bullock environmental, llc 4924 5th avenue south, birmingham, alabama 35222 t 205.876.1715 f 205.871.7379

February 1, 2021

Mr. Andrew Riddle
U.S. EPA, Region 4
Atlanta Federal Center
61 Forsyth Street S.W.
Atlanta, Georgia 30303-8960

Subject: **Site-Specific Quality Assurance Project Plan (QAPP) Addendum 1B**
City of Dothan
Aunt Katie's Garden Expansion
602 Linden Street
Dothan, Houston County, Alabama
COOPERATIVE AGREEMENT #: BF-01D11020-0
VCP Site No. 461-069-271
Bullock Environmental, LLC Project #: 20-DOTH02

Dear Mr. Riddle:

On behalf of the City of Dothan, Bullock Environmental, LLC submits the attached *Site-Specific Quality Assurance Project Plan (QAPP) Addendum 1B* for the above-referenced Site.

If you have any questions or comments concerning this document, please call us at (205) 876-1715. Alternatively, you may reach us by email at doug.bullock@bullockenvironmental.com.

Sincerely yours,
BULLOCK ENVIRONMENTAL, LLC

Douglas A. Bullock, CHMM
Principal

cc: Mr. Bob Wilkerson, City of Dothan

Enclosure

bullock environmental, llc 4924 5th avenue south, birmingham, alabama 35222 t 205.876.1715 f 205.871.7379

February 1, 2021

Mr. Bob Wilkerson
Development Services
City of Dothan
Post Office Box 2128
Dothan, Alabama 36302-2128

Subject: **Site-Specific Quality Assurance Project Plan (QAPP) Addendum 1B**
City of Dothan
Aunt Katie's Garden Expansion
602 Linden Street
Dothan, Houston County, Alabama
COOPERATIVE AGREEMENT #: BF-01D11020-0
VCP Site No. 461-069-271
Bullock Environmental, LLC Project #: 20-DOTH02

Dear Mr. Wilkerson:

Bullock Environmental, LLC submits the enclosed *Site-Specific Quality Assurance Project Plan (QAPP) Addendum 1B* for the Aunt Katie's Garden Expansion. We will keep you posted on correspondence from Environmental Protection Agency (EPA) personnel and notify you upon approval. If you have any questions or comments, please call us at (205) 876-1715. Alternatively, you may reach us by email at doug.bullock@bullockenvironmental.com.

Sincerely,
BULLOCK ENVIRONMENTAL, LLC

Douglas A. Bullock, CHMM
Principal

bullock environmental, llc 4924 5th avenue south, birmingham, alabama 35222 t 205.876.1715 f 205.871.7379

Site-Specific Quality Assurance Project Plan (QAPP) Addendum 1B
City of Dothan
Aunt Katie's Garden Expansion
602 Linden Street
Dothan, Houston County, Alabama
COOPERATIVE AGREEMENT #: BF-01D11020-0
VCP Site No. 461-069-271
Bullock Environmental, LLC Project #: 20-DOTH02

Prepared for:

City of Dothan
Post Office Box 2128
Dothan, Alabama 36302-2128

February 1, 2021

BULLOCK ENVIRONMENTAL, LLC

Alison Dunagan
Senior Environmental Manager
February 1, 2021

Douglas A. Bullock, CHMM
Principal
February 1, 2021

Site-Specific Quality Assurance Project Plan (QAPP) Addendum 1B
City of Dothan
Aunt Katie's Garden Expansion
602 Linden Street
Dothan, Houston County, Alabama
COOPERATIVE AGREEMENT #: BF-01D11020-0
VCP Site No. 461-069-271

Prepared by:
Bullock Environmental, LLC
4924 5th Avenue South
Birmingham, Alabama 35222
205.876.1715

Douglas A. Bullock, CHMM — Date: 02/05/2021
Principal, Project Manager
Bullock Environmental, LLC

Alison Dunagan — Date: 02/05/2021
Senior Environmental Manager
Bullock Environmental, LLC

City of Dothan:

Mr. Bob Wilkerson — Date
Development Services

Environmental Protection Agency (EPA):

Andrew Riddle — Date
Brownfields Project Manager
U.S. EPA, Region 4

Alabama Department of Environmental Management (ADEM):

Gavin Adams — Date
Chief
ADEM Redevelopment Section, Industrial Hazardous Waste Branch

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FIGURES

APPENDICES

A. PROJECT MANAGEMENT

A1. TITLE AND APPROVAL PAGE

See above.

A2. TABLE OF CONTENTS

See above.

A3. DISTRIBUTION LIST

The following individuals will receive copies of the approved Site-Specific Quality Assurance Project Plan (QAPP) and subsequent revisions:

- City of Dothan Distribution List:
  - Bob Wilkerson, Planning and Development, City of Dothan, P.O. Box 2128, Dothan, Alabama 36302-2128; Phone: 334.615.3415; bwilkerson@dothan.org

- ADEM Distribution List:
  - Charmagne L. Boyd, Brownfields Project Manager, ADEM Redevelopment Section, Environmental Services Branch, Land Division, P.O. Box 301463, Montgomery, Alabama 36130-1463; Phone: 334.394.4305; charmagne.boyd@adem.alabama.gov

- EPA Distribution List:
  - Andrew Riddle, Brownfields Revitalization Project Manager/Officer/Designated Approving Official (DAO), Brownfields & Redevelopment Section, U.S. EPA Region 4, Atlanta Federal Center, 61 Forsyth Street SW, Atlanta, Georgia 30303; Phone: 404.562.8437; Riddle.Andrew@epa.gov

- Bullock Environmental, LLC (Bullock) Distribution List:
  - Douglas A. Bullock, Principal, 4924 5th Avenue South, Birmingham, Alabama 35222; Phone: 205.876.1715; doug.bullock@bullockenvironmental.com
  - Alison Dunagan, Senior Environmental Manager, 4924 5th Avenue South, Birmingham, Alabama 35222; Phone: 205.876.1715; alison.dunagan@bullockenvironmental.com
  - Samuel Smith, Senior Geologist, 4924 5th Avenue South, Birmingham, Alabama 35222; Phone: 205.876.1715; sam.smith@bullockenvironmental.com

All personnel, including all field staff, will receive applicable sections of this Site-Specific QAPP Addendum and subsequent revisions.

A4. PROJECT/TASK ORIENTATION

This section describes the organizational structure, lines of authority, and responsibilities of key project individuals for this brownfield project. The organizational structure is designed to provide clear lines of authority and responsibility to ensure that proper communications are maintained; technical resources and subcontractors are managed; project schedules, performance, and costs are monitored; deficiencies are identified and rectified; and high-quality project deliverables are provided. Roles and responsibilities will include the following:

- Douglas A. Bullock, CHMM, Project Principal: Mr. Bullock will function as the primary contact for the City of Dothan, ADEM, and EPA on this project. He will also be responsible for overall project direction and Quality Assurance/Quality Control. As the founder and Principal of Bullock he will ensure that the appropriate resources are committed and actively engaged and that quality and safety protocols are observed.
- Alison Dunagan, Technical Advisor and Quality Assurance/Quality Control Officer: Ms. Dunagan will manage administrative and reporting operations under the Grant while overseeing Quality Assurance/ Quality Control.
- Samuel Smith, AL-PG, Project Manager/Field Team Leader: Mr. Smith will be responsible for project team field coordination, planning, schedules, subcontractor management, and overall supervision of sampling and remedial tasks.
- Charmagne L. Boyd, ADEM Brownfields Project Manager: Assigned by ADEM, the ADEM Project Manager provides technical and administrative guidance regarding the Alabama Brownfields Program and use of the Brownfield Risk Evaluation Procedures and community involvement.
- Andrew Riddle, EPA Brownfields Revitalization Project Manager/Officer/DAO: Assigned by the EPA, the EPA Project Manager has the responsibility to oversee and monitor the grant. As part of that responsibility he must ensure the process described in the workplan is followed. The DAO's role is to provide technical reviews of the Generic QAPPs, Site-Specific QAPP Addendum and Addenda that are generated. This includes the approval of the Generic QAPP, subsequent revisions, and the Site-Specific QAPP Addenda.

In addition, the following company will be subcontracted for this project:
- Action Environmental will be subcontracted to assist in the removal and proper disposal of soil from the Site. Mr. John Milledge will be the primary contact.
- Pace Analytical will be subcontracted for laboratory services. Ms. Heather Wagner will be the primary contact.

All personnel assigned to the project will receive and follow applicable sections of the Generic QAPP, subsequent revisions, and the Site-Specific QAPP Addenda. The proposed project team is shown in the Project Organization Chart in **Appendix A**.

A5. PROBLEM DEFINITION/BACKGROUND

A5.1 Site Location

The Site is located at the intersection Linden Street and Whiddon Street (adjacent to 602 Linden Street) in Dothan, Houston County, Alabama. It is depicted on the United States Geological Survey (USGS) 7.5-minute Topographic Quadrangle *Dothan West, Alabama*, dated 1981 (**Figure 1**). It is approximately located at north latitude 31°13'56.72" and west longitude 85°24'1.44" and consists of a 0.15-acre vacant parcel of land; the eastern portion is wooded with the remainder covered by grass. A Site map is included as **Figure 2**.

Properties surrounding the Site consist of mixed commercial and residential use with Whiddon Street located immediately north (followed by residences to the north and northeast), residential dwellings to the east, Aunt Katie's Community Garden to the south, and Linden Street (followed by residential dwellings) to the west.

A5.2 Site History and Prospective Use

Historical records indicate that the Site was undeveloped from at least 1920 until at least 1951 when it was developed as an electrical substation, which operated there until approximately 1997. The Site has reportedly remained vacant and undeveloped since the removal of the electrical substation.

Given the Site's proximity to Aunt Katie's Community Garden (immediately south), Aunt Katie's Community Garden intends to acquire the Site from the City of Dothan at the conclusion of cleanup activities and approval of those remedial activities by the EPA and ADEM through the Alabama Voluntary Cleanup Program as a Non-Responsible Party Applicant. Once cleanup is complete and the Site is transferred to Aunt Katie's Community Garden, the Site will be used to expand its growing capacity by constructing a series of tunnel houses to achieve higher crop yields.

A5.3 Summary of Previous Assessments, Reports, and Responses

The chronology presented summarizes the Site assessments conducted since February 2018.

Phase I Environmental Site Assessment (ESA), February 2018. PPM Consultants, Inc. (PPM) completed a Phase I ESA of the Site in conformance with the scope of American Society of Testing & Materials (ASTM) Standard Practice E 1527-13. The following recognized environmental conditions (RECs) as reported by PPM are presented below:

"The subject property was occupied by an electrical substation from at least 1961 to at least 1997. It appears that the substation was operated by Alabama Power until at least 1972 and possibly until at least 1981. The 1968 Sanborn map indicates a "transformer" occupied the majority of the southern half of the property. The 1981 sketch provided by Dothan Utilities indicates a transformer pad occupied the central portion of the site. A notation labeled "APCo" is shown on the sketch, which is the abbreviation for Alabama Power. Electrical substations typically use transformers that contain high capacities of insulating, dielectric oil. Between 1930 and 1971, dielectric oils were typically composed of polychlorinated biphenyls (PCBs) based on their chemical stability, low flammability, and high dielectric constant. The characteristics that make PCBs such as good dielectric fluid also allow them to persist in the environment. PCBs are hazardous substances regulated under the Toxic Substances Control Act (TSCA). In 1971, PCBs began to be phased out in new transformer construction and were federally banned in new transformers after 1979. Even so, PCBs were allowed to remain in older, serviceable transformers after 1979 as long as they met certain conditions. Releases to soil and/or groundwater within a substation can occur due to transformer fires, service, overfills, and leaks. There was no physical evidence of the former substation during the site visit. Aerial photographs from 2003 to 2014 and current site observation reveal that the soils in the center of the property have been exposed and unable to support the growth of vegetation since a short time after the removal of the substation in around 1997. The reason for the exposed soil is unknown, but this condition may be a residual effect of the substation. It is not known whether a release has occurred to the property; however, the substation operation (1961-1997) overlapped the periods that PCB-transformers were likely in use (1930-1979±) and before any form of regulatory oversight could have existed (EPA-1970, TSCA & RCRA-1976, ADEM-1982). Because the past use of PCBs on the property is very likely and some form of release before regulation is also likely, the former electrical substation on the subject property represents a REC in connection with the property."

Phase II Environmental Site Assessment, August 2018. PPM conducted a Phase II ESA in conformance with the scope of work outlined in the May 2018 Site-Specific QAPP Addendum No. 1A. Field work for the Phase II ESA was conducted between July 26, and July 29, 2018, and included the installation of nine soil borings to evaluate the effects of the former use of the Site as an electrical substation.

In an effort to assess the depth to underlying groundwater, field personnel advanced soil boring SB-1 to a depth of approximately 40 feet below land surface (BLS) and found no evidence of saturated conditions. With groundwater ruled out as a concern, the Phase II ESA focused on near surface soils, reducing the depth of each remaining boring to 12 feet BLS. The investigation yielded 18 soil samples (one surficial [0-1 foot BLS) and one subsurface [1-4 feet BLS] collected from each location.

Data collected from the Phase II ESA provided the following analytical results:

- Volatile Organic Compounds (VOCs) and Polychlorinated biphenyls (PCBs), while detected above laboratory reporting limits in two of the 18 soil samples, were not present above applicable residential screening values;
- Semi-volatile organic compounds (SVOCs), while detected in numerous soil samples above laboratory reporting limits, were only detected above residential screening values in boring SB-5 (1-4 feet BLS), located in the central section of the Site. The SVOCs present above residential screening values included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene; and
- Arsenic was present above residential screening values in 16 of the 18 soil samples collected for analysis. Only two locations (SB-1, 0-1 foot BLS and SB-5, 0-1 foot BLS) contained no arsenic above laboratory reporting limits. The remainder of the arsenic concentrations ranged from 0.87 milligrams per kilogram (mg/kg) in boring SB-4 (0-1 foot BLS) to 1,100 mg/kg in boring SB-5 (1-4 feet BLS). The arsenic levels noted in onsite soil appeared pervasive and independent of depth (e.g. higher concentrations detected from the 1-4-foot depth interval in some instances).

While arsenic is a naturally-occurring element, the results noted in onsite soil fall well outside of normal background levels (averaged to be 7.4 mg/kg, per the USGS Professional Paper PP 1270). These elevated arsenic levels, combined with the localized SVOCs noted in the central section of the Site indicate an exposure risk to area residents via dermal contact, inhalation and ingestion of dust, and stormwater runoff.

Considering the results of assessment activities conducted at the Site, the primary chemical of concern (COC) to be addressed is arsenic in surficial and shallow soil (detected across the majority of the Site area). Localized Polynuclear Aromatic Hydrocarbons (PAHs) were also detected in the central section of the Site.

Characterization of the release is less certain; however, the source appears related to the former electrical substation operations and the possible use of herbicides/pesticides on the ground surface over its years of operation. Arsenical pesticides were the predominant pesticides (insecticides/rodenticides) and herbicides in the American market until repeated studies demonstrated a strong correlation of certain formulations to significantly increased cancer rates. This resulted in EPA banning arsenate pesticides in the 1980s and phasing out three of the four remaining arsenical pesticides by 2009. Given the operational period of the electrical substation (1950s until the 1990s) before these pesticides were banned, it is possible (if not likely) that these compounds were applied to the ground surface repeatedly to control both vegetation growth and rodents within the substation boundary .

According to *Arsenical Pesticides, Man, and the Environment* (EPA, 1972), soils treated chronically with arsenical pesticides reportedly contain arsenic concentrations ranging from 1.8 mg/kg to 830 mg/kg versus 0.5 mg/kg to 14 mg/kg for untreated soils. More specifically, arsenic trioxide, the trivalent form of arsenic (and the primary component of banned arsenical pesticides) was determined to be both more toxic and more persistent in the environment than other forms.

These data, combined with the widespread nature of arsenic in surficial and shallow soil and the absence of notable PCB contamination, points to longterm surface application of arsenical pesticides as the source of elevated arsenic (and localized PAHs) in soil.

A6. PROJECT/TASK DESCRIPTION AND TIMELINE

A6.1 Description of Remediation

The primary COC at the Site is arsenic present above the residential EPA Regulatory Screening Level (RSL) over the entire property. The data indicates the arsenic that may have been applied in the past to the loose, sandy surface soils have over time leached to subsurface clayey soils where it was able to accumulate. PAHs were also detected at concentrations above residential RSLs but were limited to a singular boring in the center of the Site.

Considering the data summarized above, Bullock anticipates the proposed remedial activities to include the following :

1. Removal of the top two feet of COC-affected soil on the Site;
2. Characterization of waste material for subsequent disposal at a permitted landfill (under a solid waste profile approved by ADEM);
3. Replacement of the excavated soil area with pre-screened, clean fill material;
4. Restoration of the ground surface with vegetation or other suitable cover (i.e. grass seed, planting beds, mulch, etc.); and
5. Incorporation of future land use restrictions consistent with the proposed operations contemplated by Aunt Katie's Community Garden (and formalized in an environmental covenant executed by ADEM and Aunt Katie's Community Garden following acquisition of the Site from the City of Dothan).

