed person.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to seek medical attention and observe 14-day quarantine or provide medical clearance to return to work prior to end of the quarantine period.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms (6).	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
4B		Feeling Well/ not exhibiting any signs/symptoms.	Employee put under observation – self-observe for COVID-19 Symptoms.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions.

AECOM Managers Guideline on 2019-nCoV Scenarios

	CASE	SUB-CASE	What Business Leader must ask the "Case" Employee to do	What Business Leader should ask other employees potentially affected by "Case" Employee	Notice and Announcement (To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal)
5A	Employee having close contact with a suspected case, i.e. with a person having symptoms of COVID-19.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to seek medical attention and observe self-quarantine until outcome of the suspected case is confirmed and symptoms resolved.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
5B		Feeling Well/ not exhibiting any signs/symptoms.	Employee observes self-quarantine until outcome of the suspected case is confirmed.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms.	• Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions.
6A	Employee having visited a location of a suspected case.	Not feeling well/ Exhibiting Sign/symptoms (5).	Employee to seek medical attention and stay home until symptoms resolved.	Persons in close contact with the "Case" Employee put under observation – self-observe for COVID-19 Symptoms or until outcome of the suspected case is confirmed as negative. If "Case" employee confirmed positive, refer to 5A.	• *Resilience Team to Inform Organizational Resilience Executive resilience@aecom.com and to issue internal announcement reporting the case and our actions. • Use the Tracking Form to communicate information to Corporate Occupational Injury Management Team by submitting to nurse@aecom.com. • Business Leaders to inform stakeholders who may have employees in contact with a confirmed case.
6B		Feeling Well/ not exhibiting any signs/symptoms.	Employee put under observation – self-observe for COVID-19 Symptoms.	Observe general hygiene.	If condition changes, see above.
7	Employee not of the above cases having fever or feeling unwell but without symptoms of COVID-19.		Employee to stay home until symptoms resolved. Seek medical attention if necessary.	Observe general hygiene.	

Note:

For Cases 1-6, the Employee shall report to the People Manager, HR and Business Unit Leader. The Business Unit Leader shall report to the Regional Resilience Coordinator.

For Case 7, the Employee should report to the People Manager. The People Manager should report to the Business Unit Leader.

1. Definition of Suspected Case: an individual fulfilling the following should report to a local medical facility for further investigation:
    a. Presented with fever OR acute respiratory illness OR pneumonia; AND
    b. any one of the following conditions within 14 days BEFORE ONSET OF SYMPTOMS:
        i. With travel history to Hubei Province* (irrespective of any exposure to a wet market or seafood market); OR other location where COVID-19 is active.
        ii. Visited a medical hospital in an area that has elevated numbers of the virus as identified by the World Health Organization.
        iii. Had close contact with a confirmed case of novel coronavirus infection.
2. Close contact refers to contact within 2meters (6 ft)
3. Location refers to, places other than the AECOM Office, the same meeting room or the same confined common area where our Employee and the concerned person (of confirmed or suspected case) have visited during the concerned time.
4. For all notices and announcements, Business Unit Leader shall give the facts (details of the Case and Sub-case, date, place) to Comms Partner. Resilience Administrator, to inform Comms Partner what action is being taken, or has been planned, on the same date the case is known. Comms Partner will prepare the draft for the Regional Resilience Coordinator. Formal notice and updates to Organizational Resilience Executive via Disruptive Event Briefing Agenda Template - AECOM Global will be issued by the Regional Resilience Coordinator. Business Leaders may forward the announcement to stakeholders (e.g. Client and authorities) as a response to their queries on an as needed basis.
5. Staff feeling unwell or experiencing symptoms who stay home shall apply for leave/PTO. Staff being required to observe quarantine in the above cases will be considered as working from home. Business Leaders to report the status of quarantine and work from home cases to HR and to assess the impact on work progress and efficiency.
6. This guideline provides the minimum requirements to be observed. Business Leaders may exercise discretion to adopt more cautious measures if they consider the case is of a higher risk (e.g. for other staff affected by the concerned employees where close contact is regular/frequent).
7. To ensure privacy, any notifications/announcements regarding specific cases must be approved by AECOM Legal.

This document constitutes internal guidelines compiled based upon general external advice and publications to assist management and staff in dealing with and making management decisions in relation to the Coronavirus (COVID-19). The document should not be construed as providing medical or legal advice. To the extent that you require any further clarification or have any queries in relation to the content set out therein, please seek further guidance from Legal or the Resilience Team.

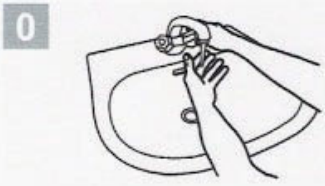
Appendix 2 - Virus Prevention Posters & Flyers

World Health Organization | Patient Safety — A World Alliance for Safer Health Care | SAVE LIVES Clean Your Hands

How to Handwash?