The items enumerated above constitute the Soil Management Plan activities to be undertaken during and following the execution of onsite remedial activities. A copy of the Soil Management Plan is included as **Appendix B**.

Considering the area of the Site (6,795 square feet), Bullock estimates a volume of approximately 705 tons with the excavation and removal of two feet of soil.

Based on this volume assumption, 705 tons of impacted soil will be removed, temporarily staged on the Site (if needed), and characterized for subsequent review and approval of a Solid Waste Profile (using ADEM Form 300) by the Solid Waste Branch. Upon ADEM's approval of the Solid Waste Profile, the material will be transported offsite for disposal at a permitted landfill. In advance of transportation, the soil will be characterized in volume increments mandated by ADEM Division 13 Solid Waste regulations to determine its character as a non-hazardous or hazardous waste. As the primary COC in onsite soil is arsenic, Bullock proposes to collect each waste characterization sample for total arsenic and analyze all soil samples exceeding 100 mg/kg using the Toxicity Characteristic Leaching Procedure (TCLP) method.

Assuming the material is determined to be characteristically non-hazardous, the affected soil will be transported to an ADEM-permitted Subtitle D landfill (likely the City of Dothan's Municipal Solid Waste Landfill or another suitable facility).

The excavation will be backfilled with pre-screened, clean fill to match the current grade (fill material will be sampled in advance of transport to the Site to ensure it is free of regulated constituents above applicable screening values and is suitable for onsite use).

During the transportation phase, field personnel will track waste manifests and provide documentation that all materials removed from the Site are accounted for at the landfill. These documents will be included in a final Remedial Implementation Report to be submitted to EPA and ADEM.

In the event that portions of the waste are determined to be characteristically hazardous, field personnel will contain and segregate this material from the non-hazardous waste (as required in Division 14 regulations) and conduct additional characterization analysis while arranging for its disposal within 90 days of generation. As the cost associated with management and disposal of hazardous waste is approximately ten times (or more) that of non-hazardous waste, field personnel will employ the sampling and waste stream sampling protocols approved by ADEM in Division 14 regulations to minimize the ultimate volume requiring disposal as a hazardous waste.

Upon completion of the remedial activities summarized above, Bullock will prepare a Remedial Implementation Report for review and approval by EPA and ADEM (under the Alabama Voluntary Cleanup Program).

With these actions completed, Aunt Katie's Community Garden would then submit a draft environmental covenant for review and approval by ADEM. The environmental covenant would include the following land use restrictions (which would be incorporated onto the deed upon transfer of the Site to Aunt Katie's Community Garden):

1. The use of groundwater for potable or irrigation purposes from or on the Site is prohibited;
2. The Site shall not house ground-level residential development;
3. The clean backfill material (extending two feet below grade) will remain in place and intact; and, in accordance with the Soil Management Plan (**Appendix B**), future Site improvements requiring the disturbance or removal of soil below two feet will be characterized and handled in accordance with the Post-Remedial Activities section of the Soil Management Plan as well as applicable ADEM Solid Waste regulations.

A6.2 Anticipated Schedule

Following ADEM's approval of the Voluntary Cleanup Plan (submitted by Aunt Katie's Community Garden as the Voluntary Cleanup Program Non-Responsible Party Applicant; approved January 15, 2021), a mandated 30-day public notice period will follow (began January 20, 2021). During this public notice period supplemental details will be provided to the public regarding the anticipated dates of the cleanup work, what the community should expect during the implementation of the cleanup work, and a description of the Site following completion. The City will advertise this information through the previously effective methods including website updates, social media posts, direct responses by phone, or meetings and email based on the preferences of the inquirer. Monthly briefings will be posted on the brownfield section of the City's website and on the Garden's bulletin board and social media pages as the project progresses. Once cleanup is complete (early March 2021), a ribbon cutting ceremony will be held to celebrate the achievement. ADEM and the EPA will be invited to attend the ribbon cutting along with the local community. A milestone schedule reflecting the anticipated timeframe of each public meeting, deliverables submitted to EPA and ADEM, and the implementation of the cleanup work is included as **Appendix C**.

A7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

A7.1 Measures for Transfer and Transportation of the Waste Material

Contaminated soil will be removed and characterized for subsequent disposal in accordance with the Soil Management Plan (included as **Appendix B**). Upon receipt of an approved Solid Waste Profile from ADEM, Bullock will oversee the transfer of contaminated media onto dump trucks staged at the Site entrance. Depending on weather conditions, a water truck may be present to mitigate fugitive dust migration beyond the Site boundary. Once each truck is loaded, the generator representative and driver

will sign the manifest designated for that load (also listing the ADEM Solid Waste Profile Number) and the driver will leave with the manifest and obtain a final signature from the receiving landfill facility. The landfill will provide final copies of all executed manifests at the conclusion of the project.

A7.2 Sampling & Testing of Surrounding Soils

Bullock has collected samples from the adjacent Aunt Katie's Community Garden property to ensure no arsenic- (or other COC-) affected media extends beyond the Site boundary. On August 31, 2020, Bullock collected five soil samples from the northern portion of the Aunt Katie's Community Garden property for analysis of arsenic according to EPA Method 6010B. Review of the results from those sampling efforts revealed no evidence of elevated arsenic concentrations in surrounding soils. With these results, the extent of the excavation (remediation) area is limited to the Site boundaries.

While surrounding soils have already been sampled (to confirm the lateral extent of COC-affected media), Bullock will position air monitoring stations along the perimeter of the Site and ensure no potential dust inhalation or ingestion exposure to adjacent and nearby community residents or the staff of Aunt Katie's Community Garden. Air sampling pumps will collect time-weighted samples for each day of excavation work. These samples will be delivered to the laboratory each day for rush analysis and reviewed daily to ensure the health and safety measures described above are working effectively.

A7.3 Criteria to Determine Extent of Remediation Necessary

Considering the future use of the Site as part of Aunt Katie's Community Garden, Bullock and City of Dothan personnel interviewed Mr. Michael Jackson (Applicant and Executive Director of Aunt Katie's Community Garden) to establish the extent of excavation needed to meet the needs of his facility.

According to Mr. Jackson, the root structure for any produce grown in connection with their operations does not exceed two feet. Moreover, Mr. Jackson's plan to erect tunnel houses on the Site will include the importation of approximately two feet of compost and select top soil material to be placed above grade. Using these data points (provided by Mr. Jackson in July and August 2020), **Bullock recommends limiting the excavation to two feet BLS based on the following criteria**:

1. The produce grown within the tunnel houses overlying the excavation area will be raised approximately 18 inches above grade;
2. The two feet of clean fill material, along with the raised beds above-grade, allows for approximately 3.5 feet of clean soil, compost, and top soil to accommodate the root structure of all produce grown by the Garden;
3. While previous assessments did not define the vertical extent of arsenic-affected media, confirmation soil sampling within the excavation should not be required based on the separation distance of 3.5 feet of clean soil between the base of the excavation and the top of the raised beds within the tunnel houses (based on information provided Mr. Jackson); and
4. Removal of two feet of arsenic-affected surface soil currently present on the Site, replacing that material with clean backfill, and further augmenting that condition with raised beds within the tunnel houses will remove the human health risk to the surrounding community which currently exists and allow for the transfer of the land to Aunt Katie's Community Garden for subsequent redevelopment and expansion of its operations.

A8. SPECIAL TRAINING/CERTIFICATION

Only personnel with the training and experience to conduct the required tasks will be selected to perform the work. All brownfields project team members shall have orientation as to the content and importance

of the Generic QAPP and each Site-specific QAPP Addenda, including applicable Standard Operating Procedures (SOPs) and Site-specific Health and Safety Plan (HASP) requirements. The QA Manager will ensure that project personnel have adequate training and credentials to complete project tasks with a high level of quality and safety, and will be responsible for communicating training needs to the Program Manager and for maintaining the documentation and location of the records.

All personnel involved in field work will have current certificates of training for the 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER)/Safety Training Class with annual 8-hour refresher courses. All personnel involved with the project should receive continual training on an as-needed basis to ensure they are current with appropriate methods, standards, procedures, and technologies in the environmental field. Final reports will be signed and sealed by either an Alabama-registered professional geologist or professional engineer (when warranted). Subcontractors are also required to provide proof of their 40-hour and 8-hour HAZWOPER certifications. The City of Dothan will be responsible for ensuring that their brownfields program personnel are HAZWOPER trained as a pre-requisite for Site visit(s) during field work.

A9. DOCUMENTATION AND RECORDS

An organized system for the identification, review, acceptance, control, and maintenance of records, which includes provisions for retention, protection, preservation, revision, traceability, accountability, and retrievability of the records will be maintained for field, office and laboratory information.

Data collected in the field (including field conditions, sampling information, and other necessary data) will be recorded in a field book. Laboratory data, which is typically received within five business days of the laboratory's receipt of the samples, is stored at the laboratory as well as a hard copy in the project file and an electronic copy in the electronic project file. Data from field collection and laboratory analysis will be compiled, tabulated, and summarized in a report.

Sample documents (i.e. raw data, chain-of-custody forms, laboratory analytical data with quality assurance [QA] reports), progress and status reports, and task authorizations will be maintained by Bullock. Final documents (i.e. progress and status reports, formal submittals, etc.) will be provided to EPA, ADEM, and the City of Dothan. Bullock will retain copies of all final documents for a minimum of three years.

B. MEASUREMENT DATA ACQUISITION

B1. SAMPLING DESIGN AND SITE FIGURES

B1.1 Soil Sampling

As detailed above in Section A7.2, Bullock has collected samples from the adjacent Aunt Katie's Community Garden property to ensure no arsenic- (or other COC-) affected media extends beyond the Site boundary. Therefore, the lateral extent of the excavation (remediation) area is limited to the Site boundaries.

Regarding the vertical extent of the excavation (remediation) area, Bullock recommends limiting the excavation to two feet BLS. This determination was made considering two feet of clean fill material, along with raised beds above-grade, allows for approximately 3.5 feet of clean soil, compost, and top soil

to accommodate the root structure of all produce grown by the Garden (see Section A7.3 for further details).

Considering the extent of the excavation laterally to the Site boundaries and vertically to two feet BLS, confirmation soil sampling within the excavation should not be required based on the separation distance of 3.5 feet of clean soil between the base of the excavation and the top of the raised beds within the tunnel houses. The proposed activities will remove the human health risk to the surrounding community which currently exists and allow for the transfer of the land to Aunt Katie's Community Garden for subsequent redevelopment and expansion of its operations.

The proposed excavation area is depicted on **Figure 3**. This figure also illustrates the area restricting excavations more than two feet in depth (to be legally described and included in the environmental covenant).

B1.2 Air Sampling

Bullock will position two air monitoring stations along the perimeter of the Site (depicted on **Figure 3**) and ensure no potential dust inhalation or ingestion exposure to adjacent and nearby community residents or the staff of Aunt Katie's Community Garden. Compound-specific cartridges (for arsenic) will be placed in each monitoring station pump for the collection of time-weighted average (TWA) samples to be analyzed according to the National Institute for Occupational Safety and Health (NIOSH) Method 7303. These samples will be delivered to the laboratory each day for rush analysis and reviewed daily to ensure the health and safety measures described above are working effectively. Sampling of arsenic concentrations from each station will provide a representative airborne concentration which may reach the breathing zone at the property boundary. The EPA RSL for arsenic in residential air is 6.5×10^{-4} micrograms per cubic meter (ug/m^3).

Considering the data collected during previous assessment activities in 2020 (see Section A7.2), no sample results indicated detectable concentrations of arsenic extending beyond the Site boundary. With these data known, Bullock has prepared this scope of work to further document that the excavation activities will not create an exposure risk to the residents in the surrounding community. Moreover, Bullock will provide results of the sampling analysis throughout the Site remediation activities in order to immediately address potential exposure concerns in the unlikely event concerns are discovered.

B2. SAMPLING AND ANALYTICAL PROCEDURES

Compound-specific cartridges (for arsenic) will be placed in each monitoring station pump for the collection of TWA samples to be analyzed according to NIOSH Method 7303. Air cartridges will be prepared and supplied by the laboratory.

Sample Matrix	Parameter	Analytical Method	Sample Container	Sample Preservation	Max Holding Time
Air	Arsenic	NIOSH Method 7303	37 mm Filter Cassette	None	

B3. SAMPLE HANDLING & CUSTODY

Each air sample will be collected in the cassette supplied by the laboratory, labeled, and shipped directly to the laboratory. The samples will be delivered under proper chain-of-custody to Pace Analytical. A copy of a chain-of-custody form and a sample label are included in **Appendix D**.

B4. ANALYTICAL METHODS AND REQUIREMENTS

Information regarding the extraction, digestion, and analytical methodologies can be found in Pace Analytical's Quality Assurance Manual (QAM), included electronically in **Appendix D**. Methods for metals can be found on page 13 of Appendix V of the QAM and semi-volatiles on page 21 of Appendix VII.

Laboratory data is typically received within five business days of the laboratory's receipt of the samples. However, for the purposes of this project, the air samples will rushed for analysis with an anticipated turnaround time of one day.

B5. FIELD QUALITY CONTROL REQUIREMENTS

This information was provided in Section B5 of the Generic QAPP. Section B2 above provides container requirements, analytical methods, and preservative requirements specific to this Site. In addition, QA/QC acceptance criteria for matrix spikes, equipment blanks, trip blanks, and laboratory control samples, etc. are provided in Pace Analytical's QAM provided in **Appendix D**.

B6. LABORATORY QUALITY CONTROL REQUIREMENTS

This information was provided in Section B6 of the Generic QAPP. In addition, Pace Analytical's QAM is provided in **Appendix D**.

B7. FIELD EQUIPMENT CALIBRATION AND CORRECTIVE ACTION

This information was provided in Section B7 of the Generic QAPP.

B8. LABORATORY EQUIPMENT CALIBRATION AND CORRECTIVE ACTION

This information was provided in Section B8 of the Generic QAPP. In addition, Pace Analytical's QAM is provided in **Appendix D**.

B9. ANALYTICAL SENSITIVITY AND PROJECT CRITERIA

Pace Analytical will be responsible for ensuring that the methods used to measure the constituents in potentially impacted media are sensitive enough to enable comparisons to regulatory compliance criteria or other health or risk-based standards.

B10. DATA MANAGEMENT AND DOCUMENTATION

B10.1 Field Documents and Records

Data collected in the field (including field conditions, sampling information, and other necessary data) will be recorded in a field book. Data from field collection (if applicable) will be compiled, tabulated, and summarized in a report. Relevant photographs taken of the Site during remediation activities will be included in a report.

B10.2 Laboratory Documents and Records

Laboratory analytical reports will include all relevant information (i.e. raw data, chain-of-custody forms, laboratory analytical data with QA reports, etc.). Data from laboratory analysis will be compiled, tabulated, and summarized in a report. In addition, the complete laboratory report will be included as an attachment to the Site report prepared by Bullock. Laboratory data is stored at the laboratory as well as a hard copy in the project file and an electronic copy in the electronic project file.

B10.3 Post Laboratory Data Manipulation

Once in table form, the data will be used in the text of the report as well as to create figures. A data check will be performed on all tables, figures, and text in order to avoid erroneous information in Site reports. Ms. Alison Dunagan or Mr. Samuel Smith will perform this task.

B10.4 Project File

The project files will be maintained and stored at Bullock's office in Birmingham, Alabama, for a minimum of three years.

C. ASSESSMENTS/OVERSIGHT

C1. ASSESSMENTS AND CORRECTIVE ACTION

Assessment and oversight of this project will be conducted in order to ensure the project is proceeding according to the schedule and procedures as planned. If a response action is warranted, it will be noted in the project file and appropriate actions will be taken to keep the project on track. Mr. Douglas Bullock will provide oversight during this project on a regular basis.

C2. PROJECT REPORTS

Quarterly progress reports will be prepared for this project and submitted to the EPA Project Manager.

A final report will be prepared at the conclusion of remediation activities and submitted to the EPA Project Manager, ADEM, and the City of Dothan. The report will include field data and analytical results for the activities conducted at the Site. Data tables and appropriate figures will be included as attachments, as well as the complete laboratory reports.

D. DATA EVALUATION

D1. FIELD DATA EVALUATION

Field data will be routinely reviewed to evaluate information gathered in the field and determine if that information will impact the project or the planned scope of work. Any important observations or limitations discovered in the field will be documented in the final report. Mr. Douglas Bullock or Mr. Samuel Smith will perform the field data evaluation.

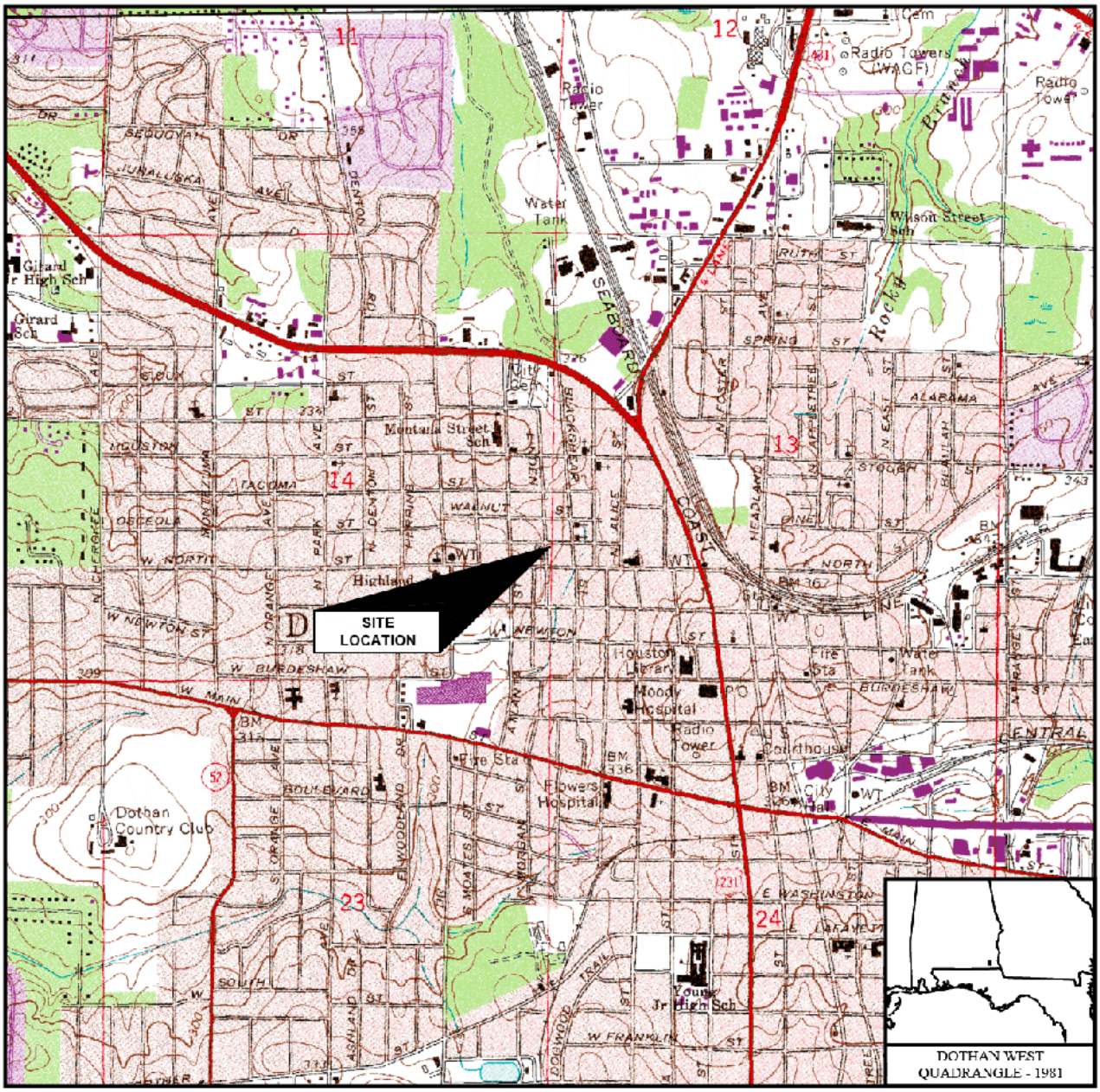
D2. LABORATORY DATA EVALUATION

Laboratory data will be reviewed to ensure that the laboratory report meets the criteria described in this QAPP. If information is missing then the laboratory will be contacted for the additional information. Any problems noted with the data, chain-of-custody, sample preservation or holding times will be noted and addressed. The laboratory QC results will be reviewed to check for any problems that have affected the sample data. Any important observations or limitations discovered during the laboratory data evaluation will be documented in the final report. Mr. Douglas Bullock will perform the laboratory data evaluation.

D3. EVALUATING DATA IN TERMS OF USER NEEDS

The project as a whole will be evaluated to document any important observations, limitations, and data gaps, and to determine if the project's objectives have been met. In addition, conclusions and/or recommendations will be made regarding the data obtained during the project and will be documented in the final report. Mr. Douglas Bullock will perform the overall project evaluation.

FIGURES



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bullock environmental, llc

PROJECT

SITE-SPECIFIC QAPP ADDENDUM 1B
AUNT KATIE'S COMMUNITY GARDEN EXPANSION
602 LINDEN STREET
DOTHAN, HOUSTON COUNTY, ALABAMA
BULLOCK ENVIRONMENTAL, LLC PROJECT #: 20-DOTH02

FIGURE 1

SITE LOCATION MAP

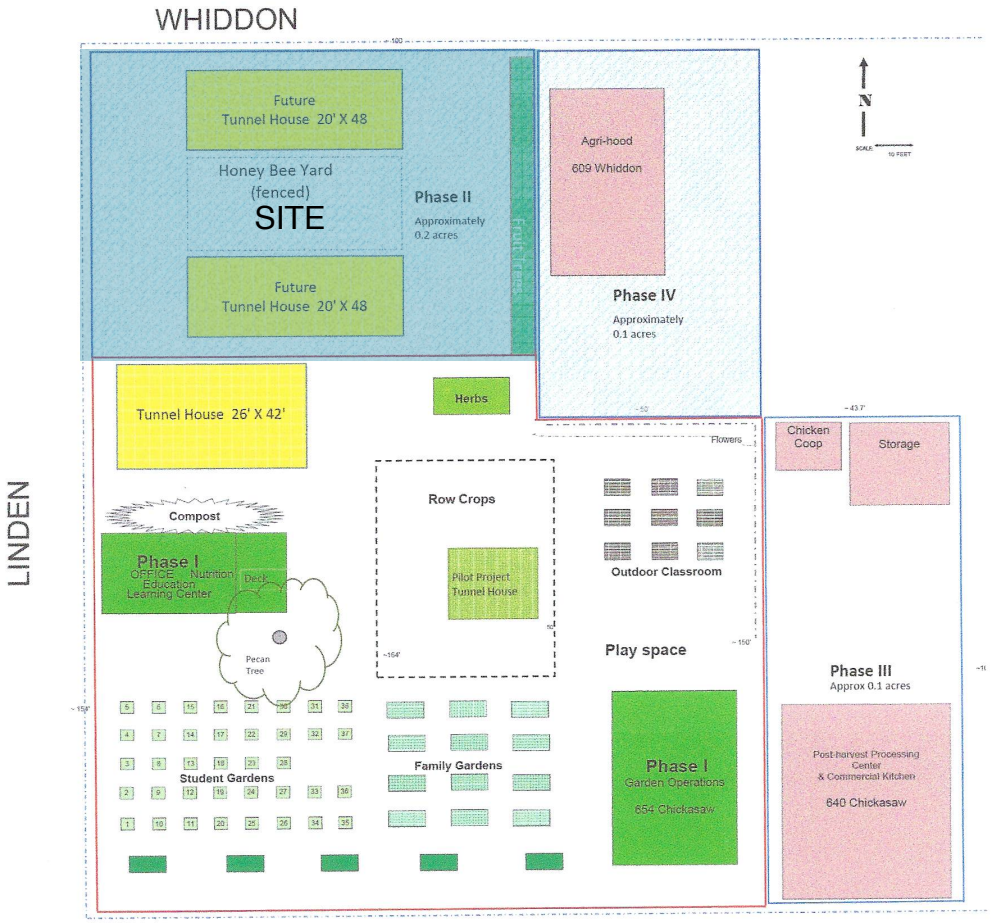
USGS 7.5-MINUTE
TOPOGRAPHIC QUADRANGLE
DOTHAN WEST, ALABAMA,
DATED 1981

SCALE: AS SHOWN

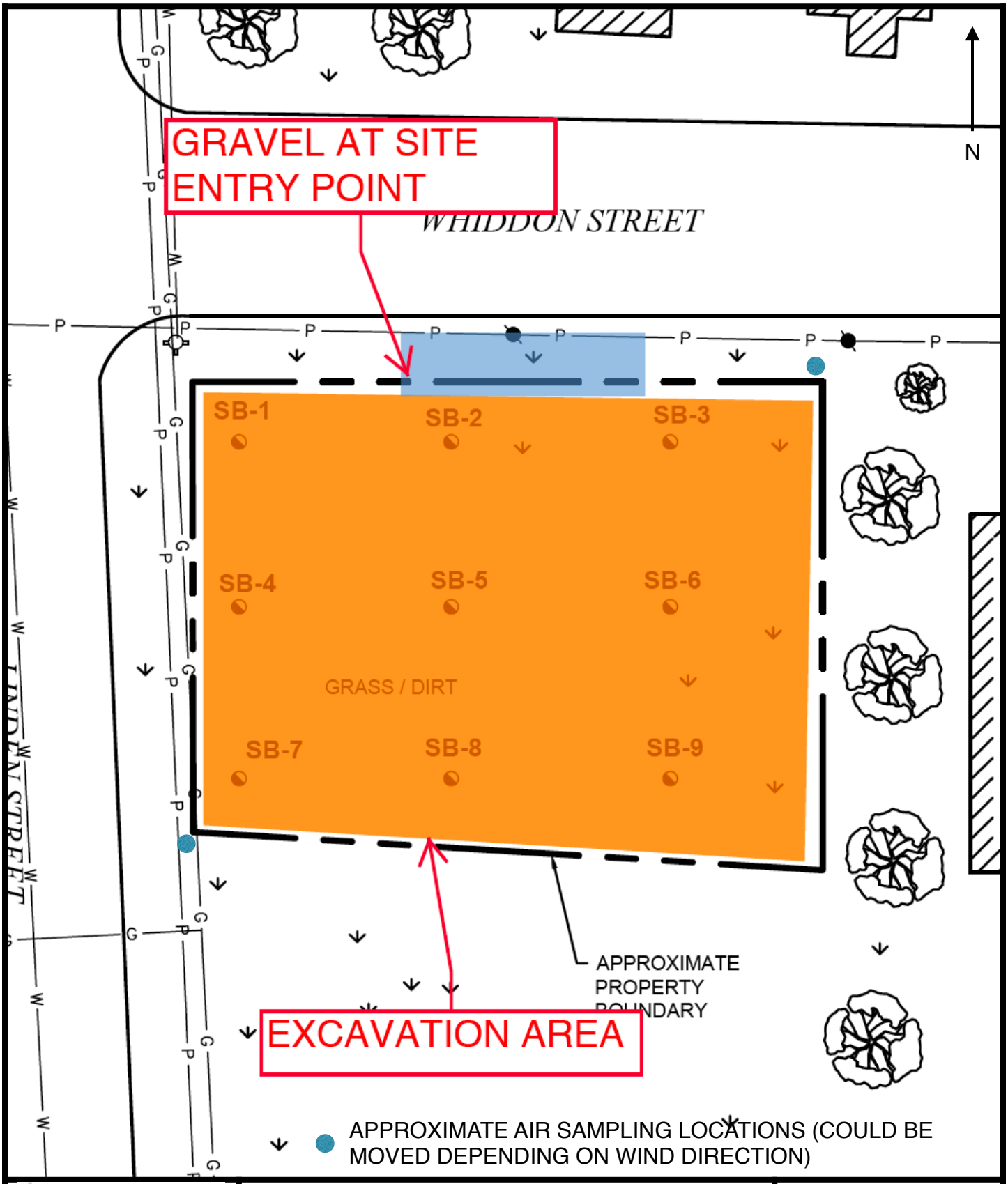
Aunt Katie's Community Garden

FoodLife Center

N



bullock environmental, llc	PROJECT SITE-SPECIFIC QAPP ADDENDUM 1B AUNT KATIE'S COMMUNITY GARDEN EXPANSION 602 LINDEN STREET DOTHAN, HOUSTON COUNTY, ALABAMA BULLOCK ENVIRONMENTAL, LLC PROJECT #: 20-DOTH02	FIGURE 2 SITE PLAN 1"=APPROX 40'



bullock environmental, llc

PROJECT

SITE-SPECIFIC QAPP ADDENDUM 1B
AUNT KATIE'S COMMUNITY GARDEN EXPANSION
602 LINDEN STREET
DOTHAN, HOUSTON COUNTY, ALABAMA
BULLOCK ENVIRONMENTAL, LLC PROJECT #: 20-DOTH02

FIGURE 3

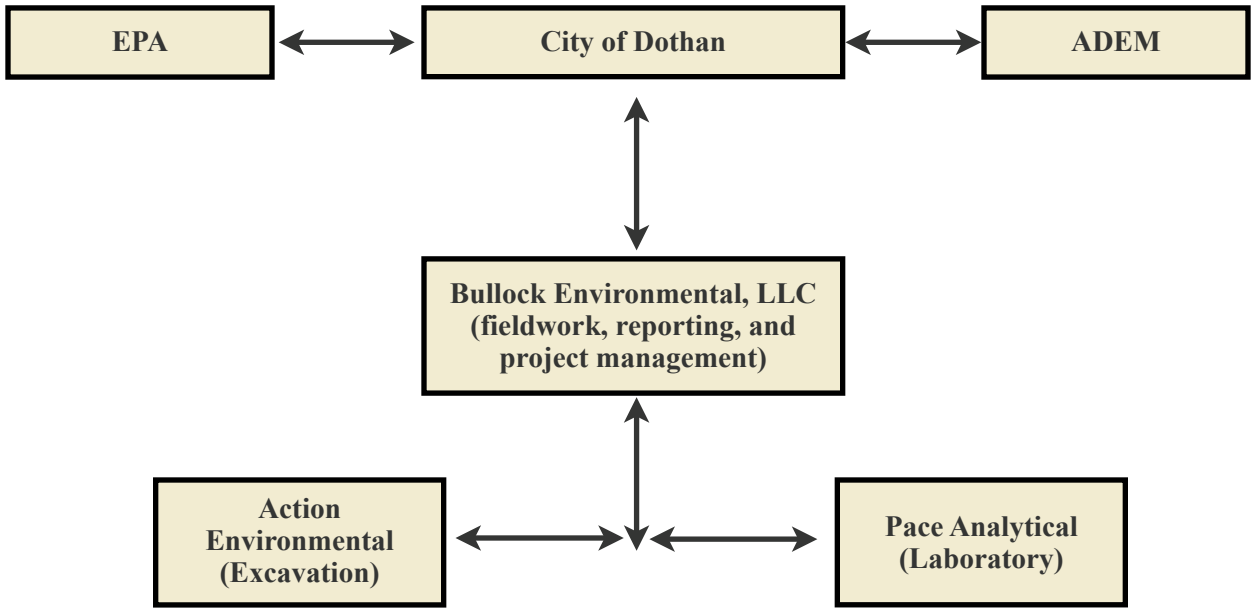
PROPOSED EXCAVATION AREA AND AIR SAMPLING LOCATIONS

1"=APPROX 20 FEET

APPENDIX A

PROJECT ORGANIZATION CHART

APPENDIX A - PROJECT ORGANIZATIONAL CHART



APPENDIX B

SOIL MANAGEMENT PLAN

bullock environmental, llc 4924 5th avenue south, birmingham, alabama 35222 t 205.876.1715 f 205.443.9413

Ms. Charmagne Boyd
Redevelopment Section
Alabama Department of Environmental Management
P.O. Box 301463
Montgomery, Alabama 36130-1463

Subject: **Voluntary Cleanup Plan**
Aunt Katie's Garden Expansion
Corner of Linden Street and Whiddon Street
Dothan, Houston County, Alabama
Bullock Environmental, LLC Project #: 20-DOTH02

Dear Ms. Boyd:

Bullock Environmental, LLC (Bullock), on behalf of the Non-Responsible Party Applicant, Aunt Katie's Community Garden, submits the following Soil Management Plan detailing the following:

1. Management of excavation and transportation of waste generated during remedial activities detailed in the Voluntary Cleanup Plan for the above-referenced site;
2. Site controls to be employed during the execution of the approved Voluntary Cleanup Plan;
3. Site restoration measures to implemented following the completion of the remedial tasks detailed in the approved Voluntary Cleanup Plan; and
4. Post-remedial procedures to mitigate potential exposure to subsurface soil and a framework for the management of this material if disturbed or removed fo subsequent disposal.

The items enumerated above are detailed in two sections below identified as "Remedial Soil Management Plan Activities" and "Post-Remedial Soil Management Plan Activities."

SECTION 1: REMEDIAL SOIL MANAGEMENT PLAN ACTIVITIES

The primary COC at the Site is arsenic present above the residential EPA RSL over the entire property. The data indicates the arsenic that may have been applied in the past to the loose, sandy surface soils have over time leached to subsurface clayey soils where it was able to accumulate. PAHs were also detected at concentrations above Residential RSLs but were limited to a singular boring in the center of the Site.