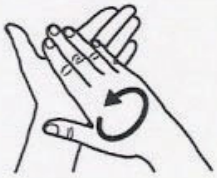
WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the entire procedure: 40-60 seconds

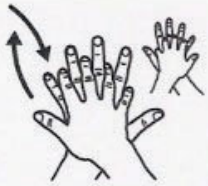


0 Wet hands with water;

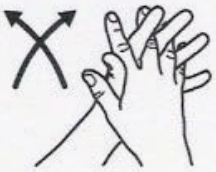
1 Apply enough soap to cover all hand surfaces;



2 Rub hands palm to palm;

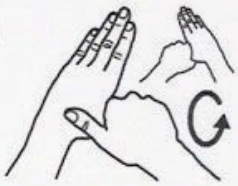


3 Right palm over left dorsum with interlaced fingers and vice versa;



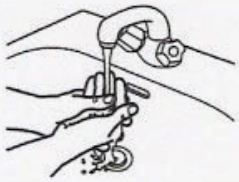
4 Palm to palm with fingers interlaced;

5 Backs of fingers to opposing palms with fingers interlocked;



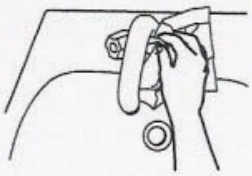
6 Rotational rubbing of left thumb clasped in right palm and vice versa;

7 Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;

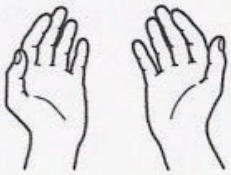


8 Rinse hands with water;

9 Dry hands thoroughly with a single use towel;



10 Use towel to turn off faucet;



11 Your hands are now safe.

Wash your hands

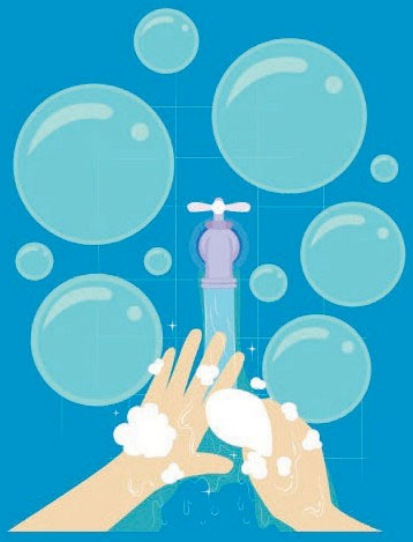
Wash your hands with soap and running water when hands are visibly dirty

If your hands are not visibly dirty, frequently clean them by using alcohol-based hand rub or soap and water

World Health Organization

Protect yourself and others from getting sick

Wash your hands



- after coughing or sneezing
- when caring for the sick
- before, during and after you prepare food
- before eating
- after toilet use
- when hands are visibly dirty
- after handling animals or animal waste

World Health Organization

Screening Set Up – Pandemic Conditions

Objective

This document provides guidance to set up a Point of Entry (POE) screening program to ensure worker health for themselves and others. The objective is to reduce risk and potential pandemic exposures to screeners and those entering the facility and/or construction jobsite. Temperature screenings and this protocol may only be used in the extraordinary circumstances of an existing pandemic as declared by the World Health Organization or the U.S. Centers for Disease Control.

There are NO exceptions to this screening procedure. All persons seeking entry to this job site must participate.

TEST REFUSAL – any person refusing to participate in the screening process will be denied entry to the site.

Entry Area

- Entrance access must be controlled by the screener/management.
- Entry area should be large enough so that persons awaiting entry can remain at least 6 feet apart during the entire screening process.
- If possible, use a physical barrier (such as a counter, waist level partition, window, etc.) between the entrant and the screener.
- Those conducting the screening process shall wear a full complement of Personal Protection Equipment (PPE) at all times during the screening process. listed below.