The proposed remedial activities will include the following :

1. Removal of the top two feet of COC-affected soil on the Site;
2. Characterization of waste material for subsequent disposal at a permitted landfill (under a solid waste profile approved by ADEM);
3. Replacement of the excavated soil area with pre-screened, clean fill material; and
4. Restoration of the ground surface with vegetation or other suitable cover (i.e. grass seed, planting beds, mulch, etc.).

The following sections detail the procedures for handling of materials, Site controls, waste management and transportation, and Site restoration activities during the remedial phase of the project.

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Handling

Field personnel will don Level D personal protective equipment (PPE), to minimize contact with potentially affected media. Beyond the standard PPE required for construction sites (hard hats, safety glasses, steel-toed boots, etc.), workers potentially contacting the soil will do so with protective gloves, including but not limited to standard work gloves or impermeable material such as latex or nitrile. To minimize potential dispersion of particulates, field personnel will have on hand a water truck to maintain adequate moisture on the ground surface to mitigate fugitive dust.

Site Controls

During the excavation work, field personnel will control access to the Site at the gate along the northern boundary and post signs regarding entry restrictions. The gate will be locked during non-working hours and access will be controlled by Bullock representatives during the excavation activities.

Excavation equipment will remain within the fenced Site boundary throughout the implementation of this Voluntary Cleanup Plan. Before demobilizing the excavator, field personnel will ensure the tracks, bucket, and/or tires are clean and any potentially contaminated residues removed and left within the fenced enclosure. The ground surface surrounding the Site entrance will be covered with a layer of gravel (likely #57 Stone) to mitigate potential tracking of soil onto the adjacent roadway by incoming and outgoing dump trucks being loaded by the excavator.

Additionally, given the slight slope of the Site area, field personnel will line the southern, eastern, and western boundaries with silt fencing or other suitable sediment controls to mitigate or altogether eliminate stormwater runoff from the Site to the surrounding roadways or adjacent properties. As the Site area does not qualify for a National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit, these controls will be implemented and maintained without a Permit. However, all controls and monitoring of the runoff controls will function in compliance with NPDES requirements and continue throughout the duration of the project.

Management of Waste Material During Remedial Activities

Excavation and Removal

Considering the area of the Site (6,795 square feet), Bullock estimates a volume of approximately 705 tons with the excavation and removal of two feet of soil. None of this waste material will be transported offsite Site without first conducting an adequate waste characterization to ensure it is handled and disposed in accordance with applicable state and federal regulations.

Based on the volume assumption above, 705 tons of impacted soil will be excavated, temporarily staged on the Site (if needed), and characterized for subsequent review and approval of a Solid Waste Profile (using ADEM Form 300) by the Solid Waste Branch. Upon ADEM's approval of the Solid Waste Profile, the material will transported offsite for disposal at a permitted landfill. In advance of transportation, the soil will be characterized in volume increments mandated by ADEM Division 13 Solid Waste regulations to determine its character as a non-hazardous or hazardous waste. As the primary COC in onsite soil is arsenic, Bullock proposes to collect each waste characterization sample for total arsenic and analyze all soil samples exceeding 100 mg/kg using the Toxicity Characteristic Leaching Procedure (TCLP) method.

Assuming the material is determined to be characteristically non-hazardous, the affected soil will be transported to an ADEM-permitted Subtitle D landfill (likely the City of Dothan's Municipal Solid Waste Landfill or another suitable facility).

Transportation

During the transportation phase, field personnel will track waste manifests and provide documentation that all materials removed from the Site are accounted for at the landfill. These documents will be included in a final Remedial Implementation Report to be submitted to EPA and ADEM.

Upon receipt of an approved Solid Waste Profile from ADEM, Bullock will oversee the transfer of contaminated media onto dump trucks staged at the Site entrance. Depending on weather conditions, a water truck may be present to mitigate fugitive dust migration beyond the Site boundary. Once each truck is loaded, the generator representative and driver will sign the manifest designated for that load (also listing the ADEM Solid Waste Profile Number) and the driver will leave with the manifest and obtain a final signature from the receiving landfill facility. The landfill will provide final copies of all executed manifests at the conclusion of the project.

Backfilling/Site Restoration

The excavation will be backfilled with pre-screened, clean fill to match the current grade (fill material will be sampled in advance of transport to the Site to ensure it is free of regulated constituents above applicable screening values and is suitable for onsite use). The backfill material will comprise, imported soil (confirmation sampling to be conducted in advance of transportation to the Site), compost, and select top soil material. Supplemental top soil and compost materials will also be placed approximately 18 inches above grade. Upon completion, the ground surface will be restored with vegetation or other suitable cover (i.e. grass seed, planting beds, mulch, etc.).

SECTION 2: P0ST-REMEDIAL SOIL MANAGEMENT PLAN ACTIVITIES

The clean backfill material (extending two feet below grade) will remain in place and intact. Should future Site improvements or utility/road work, etc. require the disturbance or removal of soil below two feet in the excavation area, the following procedures will be employed.

1. ADEM will be notified in advance of such plans for disturbance/removal;
2. At least 30 days in advance of such work, ADEM will be provided with a plan detailing the following:
    a. Area to be disturbed (with an accompanying figure illustrating the area);
    b. Depth of anticipated excavation work;
    c. Estimated volume of material be generated;
    d. A plan for the proper handling and management of these materials; and
    e. Estimated schedule for completion.
3. If solid waste is generated from such post-remedial activities, the material will be characterized and handled in accordance with applicable ADEM Solid Waste regulations*; and
4. Within 30 days of completion, a report will be delivered to ADEM demonstrating compliance with plan. If warranted, the plan will also include required documentation verifying the proper management and disposal of solid waste generated as a result of the post-remedial excavation activities.

* *Waste material (if any) generated during such grading or excavation activities will be characterized and staged in accordance with ADEM Administrative Code 335-14-2 for waste determination requirements. Representative sampling and analysis of the waste will be conducted to determine whether it exhibits one of the characteristics found at ADEM Admin. Code r. 335-14-2-.03. A "representative sample" is a sample of a universe that can be expected to exhibit the average properties of the universe. A representative sample is required to properly characterize a waste stream using sampling and analysis.*

If you have any questions about this Soil Management Plan, please contact us at (205) 876-1715.

Sincerely,

BULLOCK ENVIRONMENTAL, LLC

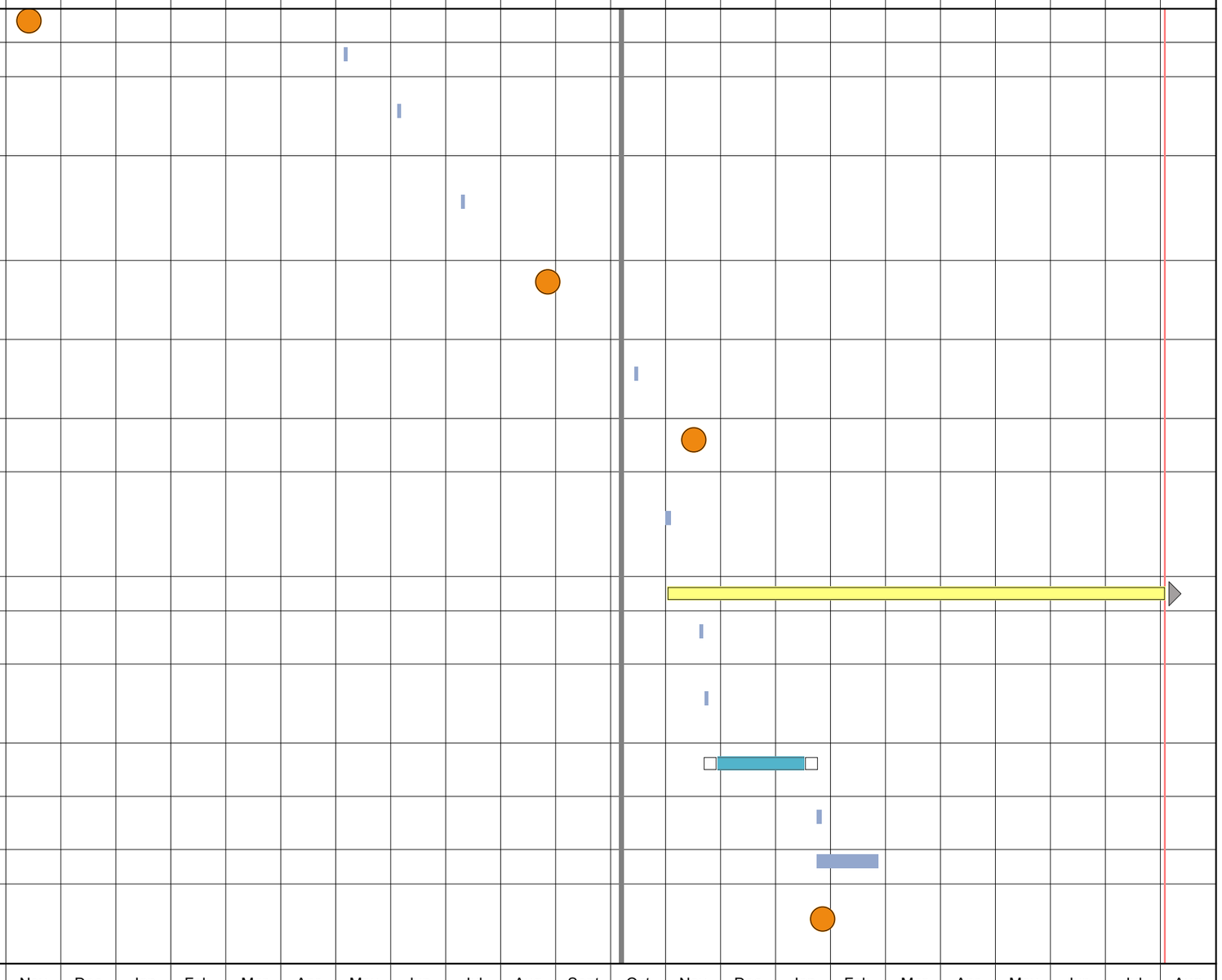
Douglas A. Bullock, CHMM
Principal

APPENDIX C

MILESTONE SCHEDULE

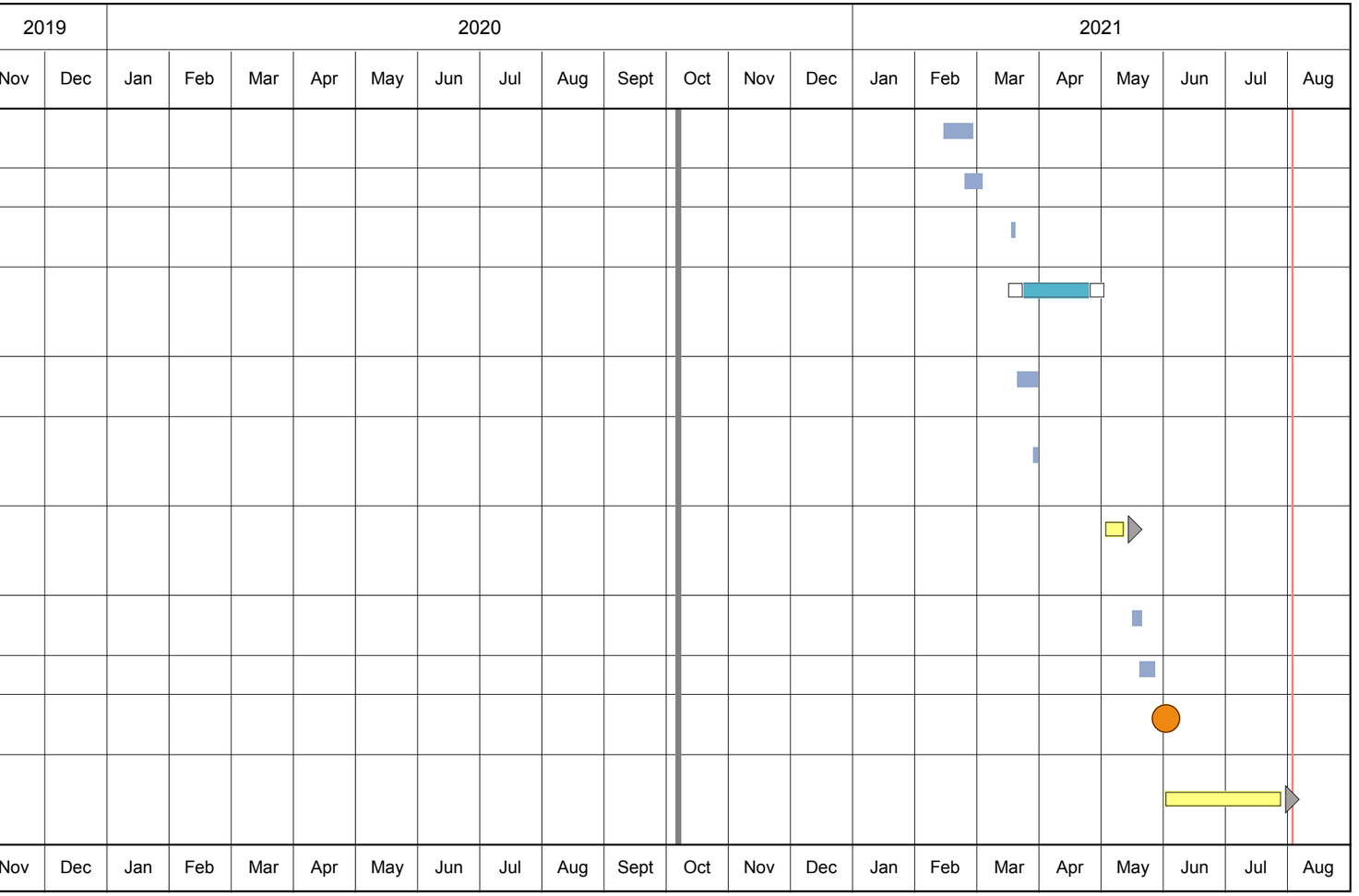
MILESTONE SCHEDULE FOR COMMUNITY RELATIONS PLAN
EPA BROWNFIELDS CLEANUP GRANT
(COOPERATIVE AGREEMENT #: BF-01D11020-0)
CITY OF DOTHAN
AUNT KATIE'S GARDEN EXPANSION

	Activity Name	Duration (Work Days)	Start Date	Finish Date
1	**Community Meeting 1**	0.00	11/13/19	11/13/19
2	EPA Notice of Grant Award	1.00	5/6/20	5/6/20
3	City of Dothan issues RFQ for Environmental Consulting Services	1.00	6/5/20	6/5/20
4	City of Dothan awards contract for environmental consulting services to manage Cleanup Grant	1.00	7/10/20	7/10/20
5	**Kickoff Meeting with EPA, ADEM, City of Dothan-1st Public Meeting following Grant award**	0.00	8/27/20	8/27/20
6	Submittal of Community Relations Plan to EPA for review and approval.	1.00	10/15/20	10/15/20
7	**Autumn 2020 Community Meeting**	0.00	11/16/20	11/16/20
8	Establish Information Repository to be managed and updated by City of Dothan representatives	1.00	11/2/20	11/2/20
9	Maintain ACRES database	196.00	11/2/20	8/2/21
10	Submit revised ABCA to EPA for review and approval	1.00	11/20/20	11/20/20
11	Submit Application and Voluntary Cleanup Plan to ADEM for review and approval	1.00	11/23/20	11/23/20
12	ADEM review of Application and Voluntary Cleanup Plan	44.00	11/24/20	1/22/21
13	Submit QUAPP for EPA/ADEM review and approval	1.00	1/25/21	1/25/21
14	Public Notice of Cleanup Plan	23.00	1/20/21	2/20/21
15	**Winter 2020 Public Meeting (during 30-day public notice period)**	0.00	1/27/21	1/27/21



MILESTONE SCHEDULE FOR COMMUNITY RELATIONS PLAN
EPA BROWNFIELDS CLEANUP GRANT
(COOPERATIVE AGREEMENT #: BF-01D11020-0)
CITY OF DOTHAN
AUNT KATIE'S GARDEN EXPANSION

	Activity Name	Duration (Work Days)	Start Date	Finish Date
16	Implementation of approved Cleanup Plan	10.00	2/15/21	2/26/21
17	Site Restoration	5.00	2/24/21	3/2/21
18	Submit Cleanup Implementation Report	1.00	3/19/21	3/19/21
19	ADEM review and approval of Cleanup Implementation Report with Certificate of Compliance	30.00	3/19/21	4/29/21
20	Prepare Environmental Covenant	7.00	3/22/21	3/30/21
21	Obtain ADEM approval of Environmental Covenant provisions	1.00	3/30/21	3/30/21
22	Execute and record Envrionmental Covenant and document recordation to ADEM	7.00	5/3/21	5/11/21
23	**ADEM issues Letter of Concurrence to Aunt Katiie's Garden**	4.00	5/17/21	5/20/21
24	Site is transferred to Aunt Katie's Garden	4.00	5/21/21	5/26/21
25	**Spring 2021 Community Meeting and Ribbon Cutting**	0.00	6/2/21	6/2/21
26	Complete Supplemental Site Improvement Tasks as allowed and approved under the Cleanup Grant	40.00	6/2/21	7/27/21