Screeners

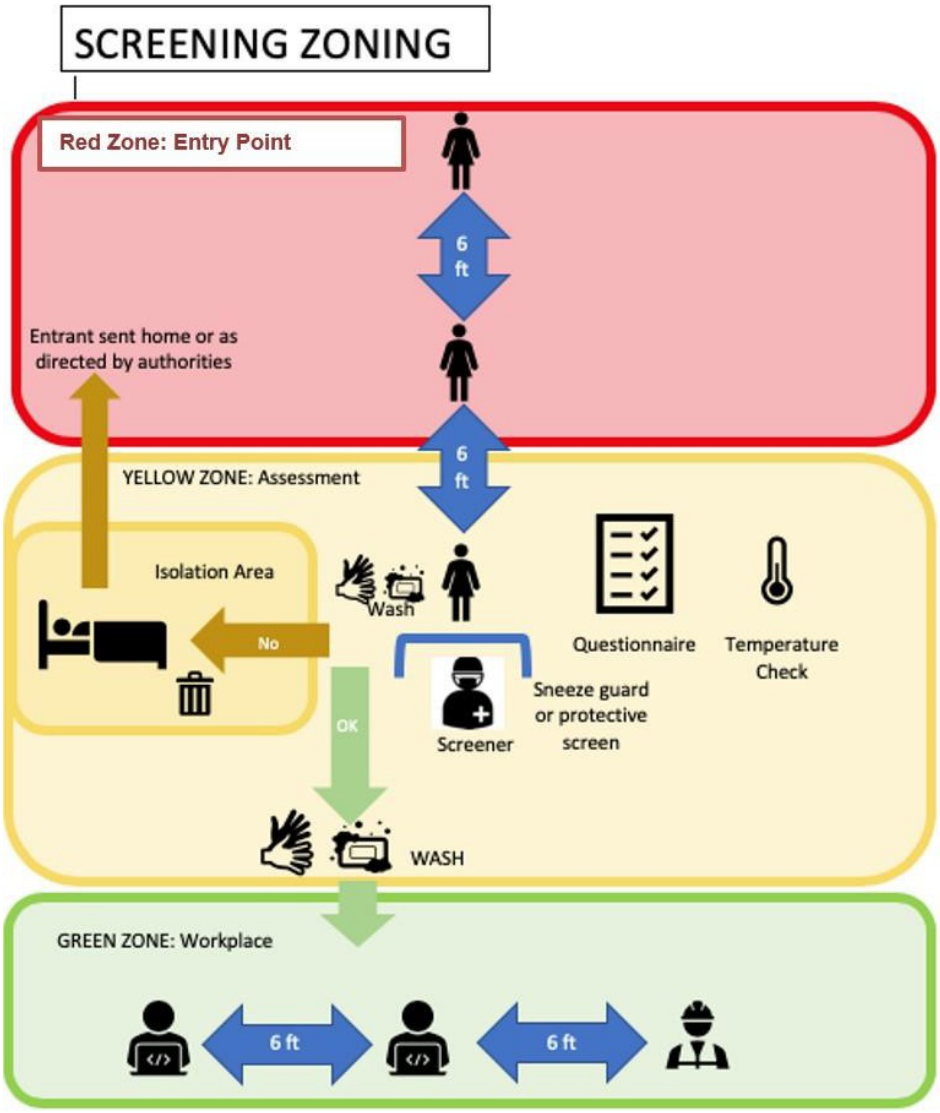
- Screener Qualification and Skill
  - It is preferable that those conducting the screening procedure have a health service background – with experience using Personal Protective Equipment (PPE).
  - If screeners with a health service background are not available AECOM staff may conduct the procedure providing they have been trained on both administering the procedure and the use of PPE.
  - The designated Site Safety Officer will act as the Project Screener.
- PPE with no barrier should include at minimum N-95/surgical masks and disposable gloves.
  - Additional PPE may be considered – i.e. gowns, facemasks or goggles.
  - Masks need to be changed once they are damp, and all PPE properly disposed after use
  - Gloves need to be changed when leaving the screening area (Yellow Zone).
- PPE with a barrier should include at a minimum CDC recommended face covering and disposable gloves.

Temperature screening

- The designated Site Safety Officer will perform the temperature function using a hand-held device and while using the appropriate PPE.
- If a hand-held device is not available, each entrant may test their own temperature using a disposable device. The entrant must show the results to the designated Site Safety Officer.

Screening Process

- Entrants should remain in the vehicle he or she arrived at the site in and don a face covering.
- The designated Site Safety Officer will approach the vehicle and the entrant will open the window approximately 2 inches. The window will provide a barrier between the screener and the entrant. If there are two people in the vehicle the person on the opposite side of the vehicle from the screener will exit the vehicle and remain within 1 foot of the vehicle while the other person is being screened.
- Entrants will be advised (by a poster and other communications) that they should not attempt to be screened if they are ill or have been in close contact with someone who has suspected or confirmed CORONAVIRUS.
    - Definition of **close contact** will be defined by local authorities and may vary.
    - *Suggested* definition of **close contact**: *social contact within 2 meters / 6 feet of a known or suspected CORONAVIRUS case for more than 15 minutes within the last 14 days.*
- Entrants will answer the Screening Questions on page 4 of this Procedure.
- Entrants will submit to having their temperature measured by the screener using a non-contact thermometer device.
- Information relevant to contact tracing will be gathered as part of the screening process.
- If the entrant appears well and has no symptoms or close contacts, the screener will allow the person to enter the construction site.
- The screener will document the results of each entrant who answer “Yes” to any of the questions and/or have a higher temperature than 100.4 degrees F.
- Any persons identified by the screeners as having a fever level temperature or close contacts will be refused entrance to the construction site.
- Any employee refused entry under this procedure will be advised to seek medical advice and follow health authority recommendations for monitoring, isolation, or quarantine before returning to the site. Employees should consult AECOM’s Pandemic Response Policy for more information.



Red Zone is the public/uncontrolled area before entering the screening area. Yellow zone is the screening area. Green zone is the area where the entrants who passed screening may enter.

Screening Questions

An outbreak of Coronavirus Disease 2019 (CORONAVIRUS) requires early and effective detection of suspected cases to limit the risk of exposure to others. Questions to ask all entrants are as follows:

QUESTIONS	YES	NO
1. Have you traveled to an CDC or WHO defined high risk geographic area in the past 14 days?		
2. Have you had contact with a confirmed case or a person under investigation for CORONAVIRUS within the past 14 days?		
3. Do you currently have fever, chills, cough, sore throat or shortness of breath?		
4. Does your temperature check show a fever? (>100.4*F)		

Note: CDC guidance will be regularly monitored and updates to these questions will be provided.