APPENDIX D

CHAIN-OF-CUSTODY FORM, SAMPLE LABEL, AND LABORATORY QUALITY MANUAL

CON-TEST ANALYTICAL LABORATORY

QUALITY ASSURANCE MANUAL

39 Spruce Street
East Longmeadow, Massachusetts
(413) 525-2332

Tod Kopyscinski
Laboratory Technical Director

09/01/2020
Effective Date

Katherine F. Allen
Quality Assurance Officer

09/01/2020
Effective Date

Revision Number: 30 **NON-CONTROLLED COPY**

Revision Record

Revision	Date	Responsible Person	Description of Change
1	1/1/2000	Sondra S. Kocot	Initial Version
2	7/16/2000	Sondra S. Kocot	Update App. A, delete distribution table and replace with distribution statement only; Update Equipment List: General Release
3	3/22/2002	Sondra S. Kocot	Update Method List, Equipment List, and Organizational Chart (Appendix A)
3A	11/21/2002	Sondra S. Kocot	Update Method List and Organizational Chart (Appendix A)
4	10/02/2003	Sondra S. Kocot	Update Organizational Chart (Appendix A); Statement for "Lab Ethics in Data Manipulation"; Statement for "Samples/Reports Involved in Litigation", change in storage-time for non-metal waters; update Equipment List
5	04/14/2004	Sondra S. Kocot	Update accreditation (section 3.3.4.1); add AZ office address (Intro. Section)
6	05/10/2004	Sondra S. Kocot	Updates for compliance with MA DEP Microbiology Audit and AZ Audit; additions affect primarily sections 4.0 & 7.0, with the addition of the Chem. Hygiene Plan as an Appendix, Org. chart also updated.
7	10/08/2004	Sondra S. Kocot	Updates include: Organizational chart, Equipment List, Metals Training, Uncertainty Statement (section 3)
8	02/21/2005	Sondra S. Kocot	Updates include: Organizational chart, EPA reference (200.7, 40 CFR Part 136 App C) added for non-potable ICP water samples
9	03/22/2005	Sondra S. Kocot	Edit MDL study paragraph to include discussion of outliers; update equipment list
10	07/19/2005	Sondra S. Kocot	Updates for compliance with June 2005 AIHA-LAP, LLC Audit: Organizational chart (App A), sections 3.2.1, 3.3.4.4, 9.2.4, and 13.0.
11	05/24/2007	Edward J. Denson/ Sondra Slesinski	Annual Updates
12	10/22/2007 , 12/05/2007	Edward J. Denson/ Sondra Slesinski	Updates per Oct 2007 AIHA-LAP, LLC audit and Nov 2007 client audit: See next page for detailed change record
13	07/14/2008	Katherine F. Delisle	Updates per recommendation of Massachusetts, to include new methods. See detailed change record.
14	03/25/2009	Katherine F. Delisle	Updates per changes in policy for Eppendorf's and MDLs. See detailed change record.
15	01/11/2010	Katherine F. Allen	Updates from July 2009 AIHA-LAP, LLC audit and MA June 2009 audit. See detailed change record.
16	06/23/2010	Katherine F. Allen	Updates from January 2010 NJ audit. App D was removed and made a controlled document #252. Updates to Sec's 3.2.1, 3.3.3.1, 4.1.2 (method blanks), and 4.2 (calibration). Section 4.2 (last 2 paragraphs deleted), and Section 11.0 (equipment list updated).
17	04/05/2011	Katherine F. Allen	Updates from Annual Review. See detailed change record.
18	10/07/2011	Katherine F. Allen	Updates from September 2011 AIHA-LAP, LLC audit. QA manual reworked.
19	08/20/2012	Katherine F. Allen	Updates from June 2012 NJ audit. See detailed change record.
20	10/15/2012	Katherine F. Allen	Updates from Sept 2012 NH audit. See detailed change record.
21	08/14/2013	Katherine F. Allen	Updates from June 2013 NY and MA Audits. See detailed change record.
22	09/03/2013	Katherine F. Allen	Updates from August AIHA-LAP, LLC audit. See detailed change record.

23	04/09/2015	Katherine F. Allen	Updates from annual review: See detailed change record.
24	10/20/2015	Katherine F. Allen	Updates from Sept 2015 AIHA-LAP, LLC audit. See detailed change record.
25	03/03/2017	Katherine F. Allen	Updates from annual SOP review: See detailed change record.
26	11/10/2017	Katherine F. Allen	Updates from September 2017 AIHA-LAP, LLC audit: See detailed change record.
27	01/18/2018	Katherine F. Allen	Updates from December 2017 NY Audit: See detailed change record.
28	04/30/19	Katherine F. Allen	Updates from annual SOP review and Annual QA Systems audit.
29	04/06/2020	Katherine F. Allen	Updates from annual SOP review and Annual QA Systems audit
30	09/01/2020	Katherine F Allen	Update from MA addition of PFAS. See detailed change record

Revision 12/12a	**Detailed Change Record**
Introduction	Reference to “industrial hygiene” as well as “environmental”
Section 1.0	Reference to “compliance with all accrediting authorities, including ISO/IEC 17025”
Section 1.3.4	Added reference to accrediting authorities
Section 2.0	For job descriptions of Technical Director, QA Officer, Supervisor, and Analyst, academic and experience qualifications were added.
Section 2.1	Commitment of management to the QA policy statement and for improvements in the management system.
Section 2.2.2.4	“Ensures compliance with all accrediting authorities and organizations (AIHA-LAP, LLC – ISO/IEC 17025, NELAP, and various states)”
Section 3.3.4	Added North Carolina certification
Section 3.3.4 (12/07 edit)	Added Florida certification
Section 3.3.4.2	Internal PT program for AIHA-LAP, LLC fields of testing not covered by AIHA proficiency studies
Section 3.3.4.3	Written pre-approval for subcontracting needed; Con-Test is not responsible for the work of subcontract lab’s which the client specifies that we use
Section 4.2.1.2	AIHA-LAP, LLC IHLAP RL’s verified per matrix in each batch
Section 4.4 (12/07 edit)	Added ICP-MS method 6020 maintenance
Section 4.11	Procurement policy added
Section 4.12	Include a statement that lots of IH media are tested to ensure no contamination, and that records of such tests are maintained by each department; also stated is that Con-Test supplies IH sampling media to the clients, who perform the sampling.
Section 6.2.2 (12/07 edit)	Use of Infra-Red gun is specified regarding sample temperature
Section 6.2.3	Assignment of laboratory numbers: “environmental” samples changed to “all” samples
Section 6.2.5	Sample storage: A locked storage area will be provided should the client require secure storage for samples which require special handling due to legal proceedings.
Section 9.0	Addition of “management review”
Sections 9.0, 9.3	Section for “Corrective Actions/Preventative Actions” was added
Section 9.2	Internal audit (per AIHA-LAP, LLC, ISO/IEC 17025 requirements) must be conducted annually
Section 10.0 (12/07 edit)	Add TOC to analytical method list
Section 11.0(12/07 edit)	Update equipment list
Section 12.0 (12/07 edit)	TCLP sampling for VOA & metals: the verbiage for preservation with acid was deleted.
Section 14.2	AIHA-LAP, LLC IHLAP/ELLAP trainees must have a training period of 20 business day’s duration, prior to completing a DOC and working independently on client samples. This 20-day period must be clearly documented on the IDOC training form.
Appendix A	Updated Organizational Chart
Appendix B	Addition of ISO/IEC 17025:2017
Appendix C	Edited “Training/IDOC” form to include “authorization” date, and specified 20-business-day training duration for AIHA-LAP, LLC IHLAP/ELLAP

Revision 13	**Detailed Change Record**
Section 3.3.3.1	Include proper use of QC trends, including monitoring for presence of trends indicating that an analysis could be heading towards "out-of-control" situation.
Section 4.2	Edit to include calibration frequency of reference weights, reference thermometers, and analytical balances.
Section 4.4	Edit to include annual calibration of Conductivity meter and bi-annual calibration of Infra-Red thermometer gun.
Section 6.2.2	Edit to include bi-annual calibration of Infra-Red thermometer gun.
Section 8.5	New section, including a list of Standard Operating Procedures (SOP's). See Appendix E.
Section 10.0	Addition of ICP-MS methods, ICP method, and mercury method. Updating EPA reference to include EPA/600R-94-11, May 2004.
Section 11.0	Deleted Bausch & Lomb 601 spectrophotometer in equipment listing section.
Section 13.1	MCL exceedance policy
Appendix A	Updated Organizational chart
Appendix E	New appendix to include listing of Standard Operating Procedures (SOPs).

Revision 14	**Detailed Change Record**
Section 3.3.4.3	Sub-contracting lab policy addition
Section 4.2	Eppendorf calibration frequency
Section 4.3	Eppendorf calibration frequency
Section 4.4	Eppendorf calibration frequency
Section 4.10	MDL policy for frequency
Section 11.0	Equipment section updated to include new Mercury Instrument, Beckman Centrifuge, flashpoint apparatus, and ENCON evaporation system.
Appendix A	Updated Organizational chart
Appendix E	Updated Listing of SOP's

Revision 15	**Detailed Change Record**
Section 3.3.3.3.1	Addition of Non-Conforming work policy
Section 3.3.4	Inclusion of WA state certification for EPH and VPH
Section 6.2.3	Change in how laboratory numbers are assigned
Section 7.6	Change to Data Storage in respect to (new LIMS) Element
Section 15.1	Addition of communication to the subcontracting lab of special report requirements
Appendix A	Updated Organizational chart
Appendix C	Updated IDOC form
Appendix E	Updated Listing of SOP's

Revision 16	**Detailed Change Record**
Section 9.2.2	Internal method audit section added
Appendix D	Appendix D was removed and made a controlled document #252
Section 3.2	Section updated for typos and changes in verbiage
Section 3.3.3.1	Section updated for changes in verbiage
Section 4.1.2	Method blank section updated for changes in verbiage
Section 4.2	Calibration section updated for changes in verbiage. Last 2 paragraphs removed from SOP
Section 11.0	Equipment List updated
Appendix A	Updated Organizational chart
Section 10.0	Addition of Herbicide Method SW-846 8151A

Revision 17 Detailed Change Record

Section 2.2 and 2.4	Deputies were added in absence of the Technical Director and QA Officer
Section 4.2, 4.3, and 4.4	Eppendorf calibration frequency change
Section 6.2.2	Sample Acceptance Policy added
Section 10.0	21st edition of Standard Methods added to reference section. Method SW-846 6010B changed to SW-846 6010C. Flame and Furnace deleted. SW-846 8015B switched to SW-846 8015C and addition of SW-846 8270D and SW-846 8260C.
Appendix A	Updated Organizational chart
Appendix E	Updated Listing of SOP's

Revision 18 Detailed Change Record

QA Manual Retyped and Reformatted

Section 1.0	Objectives added
Section 2.2	Added Project Chemists are under Technical Director
Section 2.3	Deletion of Customer Services Manager under Administration Manager
Section 2.4	Used to be section 13.0: Addition of QA reports to management and monthly meeting with Technical Director.
Section 2.5	Addition of Laboratory Manager
Section 2.10	Used to be Appendix "A": Organization Chart and org chart updated
Section 3.2.1	Addition to Estimation of Uncertainty of Measurements and reference to the new SOP "Estimation of Uncertainty of Measurements"
Section 3.2.2.6	Addition of nonconforming work being immediately evaluated and "Customers notified and work is recalled when any aspect of its testing and/or calibration work, or the results of this work, do not conform to its procedures or the agreed requirements of the customer".
Section 3.2.2.7	Addition of Corrective actions and root cause investigations will be immediately issued.
Section 3.3.3	Addition of Control limits calculated annually with at least 20 data points.
Section 3.3.3.1	Addition of Control Charts assessed monthly.
Section 3.3.3.3	Addition of "Root Cause" investigation.
Section 3.3.3.3.1	Addition of Customers notified and work is recalled when any aspect of its testing and/or calibration work, or the results of this work, do not conform to its procedures or the agreed requirements of the customer, Corrective Action taken immediately, and deviations that result in nonconforming work shall be immediately evaluated.
Section 3.3.4.2	In-house AIHA-LAP, LLC PT's run twice annually instead of quarterly. Addition of a blank sample as well as 4 varying samples. Addition of unacceptable PT results immediately initiate a corrective action and a root cause investigation will begin. Addition of blind samples are made up and spiked by either the department Supervisor (Technical Manager) or the QA Officer.
Section 3.3.4.3	Included MCL exceedances must be reported by sub-lab within 24 hours.
Section 4.2	Addition of calibration certificates from external services must be accredited to ISO/IEC 17025:2017 by a recognized accrediting body. And Addition of Refer to Manufacturer's instructions for procedures on how to transport and store measuring equipment and reference standards. Addition of documented training for staff doing in house calibrations and verifications.
Section 4.2.1.1	Reporting Limits are not less than the lowest calibration standard.
Section 4.3	Addition of "For Equipment, Reference Standards, and Reference Materials is transported, stored, maintained, inspected, and cleaned according to manufacturer's instructions" and External Services for calibration of weights, NIST Thermometers, and Eppendorf's must be accredited to ISO/IEC 17025:2017 by a recognized accreditation body.
Section 4.3.1	New Section to include Equipment List which used to be Section 11.0. Equipment listing updated.
Section 4.10	MDL spiked reagent water changed to spiked media and addition of wipe material criteria.
Section 4.10.1	New Reporting Limit section

Section 4.13	Addition of "refer to manufacturer's instructions for the procedures for safe handling, transport, storage, use and planned maintenance of measuring equipment, reference materials, and reference standards to ensure proper functioning and in order to prevent contamination or deterioration".
Section 4.14	Addition of level of acceptable contamination for lead wipe sampling defined and corrective action performed if above this level.
Section 4.16	Section renamed Review of Requests, Tenders, and Contracts. Additional detail provided along with reference to SOP Review of Requests, Tenders, and Contracts, Doc #290.
Section 6.2.2	Addition of samples checked by log-in staff
Section 7.6	Data storage procedural change
Section 8.0 and 8.1	Addition of "all personnel concerned with testing and calibration activities within the laboratory familiarize themselves with the quality documentation and implement the policies and procedures in their work".
Section 8.5	Used to be Appendix "E": SOP listing and SOP listing Updated
Section 9.0	Addition of review of overall objectives to the management review.
Section 9.3	Addition of an Outline for Corrective/Preventative Actions and reference to the CA/PA SOP.
Sections 9.3.1, 9.3.2, 9.3.3, and 9.3.4	Additional details provided on the corrective/preventative action program.
Section 10.0	Addition of statement, "Deviations from test and calibration methods shall occur only if the deviation has been documented, technically justified, authorized, and accepted by the client" as well as will be noted on the final report.
Section 12.2	Addition to training section: "All personnel concerned with testing and calibration activities within the laboratory familiarize themselves with the quality documentation and implement the policies and procedures in their work".
Section 12.6	Used to be Appendix "C": Demonstration of Capability
Section 13.1	Addition of, "Clients notified and work is recalled when any aspect of its testing and/or calibration work, or the results of this work, do not conform to its procedures or the agreed requirements of the client" and "Deviations from test and calibration methods shall occur only if the deviation has been documented, technically justified, authorized, and accepted by the client"
Section 13.3	Corrective actions initiated immediately if warranted from client inquiry and reference of Corrective action section 9.3 in QA Manual and CA/PA SOP.
Section 14.0	Used to be Appendix "B": References

Revision 19 Detailed Change Record

Section 2.10	Updated Organizational chart
Section 3.3.4.1	Addition of Virginia and Maine Certifications
Section 8.3	Addition of written explanations for rerun samples and standards as well as anything that might need explanation in the future.
Section 8.5	Updated SOP listing

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Section 2.10	Updated Organizational chart
Section 5.2	Formulas for automated computations are initially verified then locked.
Section 8.5	Updated SOP listing

Revision 21	**Detailed Change Record**
Capabilities	Rephrasing
Section 2.10	Updated Organization chart
Section 4.3.1	Updated Equipment Listing
Section 4.3 and 4.4	IR Temperature guns calibrated quarterly
Section 7.0 and 7.3	Addition of items included on reports
Section 8.5	Updated SOP listing
Section 9.0	Managerial reviews identify author and be paginated.