Screener Response Guide

QUESTIONS	IF YES
1. Have you traveled to a CDC or WHO defined high risk geographic area in the past 14 days?	Do not enter, return home and self - quarantine for 14 days.
2. Have you had contact with a confirmed case or a person under investigation for CORONAVIRUS within the past 14 days?	Do not enter, return home and self - quarantine for 14 days.
3. Do you currently have fever, chills, cough, sore throat or shortness of breath?	Do not enter, see primary care doctor or immediate care doctor. Follow instructions of doctor.
4. Does your temperature check show a fever?	Do not enter, see primary care doctor or immediate care doctor or retest or follow instructions of doctor to self-quarantine. **Cannot return until temp. is below 100.4 for 72 hours**

Contact Information for Construction Locations:

SITE SH&E DIRECTOR _____

SITE OPERATIONS EXECUTIVE _____

GENERAL SUPERINTENDENT _____

SUBCONTRACTOR EMPLOYER _____

Entry Screening for Affected Individuals Log

For use in contact tracking if applicable. The following table is a template for collecting information.

NOTE:

- Personal health information is confidential
- Screener shall complete one form per affected Individual
- Completed forms must be submitted to the AECOM site SH&E Director or medical service provider for secure file storage and should not be shared with anyone other than the screener who collected the form, the site SH&E Director, or approved medical service provider without express approval from the AECOM site SH&E Director.
- The information collected cannot be used for any other purposes and must be anonymized or securely deleted when no longer required for the pandemic purpose.

Affected Name	Employer	Foreman	Screen Outcome Questions 1,2,3 or Temperature	Date/Time	Instructions

Temperature screening

Every construction site location is unique, and a method of temperature screening must be chosen that best suits the circumstances. This template protocol must be in place for confirming temperature readings in anyone identified as having a fever as determined by this process.

Equipment must be properly maintained. People performing the screening must be trained in the protocol and how to use the equipment.

Temperature Screening Equipment

It is important to choose equipment that has been accepted as an approved method of measurement by relevant authorities, such as the US Food and Drug Administration.

Thermometers

- Contact Thermometers: In the past, thermometers which required contact with the body were used to measure temperature. They involve physical contact between the thermometer and the person who is screened.

Non-Contact Thermometers:

Allow a person's temperature to be taken without direct contact with the body. They are handheld devices that are usually aimed at the forehead or temple from about 1 inch (2.5 cm). They provide a digital temperature reading in one to two seconds. These are the preferred devices. Thermal Screening Devices

Thermal scanners are used to take a person's temperature from a greater distance than other noncontact thermometers. This makes them a good choice for use in mass screening situations however, they are costly.

A large variety of Infrared Thermal Detection systems (ITDS) are available. They range from relatively inexpensive hand-held "point-and-shoot" devices to screen a smaller number of people, to expensive mounted cameras displaying on separate monitors that are connected to software which sounds an alarm when a fever is detected. These systems are specifically developed for processing large numbers of people quickly.

Screeners must be familiar with process for managing potential entrants who are approved for work as well as those who must be restricted from entering the construction site.

Where possible there should be a holding area where entrants who have recorded an initial fever level temperature may wait for 10-15 minutes. After this waiting period entrants may have their temperature re-measured and a new determination made as to whether or not they will be allowed entrance to the construction site.

The holding area must have seating and shade. If entrants choose to not retest, they may leave the area and return at another time and day for a retest.

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	Field and Field Office – Precautions for Coronavirus	**Control #:**	Rev #4 (4/13/2020)

Project Name:	Residential Properties Remedial Action Study Area in Corning, New York	Client:	Corning Incorporated	**Date:**	2020
Permits Required? (list):	NA	**Work Location:**	Corning, NY		

THIS THA MUST BE FULLY REVIEWED AND ACKNOWLEDGED DAILY BY ALL AECOM STAFF and AECOM SUBS ON-SITE

All job steps, hazards, work practices & PPE are to be clearly understood and implemented. All necessary revisions have been written on the THA.

Required PPE:	☐ Hard Hat ☒ Safety Glasses ☐ HiVis Vest ☐ Safety Toe Boots ☒ Gloves: Disposable, Work, etc based on task ☐ Hearing Protection ☒ Other: See below
	For certain tasks (see THA below) the following are required: Potable water and soap (preferable) or hand sanitizer w/ 60% alcohol Paper towels Disinfectant wipes Tissues Nitrile gloves Safety glasses or goggles CDC recommended cleaning supplies Face covering if you are not able to maintain 6' social distance or where required by client or local order. Face coverings can be made from household materials by using needles, thread, cloth, tee-shirts, bandanas, etc. KN95, N95, dust/face masks are also acceptable. Local requirements may vary. PPE Note: Consider checking sources such as gas stations and specialty markets, as these may have equipment or materials not available at general grocery stores. If the above products are unavailable diluted bleach solutions can be made as a substitute, see the final step of this THA for instructions and precautions.
Tools & Equipment:	

REMINDER: Use 4-Sight at the start of, and continuously throughout the job/task to identify additional and/or hazards to act on!

Job Steps *List all steps required to perform a task in the sequence they are performed*	**Potential Hazards** *How could you be hurt? What would the injury be?*	**Risk** *(initial)*	**Critical Actions to Mitigate Hazards** *List control measures required to eliminate, control or protect against the potential hazards associated with each job step to minimize the risk of injury or environmental impact.* ***Identify any 'Stop Work' triggers.***	**Risk** *(final)*
1. Fitness for Duty check (performed at home prior to work)	1a. Being unfit for duty – impacted by illness including coronavirus	**15**	1a. Ensure you are fit for duty. If you feel unwell or show any signs or symptoms of the coronavirus, do not come to work. Current CDC guidance is that if you have a temperature above 100.4 F [37.8 C] (update this THA if the temperature considered a fever is lower in your Area or Region), or in close contact with someone suspected of having the coronavirus, **then you must stay home**. If you have an elevated temperature, do not come to work and contact your healthcare provider. Also contact the AECOM Occupational Health group through the AECOM hotline. By coming to work and onto the project site, employees are self-certifying that they do not have a temperature or show other signs of being unwell and are able to work within the guidelines of the CDC.	4

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	General Field Work and Office Work	Control #:	Rev #4 (4/13/2020)

On-Site Edits:					
2. Driving To and From Site	2a. Being in an enclosed space with poor air circulation in close contact with other people.	15	2a. Drive separately when possible. Minimize number of people in one vehicle. Avoid short-term rental of vehicles if possible. Use personal vehicles long-term rentals or company truck when possible. If personal vehicles are used, they must be in good condition and fit for purpose. If sharing a vehicle occurs, roll down the windows to let air circulate. No more than 2 people per vehicle. Passenger to sit in rear passenger side of vehicle.	4
	2b. Touching contaminated surfaces in vehicle.	15	2b. Use disinfectant to wipe down all "touch point" surfaces in vehicle, including door handles, steering wheel, controls on dash, and any other parts of the cab you may touch. Do this at least daily. Do not touch face while driving. Wash hands before and after driving. Wear disposable, nitrile gloves when possible while driving (Use a new pair at the start of each driving period and when appropriate). Have soap, antibacterial hand wipes or spray, or 60% + alcohol hand sanitizer in vehicles and accessible at all times and use on high-touch surfaces after encounters with the public.	4
On-Site Edits:					
3. General Field Work	3a. Working Around Others	15	3a. If experiencing signs or symptoms of COVID-19 infection, such as fever, dry cough, or other flu-like symptoms, do not report to work. Follow procedures in the AECOM Guidance for Coronaviruses for information on reporting and handling potential exposures. **Personnel shall maintain at least 6-foot distance from each other.** Practice social distancing at tailgate meetings and in break rooms and job trailers. Limit the number of people in job trailers and other confined areas at any one time so that this distance can be maintained. If possible, hold meetings outside. If indoors, open window(s) for circulation. Wipe down window handles prior to opening and use gloves to open. Even when practicing social distancing, we must limit the amount of people in any one group to less than 10 people. Clean hands often with soap and water for at least 20 seconds after using the restroom, after you have been in a public place, before and after eating or after blowing your nose, coughing, or sneezing. If soap and water are not readily available, use a hand sanitizer that contains at least 60% alcohol. Cover all surfaces of your hands, including around and under fingernails, and rub them together until they feel dry. Wear safety glasses and gloves (nitrile or other work gloves) to avoid contact and to reduce touching face, eyes, nose, and mouth. Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw used tissues in the trash. Immediately wash or sanitize your hands. Face coverings can be made using household materials such as needles, thread, cloth, tee-shirts, bandanas, etc. Access this link for more information and assistance. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html	4

	3b. Handling Shared Equipment and Tools	15	3b. Wipe down and disinfect equipment before use with soap/water or alcohol wipes. Wear disposable gloves if possible or regularly wash hands when handling tools or equipment and replace gloves regularly or wash hands, especially before eating or drinking.	4
	3c. Exposure during Lunch and Bathroom Breaks	15	3c. Be sure to wash hands with soap/water whenever a bathroom is nearby. At minimum, do so during bathroom and lunch breaks. Use a paper towel to door handle when exiting bathroom. If using outside toilet facilities (i.e. Porta Johns), wash hands with soap and water or hand sanitizer both before and after opening/closing the door. If wearing nitrile gloves, change gloves prior to using the toilet and doff and dispose of in a trash receptacle when finished. Use hand sanitizer after you dispose of the gloves. Where possible, employees are encouraged to pack meals and snacks as needed for the project duration and avoid visiting stores and restaurants. If necessary, modify your schedule to avoid restaurants and public restrooms during peak, i.e., crowded, periods to minimize contact with the public. Use drive-through service for food pick-up if available. When eating lunch as a group, try to do so outside or in a space with windows open (wipe down windows prior to opening). Maintain a distance of 6 feet and do not share dishes (e.g., bag of chips, communal salad bowl, etc.) Refrain from sharing a field office coffee pot.	4
	3d. Lack of food/water/supplies		Many locations may have shortages of food, water, or supplies or closed restaurants. Bring food, water, and supplies to allow you to work a full shift without additional provisions.	
On-Site Edits:				
4. Office Work	4a. Working around others	15	4a. Work from home when possible. Clean hands often with soap and water for at least 20 seconds after using the restroom, after you have been in a public place, before and after eating or after blowing your nose, coughing, or sneezing. If soap and water are not readily available, use a hand sanitizer that contains at least 60% alcohol. Cover all surfaces of your hands, including around and under fingernails, and rub them together until they feel dry. Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw used tissues in the trash. Immediately wash or sanitize your hands. Sit at least six feet apart from others. Change work stations to accommodate for this. Even if you are practicing social distancing, we must still limit groups of people to less that 10. Maintain social distancing during tailgate meetings and/or THA reviews, supervisor should seek verbal agreement from all and note this rather than passing pen and clipboard around for	4