Revision 22	**Detailed Change Record**
Section 2.10	Updated Organizational Chart
Section 4.3.1	Updated Equipment listing
Section 8.5	Updated SOP listing
Section 9.2	Addition of “latest” AIHA-LAP, LLC and NELAC site assessor’s checklist to be used

Revision 23	**Detailed Change Record**
Section 2.0	Chemical Hygiene Officer (safety officer) added
Section 2.10	organizational chart removed and note added referring to external document.
Section 2.2	Updated Lab Technical Director description
Section 3.3.4.2	More information provided on proficiency samples
Section 4.2	NIST thermometer and weights calibrated every year
Section 4.12	Note added that if all media is purchased then the table of tests are not needed.
Section 4.3.1	Updated Equipment Listing
Section 6.2.2	Infrared temperature gun verified quarterly
Section 7.6	Third paragraph removed from data storage section and added that Lead and Copper potable water records need to be kept for a period of 12 years.
Section 8.0	Added other documents to master list of controlled documents
Section 8.1	Added that SOP’s and QAM are available to personnel on F: Drive.
Section 8.5	Revision and date of review of each SOP removed and note added stating, for current revision and date of review see master list of controlled documents maintained by the QA department and available upon request.

Revision 24	**Detailed Change Record**
Section 3.3.3.1	Addition of lead control limit requirement
Section 4.2	NIST long stem thermometers purchased annually and digital sent out for calibration annually.
Section 4.2.2	Second Source standard traceable to ISO 17025 and ISO Guide 34.
Section 4.2.3	Standard traceable to ISO 17025 and ISO Guide 34.
Section 4.3.1	Equipment update
Section 4.11	Additional details of procurement added
Section 7.7	Reference to Records Maintenance Matrix added.

Revision 25	**Detailed Change Record**
Section 3.2.2	Additional statements added regarding free from undue pressures
Section 3.3.4.1	Deletion of WA certification
Section 4.3.1	Updated Equipment listing
Section 7.1	Addition of significant figures
Section 7.6	Updated server name to be SQL2014PRI.
Section 8.0	Additional comments added as to what is found on each document and list of SOPs updated to include any new SOP. Updated SOP listing.
Section 9.3.4	Added an internal audit may be necessary
Section 10.0	Addition of methods: EPA 537, ISO 25101, SM 5310B, EPA 300.0, 6010D, 6020B, 7303, 5503 and 6009 and deletion of some methods: SM5310C, 7300, NIOSH 1501, 1003, 7600, 3500, 1550 and 5026
Section 11.0	Updated preservation section
Section 13.1	Expanded MCL section to include MA 310 CMR42.13 requirements

Revision 26	**Detailed Change Record**
Section 3.3.4.1	Addition of VT Drinking Water certification
Section 3.3.4.2	Additional PT info added on how vendors are selected and reference to SOP PT Samples Doc #305 added.
Section 3.3.4.3	Statement added that additional information can be found in SOP Subcontracting, Document #239.
Section 4.2.2 and 4.2.3	ISO Guide 17034 added
Section 4.10	Revised MDL procedure
Section 4.13	“Humidity” deleted.
Section 4.16	Added COC is another form of contract
Section 4.11	Statement added that additional information can be found in SOP Evaluation of Vendors for Supplies, Document #231.
Section 4.12	Changes to procedure of chemical and reagent receipt. Statement add that additional information can be found in SOP Chemical Receipt, Document #114.
Section 4.13	Smoking prohibited on Con-Test Property.
Section 5.1	Hard copy data is stored in an archive building
Section 7.6	Inclusion of on-site data storage, additional archiving information added, and SOP Archiving Data, Document #358 referenced.
Section 8.0	Controlled Document #83 added.
Section 8.5	Addition of SOP’s and controlled Doc #’s
Section 9.3.5	Additional detail on what a Preventive action is was added
Section 10.0	Methods EPA 624.1, 625.1, and 608.3 added
Section 13.1	Statement added that additional information can be found on Subcontracting in Con-Test SOP Doc #239
Section 13.3	Client Comments added to Client Complaint section

Revision 27	**Detailed Change Record**
Section 3.3.4.2	Additional information of PT samples provided. Alternate rounds between analysts and only analyze for dilutions if over calibration.
Section 4.3	Additional information given on thermometer verifications: Added to apply any correction factors on NIST traceable thermometer calibration certificate and also verify at point of use.
Section 7.5	Least Squares Calibration calculation was removed and note in the beginning added that calculations are performed by Chemstation or equivalent instrument software or the LIMS Element.
Section 9.1	Additional information given about internal audits and when findings require need for corrective action and clients need to be notified. Also added, a follow up to verify the effectiveness of the corrective action taken after the internal audit.
Section 9.3.1	Time frame for corrective action and follow up stated.
Section 8.0	New procedures added for document control as well as “effective” date added.
Section 8.1	New procedures added for document control.

Revision 28	**Detailed Change Record**
Table of Contents	Updated Cross Reference to ISO 17025:2017
Section 1.0	Added management system documentation
Section 2.12	Added section on Impartiality
Section 2.13	Added section on Confidentiality
Section 2.14	Now Org chart section
Section 3.2.1	Added more on estimation of uncertainty
Section 4.2	Added to metrological traceability
Section 4.3	Added information to equipment section
Section 4.3.1	Updated Equipment listing
Section 4.11	added to externally provided products and services
Section 4.13	Added to Lab environment section
Section 4.15	Added to review of requests, tenders and contracts
Section 4.16	Added section on QAPPs
Section 5.0	Added to control of data and information management
Section 6.0	Added handling of test or calibration items
Section 7.0	Added information on Technical records
Section 7.4.1	Added section on reporting statements of conformity
Section 7.4.2	Added section on reporting opinions and interpretations
Section 7.4.3	Added section on amendments to reports
Section 9.4	Added section on risks and opportunities
Section 9.5	Added section on improvements
Section 10.1	Added section on selection and verification of methods
Section 10.2	Added section on validation of methods
Section 10.3	Updated methods listing
Section 12.1	Additions to personnel
Section 13.3	Additions to complaints

Revision 29	**Detailed Change Record**
Table of Contents	Add back in a Cross Reference to ISO 17025:2005
Section 3.3.4.1	Addition of PA certification
Section 4.3.2.1	Equipment Listing updated to include new LC/MS/MS and S-EVAP conc. and remove Petrotest Flashpoint apparatus
Section 4.12.6	Use of Class "A" glassware for measurements
Sec 8.5	SOP listing updated to include new Gallery SOPs and delete Lachat SOP's
Section 9.3.4	Training in corrective action must be documented and recorded
Section 10.2.5	Added validation study procedure
Section 10.3	Methods updated to include new NECi methods, new EPH method, new SW-846 updates and remove 6010C and 6020A.
Section 12.3	Added #6 – Be sure to evaluate the method blank and be sure it passes method criteria.
Section 14.0	Addition of ISO 17025:2005 and TNI Standards 2009 and 2016.

Revision 30	**Detailed Change Record**
Capabilities Section	Addition of MI and deleted HPLC
Section 3.3.4.1	Addition of Michigan certification
Section 4.2.4	Removed HPLC and added Discrete Gallery
Section 4.3.16	Removed HPLC and added software and firmware versions must be included in main. log
Section 4.3.21	New Conductivity meter added
Section 4.3.22	Conductivity Meter calibration frequency reworded
Section 4.11.13	Added that DI reagent water is tested daily for conductivity
Section 8.5	Addition of new PFAS SOPs
Section 10.3	Addition of Method EPA 533 and ref as Ref #28
Section 11.0	Changed Fecal H.T from 6 hours to 8 hours and added EPA 533
Section 12.2	Added on-going CDOC performed
Section 12.6	Added CDOC form

Distribution/Training List

See Employee Training Record File for signed training statements for trained user

Table of Contents

Table of Contents Cross Referenced to ISO17025:2017

ISO17025:2017 Reference		Con-Test QAM Section
	8.1.3 Option B	N/A
8.2	Management system documentation (Option A)	Section 1.0
8.3	Control of management system documents (Option A)	Section 8.0
8.4	Control of Records (option A)	Section 7.7 and 7.8
8.5	Actions to address risks and opportunities	Section 9.4
8.6	Improvement (Option A)	Section 9.5
8.7	Corrective actions (Option A)	Section 9.3 and Doc#84
8.8	Internal audits (Option A)	Section 9.1 and 9.2
8.9	Management reviews (Option A)	Section 9.0

Table of Contents Cross Referenced to ISO17025:2005

ISO17025:2005 Reference		Con-Test QAM Section
4.0	Management requirements	Section 1.0 and 3.0
4.1	Organization	Section 2.0
4.2	Management System	Section 9.0
4.3	Document Control	Section 8.0
4.3.1	General	Section 8.0
4.3.2	Document approval and issue	Section 8.0
4.3.3	Document changes	Section 8.0
4.4	Review of requests, tenders and contracts	Section 4.16
4.5	Subcontracting of tests and calibrations	Section 13.1
4.6	Purchasing services and supplies	Section 4.11 and 4.12
4.7	Service to the Customer	Section 13.0
4.8	Complaints	Section 13.3
4.9	Control of nonconforming testing and/or calibration work	Section 3.2.2.6 and 3.3.3.3.1
4.10	Improvement	Section 1.0 and 9.0
4.11	Corrective action	Section 9.3
4.11.1	General	Section 9.3
4.11.2	Cause analysis	Section 9.3.2
4.11.3	Selection and implementation of corrective actions	Section 9.3
4.11.4	Monitoring of corrective actions	Section 9.3.4
4.11.5	Additional audits	Section 9.3.4
4.12	Preventative action	Section 9.3
4.13	Control of records	Sections 7.6 and 7.7
4.13.1	General	Sections 7.6 and 7.7
4.13.2	Technical Records	Sections 7.6 and 7.7
4.14	Internal Audits	Sections 9.1 and 9.2
4.15	Management reviews	Section 9.0
5.0	Technical Requirements	Section 4.13
5.1	General	Section 4.13
5.2	Personnel	Section 12.0 and 2.0
5.3	Accommodation and environmental conditions	Section 4.13
5.4	Test and calibration methods and method validation	Section 10.0
5.4.1	General	Section 10.0
5.4.2	Selection of methods	Section 10.0
5.4.3	Laboratory-developed methods	N/A
5.4.4	Non-standard methods	N/A
5.4.5	Validation of methods	N/A
5.4.6	Estimation of uncertainty of measurement	Sec 3.2.1, 4.0 and Doc #312

ISO17025:2005 Reference		Con-Test QAM Section
5.4.7	Control of data	Section 5.0
5.5	Equipment	Section 4.3
5.6	Measurement traceability	Section 4.2
5.6.1	General	Section 4.2
5.6.2	Specific requirements	Section 4.2
5.6.3	Reference standards and reference materials	Section 4.2
5.7	Sampling	Section 11.0
5.8	Handling of test and calibration items	Section 6.0 / Doc # 268 and 375
5.9	Assuring the quality of test and calibration results	Section 4.0
5.10	Reporting the results	Section 5.0 and 7.0
5.10.1	General	Section 7.0
5.10.2	Test reports and calibration certificates	Section 7.0
5.10.3	Test reports	Section 7.0
5.10.4	Calibration certificates	Section 7.0
5.10.5	Opinions and interpretations	Section 7.0
5.10.6	Testing and calibration results obtained from subcontractors	Sections 3.3.4.3 and 13.1
5.10.7	Electronic transmission of results	Section 7.0
5.10.8	Format of reports and certificates	Section 7.0
5.10.9	Amendments to test reports and calibration certificates	Section 13.0

CON-TEST Analytical Laboratory

Location of Facility

Con-Test Analytical Laboratory, a full-service facility is located at 39 Spruce Street, East Longmeadow, Massachusetts 01028. The laboratory is easily accessible from both CT Interstate I-91 and I-90 (Massachusetts Turnpike).

Brief Company History

Con-Test celebrated its thirtieth year in 2014. Con-Test was started in 1984 as a consulting and engineering firm with laboratory services and in 1994 the company was sold. In 1996 the laboratory was bought back and became strictly a family owned, independent laboratory.

We are proud to have established a reputation based on ***quality, integrity, and reliability*** within the environmental field. Initially, laboratory testing was limited to industrial hygiene analysis mainly in support of in-house consulting services. But the laboratory rapidly expanded its capabilities to include numerous techniques in air analysis, classical (wet) chemistry, metals, and organics.

Con-Test is presently a privately owned, independent laboratory which provides environmental and industrial hygiene analytical services with AIHA-LAP, LLC IHLAP and AIHA-LAP, LLC ELLAP (Environmental Lead) accreditation. Continuing to update our accreditations and technology, we also attained the nationally recognized NELAP accreditation and certification. We are also individually certified in many areas and states by a diverse group of recognized organizations and we have consistently demonstrated proficiency in numerous analyses and matrices under established programs.

Capabilities

The laboratory has the capability for water, air, soil or solid matrices, and lead in soil, air, wipes and paint. The laboratory currently serves a diverse range of clients in an even broader range of analytical services. Analyses are performed to satisfy the following regulatory requirements and purposes:

- National Polluant Discharge Elimination System (NPDES)
- Industrial Pretreatment Program (IPP)
- Resource Conservation and Recovery Act (RCRA)
- EPA Requirements
- OSHA Compliance Requirements
- Code of Federal Regulations (CFR) Requirements
- Massachusetts Department of Environmental Protection (DEP)
- Safe Drinking Water Act (SDWA)
- Clean Water Act
- Massachusetts Water Resources Authority (MWRA)
- Hazardous Waste Characterization (SW-846)
- Groundwater Monitoring Programs
- Industrial Hygiene/Indoor Air Quality (AIHA-LAP, LLC)
- Microbiology
- Well Water Testing
- State Certifications (MA, CT, NY, VT, RI, NH, NJ, NC, ME, VA, MI and FL)
- Connecticut RCP (Reasonable Confidence Protocols)
- Massachusetts MCP (Massachusetts Contingency Plan)

Con-Test Analytical Laboratory is an established laboratory, which realizes the need for remaining on the cutting edge of environmental/industrial hygiene technology. Automation of systems to the greatest extent possible is a primary objective of the laboratory. Current applications and systems are continually being expanded and updated whenever possible to achieve unrivaled quality and information turnaround. Con-Test believes that the use of state-of-the art instrumentation, including data management systems is imperative in maintaining needed efficiency and effectiveness of services. The laboratory is equipped with the latest instrumentation including Gas Chromatographs (GC), GC Mass Spectrometers (GC/MS), LC/MS/MS, Thermo Discrete Gallery, Inductively Coupled Plasma-Atomic Emission Spectrometers (ICP-AES), Inductively Coupled Plasma – Mass Spectroscopy (ICP-MS), Ion Chromatography (IC) and a Laboratory Information Management System (LIMS).

The laboratory is committed to providing analytical services of the highest quality achievable, offering a high level of client commitment, balancing response and prompt turnaround with quality and reliable analyses. The laboratory strives to maintain, and ultimately exceed, established quality standards when providing objective and cost affective services in today's competitive environmental/analytical marketplace. The laboratory's Quality Assurance program insures accuracy of data from testing methodologies to provide a high level of confidence in test results and is committed to continuous improvement.

1.0 Introduction, Objectives, and Quality Assurance Policy Statement

The objective of the Con-Test Quality Assurance Program is to assure the production of the highest quality of data and service possible, with commitment to compliance with all regulatory authorities and organizations, including ISO/IEC 17025:2017 and 2005. This manual outlines the quality control and quality assessment systems which are used to achieve Con-Test's Quality Assurance Goals. The QA program is management's tool to ensure commitment to quality and excellence. All personnel concerned with testing and calibration activities within the laboratory will familiarize themselves with the quality documentation and implement the policies and procedures in their work. All tests and calibrations shall always be carried out in accordance with stated methods and customers' requirements.

The laboratory management shall establish, document, and maintain policies and objectives for the fulfillment of the purposes of the ISO17025:2017 and 2005 standards and shall ensure that the policies and objectives are acknowledged and implemented at all levels of the laboratory. The policies and objectives shall address the competence, impartiality and consistent operation of the laboratory. Laboratory management shall provide evidence of commitment to the development and implementation of the management system and to continually improve its effectiveness. All documentation, processes, systems, records, related to the fulfilment of the requirements of the ISO17025:2017 and 2005 standards shall be included in, referenced from, or linked to the management system. All personnel involved in laboratory activities shall have access to the parts of the management system documentation and related information that are applicable to their responsibilities.

The Quality Assurance Program addresses all areas of Industrial Hygiene and Environmental chemistry.

1.1 Quality Control

Quality control consists of specific procedures or measures adapted to specific operating conditions. These procedures, which apply to every phase of business done at Con-Test Analytical Laboratory, provide a quality structure upon which each procedure is constructed. The purpose is to ensure quality of data and service to our clients.

1.2 Quality Assessment

Quality assessment involves the continuous evaluation of data and monitoring of analytical processes to ensure that quality control procedures are performing correctly.

1.3 Major Elements of the Quality Assurance Program

1.3.1 The use of appropriate methodologies by technically competent, well-trained personnel, using state of the art instrumentation and equipment.