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	General Field Work and Office Work	Control #:	Rev #4 (4/13/2020)

	4b. Encountering frequent "touch points" and handling shared equipment	15	signature. Make hand-sanitizers, sanitizing wipes, and other hygienic supplies readily available. Do not eat or hang out in common areas. 4b. Wipe down keyboards, mouse, phone, headset/headphones, any other "touch points". Limit contact of shared items. Wipe down surfaces before coming into contact with them. Wash hands after handling or wear disposable gloves. In reception areas, use your own pen to sign in and out of offices, and do not eat candy out of candy dishes. Assign someone to clean AND disinfect frequently touched surfaces daily. Follow the manufacturer's instructions for all cleaning and disinfection products (e.g., concentration, application method and contact time.	4
On-Site Edits:				
5. Traveling/Out of Town Work	5a. Being in an enclosed space with poor air circulation in close contact with other people.	15	5a. Drive separately when possible and complete a Journey Management Plan for travel over 250 miles. Minimize number of people in one vehicle. Avoid short-term rental of vehicles if possible. Use personal vehicles long-term rentals or company truck when possible. If personal vehicles are used, they must be in good condition and fit for purpose. If sharing a vehicle occurs, roll down the windows to let air circulate. For projects of multiple days duration, plan on traveling home rather than staying in a hotel if this can be done in accordance with AECOM's fatigue management plan. Where possible, employees are encouraged to pack meals and snacks as needed for the project duration and avoid visiting stores and restaurants. If necessary, modify your schedule to avoid restaurants and public restrooms during peak, i.e., crowded, periods to minimize contact with the public. Use drive-through service for food pick-up if available.	4
	5b. Touching contaminated surfaces in vehicle.	15	5b. Use disinfectant to wipe down all "touch point" surfaces in vehicle, including door handles, steering wheel, controls on dash, and any other parts of the cab you may touch. Do this at least daily. Do not touch face while driving. Wash hands before and after driving. Wear disposable, nitrile gloves when possible while driving (Use a new pair at the start of each driving period and when appropriate). Have soap, antibacterial hand wipes or spray, or 60% + alcohol hand sanitizer in vehicles and accessible at all times and use on high-touch surfaces after encounters with the public.	4
	5c. Exposure at hotels	15	5c. Where logistically feasible, if a project extends beyond a day's duration, plan on traveling home rather than staying in a hotel if this can be done within AECOM's fatigue management program. Book through CWT and in known chains to ensure maximum cleanliness, even if for that the hotels needs to be some miles away from the site. If long stay, there may be other options to consider such as Airbnb (full house) to minimize contact with people. Ask for the room in the first floor to avoid using the elevator if possible. Maintain social distance (minimum six feet) with people. Do not touch anything if not needed in your hotel or room as the first measure. If in doubt of cleanliness of the	4

Task Name:	General Field Work and Office Work	Control #:	Rev #4 (4/13/2020)

				accommodation, bring it up to the accommodation responsible person. Wipe down all touch point surfaces in hotel room with disinfectant or alcohol wipes. Put a "do not disturb" sign on door handle to prevent hotel staff from entering room to clean during the day. If possible, open window(s) for circulation. Wipe down window handles prior to opening and use gloves to open. Refrain from using hotel room coffee machines. Wash hands frequently. Have in mind each location is different, if you have questions or concerns from a specific location, contact your SH&E Manager.	
On-Site Edits:					
6. Preparing bleach solution as a substitute for other disinfectants	6a. Inhalation hazard	**15**		6a.. Never mix bleach with anything other than water. Use only household bleach solutions, not concentrated bleach; if you need to use concentrated bleach a specific THA will need to be generated.	1
	6b. Hazard of contact with bleach (skin and eye hazard)	6		6b. Review manufacturers instructions and warning prior to use. Use safety glasses and nitrile gloves during the mixing process and pour bleach slowly into measuring containers. Perform this task in a well-ventilated area. Pour the bleach into the water, not the water into the bleach.	1
	6c. Untrained employees performing task	6		6c. Hazard Communication (in US) or WHIMS (in Canada) training is required.	1
	6d. Transportation hazards	6		6d. Only transport 'household' quantities of bleach (i.e. 2-3 gallons) at a time.	1
	6e. Unsafe final product	6		6e. Mix 5 tablespoons (1/3rd cup) bleach per gallon of water or 4 teaspoons bleach per quart of water. Label container you store the material in clearly "BLEACH"	1
	6f. Product damages surfaces	5		6f. Test on small, inconspicuous surface first. Never use on skin or eyes!	1
On-Site Edits:					