1.3.2 Adherence to well defined standard operating procedures, with emphasis on sound laboratory techniques.

1.3.3 Monitoring of analytical methods to ensure that data user's needs for precision, accuracy, and sensitivity are met. Assessment of data by use of quality control samples including (but not limited to); blanks, independent laboratory control samples, duplicate samples, matrix spiked samples, and surrogate spiked samples.

1.3.4 Internal and external system and performance audits to monitor compliance with procedures and accrediting authorities (AIHA-LAP, LLC – ISO/IEC 17025, NELAP, and various states), and assess performance of analytical methods.

2.0 Laboratory Structure, Personnel, and Responsibility Organizational Structure (See External Document #318)

2.1 General Manager

The General Manager is immediately responsible for all functions pertaining to laboratory operations including overall financial monitoring and management (P&L), preparation of financial reports and statements, marketing, and overseeing issues concerning client relations and laboratory efficiency. Additional responsibilities include; laboratory personnel management including support and performance evaluation, cost analysis and pricing, and overall laboratory business coordination. The top management is committed to the quality assurance policy and objectives, while continually striving to improve the effectiveness of the management system.

2.2 Laboratory Technical Director

The laboratory Technical Director is responsible for overseeing all aspects of Laboratories Technical operations. The Technical Director provides scientific management, organization, direction, and support to both clients and laboratory personnel to ensure that the highest quality and appropriate product is delivered. The Technical Director ensures compliance with all accrediting authorities and organizations (AIHA-LAP, LLC – ISO/IEC 17025, NELAP, and various states). The daily duties for this position include managing the Quality Control. The Technical Director is also responsible for addressing client and lab personnel questions or concerns with methodology and data quality, and makes recommendations on technical issues. The Technical Director must certify that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited. Such certification shall be documented: all employees must have on file a Demonstration of Capability, and documentation that they have read and understood the QA Manual and appropriate SOP's. He/she must ensure that the training of each member of the technical staff is kept up-to-date (on-going). Other major duties include: coordinating with General Manager and Quality Assurance Officer on technical issues, final review and approval of analysis reports and maintenance of technical as well as program standards. The

Technical Director shall possess a bachelor's degree in an applicable physical or biological science (with at least 24 college credits in chemistry and 4 college credits in microbiology), a minimum 3 years' relevant nonacademic analytical chemistry experience (a minimum of 2 years' experience must be in industrial hygiene/metals analyses within the laboratory's scope of accreditation; the remaining one year can be from other non-AIHA-LAP, LLC laboratory analytical procedures). The Technical Director must possess knowledge of IH chemistry calculations with respect to lead-in-air principles and calculations. Relevant academic experience may be substituted for work experience. A relevant master's degree shall be considered equivalent to one year of work experience. The Laboratory Manager has been named the deputy in the absence of the Technical Director.

2.3 Administrative Manager

The Administrative Manager is responsible for managing the Administrative Assistant staffing. This individual is also responsible for all aspects of the corporate accounting system such as payroll, accounts payable, accounts receivable, collections, as well as preparation of financial reports (P&L) and statements.

2.4 Quality Assurance Officer

It is the responsibility of the Quality Assurance Officer to maintain and administer all aspects of the laboratory's Quality Assurance plan therefore ensuring all QA goals are achieved. The Quality Assurance Officer assists the Technical Director in ensuring compliance with all accrediting authorities and organizations (AIHA-LAP, LLC – ISO/IEC 17025, NELAP, and various states). The QA officer addresses every analysis performed in the lab, including documentation of procedures, formulation and use of control charts, addressing of client and regulatory agency quality concerns and audits, and validation of data. The QA Officer also develops and maintains QC procedures for all analytical areas and prepares quality control reports, monthly or when applicable, for presentation to the laboratory director for routine assessment of measurement systems for precision and accuracy. The QA Officer shall possess a bachelor's degree in an applicable basic or applied science and have at least one year of nonacademic analytical experience appropriate to the types of analyses performed by the laboratory; or in lieu of a bachelor's degree, four years of nonacademic analytical experience. The QA Officer shall have documented training in statistics. Training in quality control procedures is strongly encouraged. The Technical Director has been named deputy in the absence of the QA Officer.

2.4.1 The Quality Assurance Officer prepares Quality Assurance Reports for review by the laboratory management on a regular basis (monthly). The main structure of a report is based on summarization of one or more of the following categories: Quality Assurance Activities, Quality Control Performance, Corrective Actions, and QA review of data packages as part of internal audits. Each month the Technical Director and the QA Officer meet and discuss the contents of the monthly report.

2.5 Laboratory Manager

It is the responsibility of the Laboratory Manager to oversee staff and production management and to meet the needs of clients on data completeness and delivery. The Laboratory Manager is responsible for production control, monthly management reports, staff management, training, industry events, quality systems, cost control, add new products or market segments, innovation and data review. In addition to management of all departments in the laboratory.

2.6 Operations Director

The Operations Director assists in laboratory renovations and design, improvements in the facility and work flow, standardization of lab processes and maintenance of leading-edge technology, as well as final review and approval of analysis reports. The operations director also heads up the IT department, and is the LIMS administrator.

2.7 Section Heads/ Supervisors

It is the duty of each Section Head to perform and maintain proficiency in the analysis of specified areas and techniques, provide training, supervision, and direction to analysts, insure that work flows smoothly, that quality and turnaround standards are maintained and ultimately exceeded, ensure safety measures are being followed, and to assist development of projects, planning and quality control program in the specified area.

A Supervisor shall possess a bachelor's degree in chemistry, biology, or a closely related field, and have at least 30 college credits in chemistry (or 4 college credits in microbiology for a microbiology supervisor). A supervisor shall have a minimum 2 years' experience in chemical analysis (or a minimum one-year experience in microbiology for a microbiology supervisor).

Per MA DEP regulations, the following requirements apply:

Inorganic chemistry I (includes AA Spectroscopy): the supervisor shall have a minimum of 2 years' laboratory experience in chemical analysis, including 6 months training or experience in the operation of an AA spectrophotometer.

Inorganic chemistry II (Includes ICP): the laboratory supervisor shall have a minimum of 2 years' laboratory experience in chemical analysis, including one-year training or experience in ICP methods.

Organic chemistry I (includes GC): the laboratory supervisor shall have a minimum of 2 years' experience in chemical analysis, including 6 months training or experience in the operation of a GC.

Organic chemistry II (includes GC/MS): the laboratory supervisor shall have a minimum of 2 years' experience in chemical analysis, including 6 months training or experience in GC methods and one-year training or experience in the operation of a GC/MS.

2.8 Chemical Hygiene Officer (Safety Officer)

The Chemical Hygiene Officer is responsible for the development and implementation of the Chemical Hygiene Plan for the laboratory.

- Responsible individuals will be designated for duties to insure compliance with safety, training and medical monitoring requirements of the plan
    - The laboratory supervisors are responsible for conducting regular hazard inspections using the Department Safety Check List (Document#316), either by themselves or a designated individual in the department. The completed checklist is forwarded to the Chemical Hygiene Officer at the end of each month. The Chemical Hygiene Officer addresses any deficiencies and retains the checklists in a binder.
- Ensuring laboratory personnel are using the proper personal protective equipment
- Evaluation of Hood Performance, Coordinate the operation, acquisition and maintenance or fume hoods, emergency safety showers, eyewashes and fire extinguishers
- Hazardous Chemical and Waste training
- Evaluating circumstances requiring pre-approval for work, i.e. dangerous samples or procedures using dangerous reagents
- Provisions for working with Particularly Hazardous Substances
- Enforcement of safety policies
- Provide technical expertise and administrative support to the laboratory community in the area of laboratory safety and health, and direct inquiries to appropriate resources
- Ensure that extremely hazardous substances are appropriately handled and stored and that specific standard operating procedures are developed and followed which instruct all personnel in the safe use of these substances
- Review specific operating procedures for the use, disposal, spill clean-up, and decontamination of extremely hazardous chemicals and substances

- Investigate all incident reports, chemical spills and near-misses to prevent repeat incidents
- Act as a liaison between the laboratory and management bringing unresolved and potentially serious health and safety problems to their attention
- Chemical Hygiene/Safety Committee containing representatives from all departments/areas of the company
- Ensuring all employees receive proper safety training
- Helps maintain SDS sheets

2.9 Individual Analysts

It is the responsibility of each analyst to be cognizant of always maintaining and ultimately exceeding quality standards during the generation of consistently reliable data of the highest achievable.

At Contest, it is the duty of each and every employee to help foster an attitude of continuous improvement in the laboratory with regard to decreasing turnaround in all areas, improving quality of results and providing excellent customer service to produce "delighted clients" who have no reason to go anywhere else.

Per AIHA-LAP, LLC policy, an analyst shall possess a bachelor's degree in chemistry or a related science. A technician is one who does not have a degree in chemistry or a related science. An AIHA-LAP, LLC analyst must complete in-house training per AIHA-LAP, LLC policies (see section 12.0 of this QA Manual).

Per MA DEP regulations, the following requirements apply:

Instrumentation analysts shall possess a high school diploma or equivalent and 8 college credits in chemistry for an instrumentation analyst; have a minimum of 6 months training or experience in the operation of the appropriate instrumentation except for GC/MS or ICP. One year of training or experience is required for the operation of GC/MS or ICP.

Non-instrumentation analyst shall possess a minimum of a high school diploma or equivalent; an analyst shall receive specialized training in the methods to be performed.

2.10 Statement of Confidence

Due to the inherent nature of work provided by Con-Test, employees are required to work with confidentiality. Information concerning analysis data and reports is considered confidential and will be released only to a client or their authorized representative.

Only authorized personnel have access to, and the responsibility for control and issuance of data, materials, and supplies.

2.11 Laboratory Security

Con-Test Analytical Laboratory is a secure laboratory. In order to assure our clients strictest confidentiality, Con-Test has several security measures, including a building security system and laboratory entry system restricting access to only authorized personnel. Unauthorized sample contact or data manipulation is therefore controlled.

2.12 Impartiality

2.12.1 Laboratory activities shall be undertaken impartiality and structured and managed so as to safeguard impartiality.

2.12.2 The laboratory management shall be committed to impartiality.

2.12.3 The laboratory shall be responsible for the impartiality of its laboratory activities and shall not allow commercial, financial or other pressures to compromise impartiality.

2.12.4 The laboratory shall identify risks to its impartiality on an on-going basis. This shall include those risks that arise from its activities, or from its relationships, or from the relationships of its personnel. However, such relationships do not necessarily present a laboratory with a risk to impartiality.

2.12.5 If a risk to impartiality is identified, the laboratory shall be able to demonstrate how it eliminates or minimizes such risk.

2.13 Confidentiality

2.13.1 The laboratory shall be responsible, through legally enforceable commitments, for the management of all information obtained or created during the performance of laboratory activities. The laboratory shall inform the customer in advance, of the information it intends to place in the public domain. Except for information that the customer makes publicly available, or when agreed between the laboratory and the customer (e.g. for the purpose of responding to complaints), all other information is considered proprietary information and shall be regarded as confidential.

2.13.2 When the laboratory is required by law or authorized by contractual arrangements to release confidential information, the customer or individual concerned shall, unless prohibited by law, be notified of the information provided.

2.13.3 Information about the customer obtained from sources other than the customer (e.g. complainant, regulators) shall be confidential between the customer and the laboratory. The provider (source) of this information shall be confidential to the laboratory and shall not be shared with the customer, unless agreed by the source.

2.13.4 Personnel, including any committee members, contractors, personnel of external bodies, or individuals acting on the laboratory's behalf, shall keep confidential all information obtained or created during the performance of laboratory activities, except as required by law.

2.14 Con-Test Analytical Laboratory organization chart

To view organizational chart, see External Document #318.

3.0 Quality Assurance Objectives

The purpose of Con-Test's Quality Assurance Plan is to ensure the production of quality, objective, and cost affective services to our clients. The laboratory operation offers a high level of client commitment, balancing response and prompt turnaround with quality and reliable analyses.

3.1 Quality Assurance Goals

3.1.1 Establish and maintain the quality management and assurance systems in the production of consistently reliable and accurate "quality data" of known precision and accuracy.

3.1.2 Monitor analytical methods to insure use of appropriate, EPA, State, or recognized agency endorsed or approved methodology insuring that client's need for precision, accuracy, and sensitivity are met or ultimately exceeded.

3.1.3 Insure the use of sound laboratory techniques and practices, by competent trained individuals.

3.1.4 Establish and maintain Standard Operating Procedures for all processes producing uniformity and definition.

3.1.5 Maintain systems for early identification of problems and defined procedures for quick resolution.

3.1.6 Promote a positive attitude toward improvement of total quality.

3.2 Measurement of Data

In the pursuit of the highest data quality achievable, Con-Test utilizes specific procedures applicable to defined situations in the tracking and evaluation of data and data systems.

3.2.1 Use of Quality Control Measures

3.2.1.1 Quality control measures are part of the daily laboratory routine from which data quality is assessed and controlled. These defined processes are built into each analysis or Standard Operating Procedure. Standard Operating Procedures address all aspects and processes performed in the lab and ensure correct definition and proper utilization through incorporation of method specific QC into applicable methodology. An overview of the entire process and its utilization is addressed in the following sections.

3.2.1.2 Most Quality Control data, which is obtained during sample analysis provides an indication of the "Quality" of sample data and therefore is provided in laboratory deliverable packages with the applicable sample data. It must be noted that not all reports will contain QC information. This does not mean that the same care and attention was not given to all samples but that regulations dictated that specific QC measures be analyzed on an alternate sample in the analytical batch. Other QC measures are not reported to clients because it does not provide supplemental information about the sample and is therefore not helpful.

3.2.1.3 Evaluation of measurement uncertainty **–** The laboratory shall identify the contributions to measurement uncertainty. When evaluating measurement uncertainty, all contributions that are of significance, including those arising from sampling, shall be taken into account using appropriate methods of analysis.

3.2.1.4 A laboratory performing calibrations, including of its own equipment, shall evaluate the measurement uncertainty for all calibrations.

3.2.1.5 A laboratory performing testing shall evaluate measurement uncertainty. Where the test method precludes rigorous evaluation of measurement uncertainty, an estimation shall be made based on an understanding of the theoretical principles or practical experience of the performance of the method.

3.2.1.6 The components of uncertainty are identified and estimated for all quantitative tests in the laboratory using the standard quality control procedures for determining precision and accuracy as outlined in section 4.0 of this manual. These include but are not limited to the use of standard reference material; laboratory fortified sampling media or blanks and their duplicates, and sample duplicates.

3.2.1.7 Primary components of uncertainty arise from: instrument calibration bias, instrument noise/drift, instrument response/line voltage transients, purity of reagents/variation of reagent addition, and analyst technique (including dilutions and subjective measurements).

3.2.1.8 Quality control results associated with samples are reported in the QC summary report that accompanies the sample results. Where necessary for the interpretation of the test results and when requested, the overall estimate of uncertainty is reported to the client.

3.2.1.9 See SOP "Estimation of Uncertainty of Measurements" controlled document #312 for details on the procedure of estimating uncertainty as well as an example of how Con-Test calculates the estimation of uncertainty.

3.2.2 Laboratory Data Integrity and Ethics Policy

Con-Test Analytical Laboratory understands the importance of environmental testing data to nearly every significant public health and environmental management decision made and consequently has developed this policy to ensure that strict ethical standards are adhered to in the performance of analytical procedures and reporting of analytical results. Con-Test will ensure that its management and personnel are free from any undue internal and external commercial, financial and other pressures and influences that may adversely affect the quality of their work. Con-Test Analytical Laboratory is committed to compliance with all applicable laws, regulations, and other requirements that are imposed upon the laboratory in the conduct of its business, and to practice the highest professional laboratory standards. See SOP Ethics, controlled document #392 for expanded detail.

3.2.2.1 Principles and Program Components

1) The laboratory is ethically and morally obligated to provide data that is precise, accurate, and of known and documented quality.
2) The laboratory will self-police its operations in order to maintain data user confidence.
3) Data integrity training will be provided to all employees.
4) A quality assurance officer will be appointed to insure compliance with the ethics policy within the laboratory.
5) An enforcement policy through disciplinary action will be implemented.
6) A confidential mechanism will be implemented for anonymously reporting alleged misconduct that will require a full investigation.
7) Procedures are described for guidance on the recall of data if and when necessary.

8) Internal auditing and corrective action procedures are in place to detect integrity issues.
9) Internal data integrity investigations will be thoroughly documented.

3.2.2.2 Role of Quality Assurance Officer within Ethics Program

A Quality Assurance Officer (QAO) is appointed within the laboratory with direct access to the laboratory director and highest levels of management. Among other duties the Quality Assurance Officer will be responsible for compliance within the laboratory and adherence to the data integrity policy. The QA Officer also maintains an internal auditing system whereby all analytical methods are audited at least annually to detect and correct systematic errors, improper practices, and non-compliance. Internal audits are conducted on a pre-determined schedule, in response to external audit findings, based on client complaints, or anonymous allegations of misconduct. A master list of corrective actions is maintained and progress in the resolution of corrective actions is reported to management on a monthly basis.