Task Hazard Assessment

Task Name:	General Field Work and Office Work	Control #:	Rev #4 (4/13/2020)

Additional Notes:

Ensure required supplies (i.e., disinfectant spray/wipes, soap/hand sanitizer, nitrile gloves) are available prior to starting work. Request re-supply if stock runs low.

Use disinfectant products that contain at least 70% alcohol. Use alcohol-based hand sanitizer that contains at least 60% alcohol. Wash hands with soap and water whenever available. Remember that soap (including bar soap) is generally available and is considered superior to hand sanitizer or disinfectant wipes/spray. If disinfectants are unavailable, prepare diluted bleach solution as described on page 1 and use in their place.

Common touch points and surfaces include but are not limited to:

- Arms on chairs
- Table tops
- Doorknobs and handles
- Countertops
- Elevator Buttons
- Coffee Pots
- Refrigerator / microwave / dishwasher / toaster handles
- Water Dispensers
- Cabinet and file drawer knobs / handles
- Shared office supplies such as staplers, paper cutters, scissors, packaging tape dispensers, writing utensils
- Phone receivers, keypads
- Copier / printer / fax control buttons
- Sink faucets
- Light switches

If any AECOM staff are showing any possible symptoms of or have been in recent close contact with others showing symptoms of CORONAVIRUS, **STOP WORK**. Notify the site supervisor and the project manager and go home and/or stay home. Contact the AECOM Incident Reporting Hotline (1-800-348-5046) and/or the AECOM Nurse Line (1-512-419-5016).

Visit the CDC webpage on cleaning and disinfecting procedures: CDC Guidance for Community and Residential Cleaning-Disinfection for Coronavirus (website address: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cleaning-disinfection.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fprepare%2Fcleaning-disinfection.html)

A list of approved disinfectants for use against SARS-CoV-2, the cause of CORONAVIRUS, is available here: US EPA List of Disinfectants Effective Against Coronaviruses (website address: https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2)

Task Hazard Assessment

AECOM Imagine it. Delivered.

Task Name:	General Field Work and Office Work	Control #:	Rev #4 (4/13/2020)

All Employees:

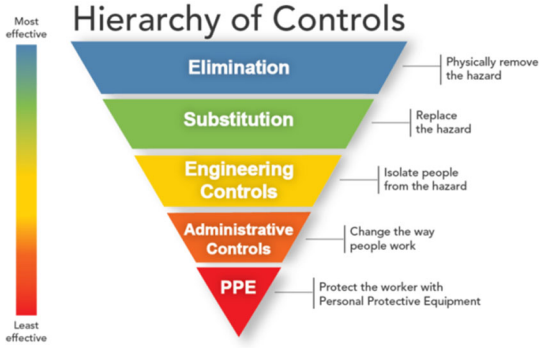
STOP WORK if uncertain about safety or if a hazard or additional precaution is not recorded on the THA.

Be alert, recognize and communicate any changes in scope, personnel or conditions at the worksite to the supervisor.

Use **4-Sight**, AECOM's last-minute risk assessment process continuously throughout the day by asking yourself and your co-workers to assess your task, hazards, and mitigations. Amend the THA when needed.

- ***What am I about to do?***
- ***What can go wrong?***
- ***What can be done to make it safer?***
- ***What have I done to communicate the hazards?***

For a more thorough identification of hazards, ask "What else could go wrong?" using the Hazard Categories



- ***Most hazards need more than one control***
- ***What should you do? Stack your controls***
- ***PPE can NEVER be your only means of protection***

Worker Sign On	
I participated in the on-site review and fully understand the content of this Task Hazard Assessment.	
Printed Name	**Signature**
1. Supervisor:	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Visitor Acknowledgement
Visitors review task hazards and acknowledge understanding
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Submit a new THA for addition to the DCSA THA Library or send THA improvement suggestions to AECOM.

AECOM

APPENDIX E

COMMUNITY AIR MONITORING PLAN (CAMP)

AECOM

APPENDIX E
Community Air Monitoring Plan
Corning-Painted Post School District Soil Cover Sampling Work Plan

Corning, NY
NYSDEC Project ID 851046

June 2020

Prepared for

Corning Incorporated
Corning, New York

Prepared by

AECOM Technical Services, Inc.
Latham, New York 12110

Project Number 60599493

TABLE OF CONTENTS

LIST OF ACRONYMS

AECOM	AECOM Technical Services, Inc.
CAMP	Community Air Monitoring Plan
HASP	Health and Safety Plan
mg/m^3	milligrams per cubic meter
µm	micrometer/micron
$µg/m^3$	micrograms per cubic meter
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
pDR	personal DataRAM
PM_{10}	particulate matter 10 microns or less in diameter

1. INTRODUCTION

This Community Air Monitoring Plan (CAMP) has been prepared by AECOM Technical Services, Inc. (AECOM) on behalf of Corning Incorporated to detail the dust control and air monitoring procedures to be performed during the execution of sampling activities at the Study Area located in Corning, New York, bound by the Chemung River to the south; Post Creek and Interstate 86 to the east and north; and the Guthrie Medical Center, the City of Corning Fire Department, and Centerway to the west (Study Area). This air monitoring plan will supplement the existing Health and Safety Plan (HASP).

As presented in the Corning-Painted Post School District Soil Cover Sampling Work Plan (Soil Cover Sampling Plan), sampling activities planned to be conducted within the Study Area may include subsurface soil sampling. Air monitoring for dust particulates and dust control techniques will be performed during subsurface soil sampling activities.

2. METHODS

Perimeter air monitoring for dust particles will be conducted at two stations, one generally located upwind, and one generally located downwind of any intrusive characterization activity. In addition, due to the close proximity of athletic playing fields and schools, more stringent CAMP requirements will be necessary. When work areas are within 20 feet of these locations, the continuous monitoring locations for particulates must reflect the nearest potentially exposed individuals. The use of engineering controls such as dust barriers will be considered to prevent exposures related to the work activities and to control dust and odors. Where possible, consideration will be given to implementing the planned activities when potentially exposed populations are at a minimum (i.e. during hours when children are not likely to be present). Common-sense measures to keep dust and odors at a minimum around the work areas will also be implemented to ensure that the children are protected at all times. No visible dust will leave the work area.

As the location of sampling activities will change, the location of the monitoring point relative to the activities will be modified as needed. The monitoring location will be positioned to provide

data representative of potential migration of dust in the direction of nearby receptors. The perimeter monitoring equipment will be portable, which will allow the monitoring network to be adjusted, if needed, to adapt to changes in activities or meteorological conditions.

Particulate monitoring is the measurement of fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, in particulate matter 10 microns or less in diameter (PM_{10}), in the ambient air. During subsurface soil sampling and groundwater monitoring well installation, the generation of dust particles will be monitored. The equipment selected to monitor PM_{10} will be the Thermo Electron Corporation personal DataRAM (pDR), or equivalent. The pDR is a light-scattering monitor, designed for measuring airborne particulates such as aerosols and dusts. The units are portable and measure the concentration of airborne particulate matter (up to 10 micrometers [µm]/microns in size) continuously and in real time, with results expressed in milligrams per cubic meter (mg/m^3), or 1,000 micrograms per cubic meter ($\mu g/m^3$). Particulate concentrations can be measured over the following ranges: 0.01 – 10 mg/m^3 (equivalent to 10 – 10,000 $\mu g/m^3$) and 0.1 – 100 mg/m^3 (equivalent to 100 – 100,000 $\mu g/m^3$). The pDR meets the performance standard for a real-time particulate monitor according to the New York State Department of Environmental Conservation (NYSDEC) Technical Guidance for Site Investigation and Remediation, May 2010.

3. CALIBRATIONS

Calibration of instruments will be performed prior to the start of daily activities. Additional calibrations will be performed as needed or whenever maintenance is performed involving the functional elements of the unit. Calibration data will be documented in the field log book or on designated calibration log sheets.

4. DATA RECORDING

The data collected during the monitoring program will be used for real-time data display and notification to on-site personnel when the action levels are exceeded (action levels are discussed in Section 5). The ambient air monitoring data will be recorded in the site field logbook or designated field sheets and the results of the air monitoring will be communicated to the NYSDEC

and New York State Department of Health (NYSDOH) on a scheduled basis (i.e. daily for levels which require actions, weekly for routine monitoring data).

5. ACTION LEVELS

The action level established herein will be used as an indicator that potential excessive migration of dust particles may be occurring during the characterization activities. Monitored ambient air concentrations that exceed the action level will result in actions being taken to more stringently control fugitive emissions or trigger quantitative sampling.

The NYSDEC recommended action level for fugitive dust is 100 $\mu g/m^3$ greater than background (measured at the upwind location) for a 15-minute period. At this concentration, work may continue with dust suppression techniques provided that no visible dust is migrating from the working area and the downwind particulate levels do not exceed 150 $\mu g/m^3$ greater than background (measured at the upwind location). If the downwind particulate levels exceed 150 $\mu g/m^3$ greater than background (measured at the upwind location), work will stop and dust suppression techniques will be re-evaluated.

If the perimeter monitors detect concentrations greater than the 100 $\mu g/m^3$ action level, Site supervisory personnel will be notified. Notifications will be sent to the AECOM Site Manager and the Site Health and Safety Officer. Upon receiving the notification message, the supervisor will assess the situation and initiate appropriate administrative and/or engineering controls to mitigate the migration of dust particles.