3.2.2.3 Data Integrity and Ethics Training Program

Data Integrity Training shall be provided as a formal part of new employee orientation and must also be provided on an annual basis for all current employees. Topics covered shall be documented in writing and provided to all trainees. The training will include training in the critical need for honesty and full disclosure in analytical reporting, acceptable and unacceptable scientific practices, including proper manual integration, calibration, and documentation procedures. The laboratory ethics policy will be discussed including the mission statement and consequences of non-compliance including possible enforcement and disciplinary actions. The initial data integrity training and annual refresher training shall have a signature attendance sheet that demonstrates all staff has participated and understand their obligations related to data integrity.

3.2.2.4 Enforcement Actions

Employees who violate the laboratory data integrity policy or knowingly bypass required quality control or quality assurance procedures will be disciplined consistent with the severity of circumstances surrounding the violation. Individuals who knowingly and intentionally falsify data or otherwise commit criminal acts will not be tolerated. Individuals who are discovered using improper practices including “peak juicing”, “peak shaving”, inappropriate and inconsistent manual integration, falsifying dates, inappropriate changes in the concentrations of standards, and fabricating data (“dry Lab”), after investigation, will be subject to disciplinary action up to and including immediate termination as specified in the employee personnel handbook.

3.2.2.5 Internal Investigations, Reporting, and Monitoring

While it is hoped that allegations of misconduct or violations of the laboratory ethics and data integrity policy will be brought to the attention of supervisors, senior management or the Quality Assurance Officer, issues may also be raised and reporting privately and anonymously to any of the same individuals without fear of reprisal. In the case that employees wish to anonymously report misconduct, a locked drop-box is provided. The QA Officer routinely checks the lock box for reports containing anonymous allegations. All allegations of misconduct will be investigated free from the influence of those being investigated. All investigations and resolutions to allegations of misconduct will be conducted privately and discreetly and must be reported to senior management.

3.2.2.6 Data Recall

In the normal course of business, periodically there will be some reports submitted to customers with erroneous data. There may be many possible causes for the erroneous data, including calculation errors, data entry errors, analytical problems that were not caught during data review, and deviations from standard operating procedures. Some erroneous data could be caused by misconduct or deceptive data recording practices by an individual within the laboratory.

Erroneous data (nonconforming work), once discovered, will immediately be evaluated and subject to the corrective action reporting procedures. When necessary, the customer is notified and work is recalled when any aspect of its testing and/or calibration work, or the results of this work, do not conform to its procedures or the agreed requirements of the customer. Revised report forms will be completed for each report involved, and the client will be notified that changes will be made to the report. A revised report will be issued. A corrective action form will be completed and the error will be recorded in the corrective action database and investigated, unless the error was a simple typographical error that did not affect the data. Discovery of erroneous data might lead to an investigation of improper practice and disciplinary action.

3.2.2.7 Proper and Improper Practices

In the course of laboratory testing it is inevitable that some things will go wrong from time to time. Problems encountered in the laboratory should never be covered up. Improper practices can be perpetuated by inadequate training, ineffective internal assessments, and lack of independent QA review. Most improper practices are shortcuts, appearing to be done to save time and effort. In any case, a corrective action shall be issued immediately and a root cause investigation will be initiated.

Data should always be able to be reconstructed without having to talk to the analyst who performed the test and should stand by itself.

In the light of these principles, realities, attitudes, and the associated pressures, an extensive, although not all-inclusive list of proper and improper practices are presented below.

3.2.2.7.1 Proper Practices

1) Analytical results must be reported from actual analysis.
2) Record exceptions to and deviations from documented procedures.
3) Records must be complete to trace actual analysis and stand by themselves without discussion with analyst.
4) If calibration or QC is not within limits – consistently integrate peaks and perform corrective action of maintenance.
5) Only reject points from an MDL calculation using statistical evaluation or if a known error has occurred.
6) Document all calibration and QC data.
7) Adjust laboratory reporting limit and upper end of linearity based on current initial calibration.
8) Report and document problems and the need for corrective actions.
9) Report knowledge of unethical behavior to management.
10) Exceeded holding times must be reported to clients.
11) Document all manual integrations with before and after print-out, reason, name, and date.
12) Document all out-of-control events.
13) Retain non-compliant data or data for assays that did not work.
14) Document corrective actions and maintenance procedures.

3.2.2.7.2 Improper Practices

1) Fabrication of data or other information
2) Misrepresentation of QC sample results
3) Improper date/time setting or recording
4) Improper peak integration
5) Improper GC/MS tuning
6) Improper calibration and verification
7) Data file substitution or modification
8) Unwarranted sample dilution
9) Improper alteration of analytical conditions
10) Unwarranted manipulation of computer software
11) Concealment of a known problem malfunction issues

Any of these items shall have a corrective action issued, with a root cause investigation.

3.2.2.7.3 Avoid Non-Authentic Data – Intentional or accidental reporting of incorrect data

1) Wrong number of significant figures used in calculations and reports
2) Quality Control samples not analyzed or reported at proper frequency
3) Missing units, headers, and initials in the record

Any of these items shall have a corrective action issued, with a root cause investigation.

3.3 Specific Routine Procedures Used to Assess Data Precision and Accuracy

3.3.1 Precision: Assessment of Precision

Precision, as defined by the Environmental Protection Agency (SW-846), “is the measure of the degree of agreement among duplicate sample analyses without assumption of knowledge of its true value.” At Con-Test, precision is estimated by means of duplicate analyses expressed as relative percent difference or range. Duplicate control limits vary from zero (no difference between duplicate samples) to the historical mean of the applicable accumulated set of duplicate measurements plus three standard deviation units.

Con-Test analyzes duplicates at a frequency of at least 5% or one per batch in order to construct data control charts, and sometimes more frequently if required or deemed necessary.

3.3.2 Accuracy: Assessment of Accuracy

Accuracy, as defined by the EPA, "is the closeness of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy is the combination of bias and precision of an analytical procedure, which reflects the closeness of a measured value to the true value."

Bias is the deviation of the measured value from a known spiked amount due to matrix effects and other undeterminable sources.

By determining the recovery of a known amount of target analyte spiked into a sample (matrix spike) or medium blank, Con-Test monitors the accuracy of an analytical process. An indication of laboratory total accuracy can be obtained after the accumulation of a significant number of observations.

Matrix spikes, as well as matrix spike duplicates are utilized for the assessment of accuracy and precision. Con-Test utilizes control limits for accuracy based on the historical mean percent recovery of the applicable accumulated population plus or minus three standard deviation units.

3.3.3 Assessment of Data Quality

Historical monitoring and evaluation of performance through the use of X bar and R control charts provides a reliable way of assessing quality of data. Through the compiling and plotting of historical data points duplicate and spike results) a historical data point spread or control chart (assuming a normal distribution) using the population is obtained. Through the use of statistics, specifically the calculation of the mean value of the population and the standard deviation (average difference from the mean value), control limits are calculated annually, using at least 20 data points. The purpose of control limits is to demonstrate that the method is performing in a state of statistical control.

3.3.3.1 Control Charts and Control Limits

Control charts provide a tool for distinguishing the pattern of indeterminate (random) variation from the determinate (assignable cause) variation.

The control chart is actually a graphical representation of quality control efficiency. The data from a series of analyses can be plotted with the vertical scale in units of the test result and the horizontal scale in units of time or sequence of analysis. The mean value of the population and standard deviation can be calculated and the spread can be established.

A minimum of twenty data points is normally required to determine chart limits. The determination of appropriate control limits or statistically acceptable deviations can be based on the capability of the procedure as known from past experience or can be arbitrarily set at a desired level (prescriptive limits). Commonly, the limits are set at three standard deviation units on each side of the mean.

If a procedure is “in control”, the results will almost always fall within the established statistical control limits. The charts may also disclose trends and cycles from assignable causes.

Control charts are generated and assessed on a regular basis; in order to identify, explain, and correct any observed trends in a timely manner. A “trend” is defined as 7 consecutive points on either side of the mean. Trends indicate issues, which necessitate explanation. If trend continues a corrective action shall be needed. Charts are generated according to a schedule. They are assessed and trends are identified by the following criteria:

- Must span 7 or more analysis dates
- Must be outside the 90-110% recovery window
- If the chart is for RPD, and the chart trend is below the mean, then it is not designated as a trend
- The mean may be skewed, due to an extreme outlying point, causing a false trend
- If all data points for an analyte are always below 70% recovery, an investigation is warranted. (It may need to be classified as a difficult compound, or a corrective action may be issued)

- For "real time" trend analysis, only review the last quarter (3 months) of data: anything further back is too old for real-time viewing

Any trends that are identified are logged into a database, and assigned to the analyst, who will investigate the trend and write an explanation, and then forward it back to the QA department.

When evaluating control charts, the following general criteria are considered:

- 1 Measurement > Control Limit
  Analyze another
  Stop test if > Control Limit

- 2 of 3 successive point > Warning Limit
  Analyze another
  Stop test if > Warning Limit evaluate bias and correct

- 4 out of 5 points exceed 1 standard deviation or decreasing or increasing order on the same side of the central line.
  Analyze another
  Stop test if exceeds 1 standard deviation or same pattern and correct

- 7 Successive points on the same side of the central line.
  Stop test and correct

In some cases, the laboratory monitors and establishes its own control limits, in order to meet method requirements, method specified control limits take precedence over those established in the laboratory. Data outside laboratory control limits but within method specified limits may be considered of sufficient accuracy to report.

For the AIHA, LAP-LLC lead program, laboratory determined statistical acceptance limits and frequencies must be at least as stringent as the interim limits of 80-120%.

3.3.3.2 Con-Test Classification System for Waters and Wastes

The laboratory has developed control charts and acceptance limits based on general matrix stability and characteristics. Most waters and wastes can be adequately categorized and evaluated under two major groupings; Potable & Non-Potable Water. Classification of Waters for the purpose of comparison and evaluation of data to establish control limits is based on the following table and comments.

Con-Test Classification of Waters and Wastes
Categorization of Potable and Non-Potable Water

Potable Water	Non-Potable Water
-Public Drinking Water	-Wastewater
-Well Water (other than monitoring)	-Effluent of Discharge Waters
-Water (depending on matrix characteristics)*	-Storm Water (matrix related)
-Bulk or Bottled Water	-Water (depending on matrix)*
-Other	-Monitoring Well Water
	-Leachate
	-Ground Water (other than effluent)
	-Recreational water (Pools, Beaches)
	-Streams, Lakes, Rivers
	-Other

*If the sample has been evaluated by the client as “WATER” it may be compared to either of the above categories according to the laboratories’ discretion (determined matrix characteristics).

Samples previously classified by Clients in one of the above categories may occasionally be laboratory re-classified and subsequently compared to matrix control limits other than the one which was specified by the client when deemed more applicable by the laboratory. This is based upon laboratory matrix characterization including; appearance, matrix consistency, and matrix components. If difficulties encountered in the analysis of a sample can reasonably be determined as matrix and not system related, a sample matrix may be compared to limits other than one listed on the chain of custody or categorized as Other than one of the above.

3.3.3.3 Out of Control Events:

An '" Out of control Event" is any event, which does not fall within established control limits. Con-Test laboratory takes immediate corrective action whenever quality control data is outside acceptance limits. Data is either not reported or reported as qualified data until the root cause of the problem is determined and corrected. Records are kept of all out of control events.

If the sample values do not meet the minimal acceptance criteria, a root cause investigation is conducted to determine, correct, and document the source or suspected cause of the variance. The root cause investigation continues until acceptance criteria are met or the data is flagged with an appropriate explanation of the variance. Attempting to accurately identify the root cause of the variance shall involve initiation of a formal corrective action.

The following steps are taken for these events:

The analyst/technician will attempt to determine why the analytical values exceed the control limits and correct the problem if identified. Calibration-related out of control events are documented on non-conformance forms. Out of control events detected during control chart review are logged into a database, and assigned to the analyst, who will investigate the trend and write an explanation, and the forward it back to the QA department.

Additional actions include:

- Data Integrity Validation

  A check of data transcription from log books, calculations, method requirements, reviews of sample matrix data and other possible causes.

- Data Re-evaluation

  The analyst will re-analyze / possibly re-prepare both the quality control samples and samples a second time if the samples are such that significant degradation has not occurred or sufficient sample is available.

Additional QC measures can be utilized to eliminate suspect sources of error. (I.e. Fortified Blanks can be prepared to run with the samples to eliminate suspicion of inaccuracy in spiking procedures and/or spiking equipment).

- Determination of Root Cause

In the event a consistent bias is discovered in procedure, method, or the like, a formal corrective action is initiated to ensure that the problem is tracked to resolution.

3.3.3.3.1 Nonconforming Work

When necessary, the customer is notified and work is recalled when any aspect of its testing and/or calibration work, or the results of this work, do not conform to its own procedures or the agreed requirements of the customer. Deviations that result in nonconforming work shall be immediately evaluated. Correction is taken immediately, together with any decision about the acceptability of the nonconforming work.

Non-conforming QC samples such as infrequent LCS/MS/CCV failures are addressed through case narrative notes with the analytical report and/or sample re-preparation and/or reanalysis when applicable.

Non-conforming QC problems will be addressed by the QA department immediately through corrective action. This will start a root cause investigation including routine data review, data validation, internal or external audits as follows: An evaluation of the significance and extent of the problem will be conducted by the QA department, with oversight by management staff including the laboratory manager and laboratory director. If the problem significantly affects previously reported data, the client is notified by the project chemist assigned to the particular client and a new report will be issues after the problem is corrected. If a significant problem is found that is not able to be addressed and corrected immediately, all affected work will be halted in the laboratory by the QA department

and/or laboratory manager. Clients with affected samples will be notified by their project chemist, and work will be subcontracted to a qualified laboratory at the clients' request. Work will not be resumed on affected analyses until a root cause analysis of the technical aspects of the procedure is performed by laboratory management, previously reported results are reviewed for accuracy and method compliance, and the QA department has approved changes that will bring the method into full compliance. When all three of these conditions have been met, the laboratory director will again allow work to be accepted for these procedures.

3.3.3.4 Sample Matrix Interferences

Samples, which indicate the presence of interferences, are normally treated in one or more of the following ways in an attempt to eliminate the interference(s) and obtain a defensible, valid result.

- The sample is successively diluted and reanalyzed to eliminate interferences.
- Modification of sample matrix is used to remove interferences or to stabilize the analyte of interest.
- The sample is analyzed by method of Standard Additions.
- An applicable (approved) alternate method or wavelength which is not subject to the interference(s) is utilized.
- Various sample/extract clean-up procedures may be employed.

3.3.3.5 Non-method Performance Factors

The following are examples of non-method performance factors:

- Sample non-homogeneity
- Method applicability questionable due to sample matrix or other factors outside the control of the laboratory.
- Client did not submit samples according to method required or recommended procedure (i.e. field blank/media blank for background or contamination determination, etc.).

3.3.3.6 Data Conclusions

If upon reanalysis the data meets acceptance criteria and it can be reasonably assumed the original variance or bias in technique or procedure has since been eliminated or corrected, the analysis may continue and results are reported.

If the result continues to fall outside the established control limit range and the laboratory method performance factors for that analyte are shown to be in control, the variance is judged to be matrix related, not system related. The data user is informed that the result for that analyte is suspect due to matrix chemical or physical effects and analysis by an alternate method if possible, should be considered.

Result data is flagged with the appropriate message on the analysis report if the interference could not be satisfactorily eliminated or response was marginal.

If analysis results are rejected or considered of questionable integrity they may not be utilized or plotted on the X bar and R charts.

3.3.4 Certification, Accreditation, & Regulatory Agencies

Con-Test Laboratory holds and maintains certification and accreditation from a number of different states, federal, local, and regulatory agencies encompassing all regulated services.

3.3.4.1 Certifications and Licenses

Original certificates are displayed in the log-in reception area. Copies are available on the network and in a binder in the QA department.

Con-Test holds certifications/accreditations and licenses with the following agencies:

- AIHA-LAP, LLC Accreditation # 100033
- AIHA-LAP, LLC Environmental Lead Laboratory Accreditation Program (ELLAP) (NLLAP recognized)
- Commonwealth of Massachusetts Chemical Analysis of Potable, Non-Potable, and Microbiological Analysis of Water Certificate of Approval, Lab ID #MA0100
- Connecticut State Approved Public Health Laboratory # PH-0567 – Potable Water, Wastewater, Sewage, and Soil
- ELAP/1° NELAP Accreditation, State of New York Environmental Laboratory Certification
  Lab ID #10899 – Solid & Hazardous Waste, Air and Emissions, Potable Water, and Non-Potable Water
- New Hampshire (State of), Department of Environmental Services
  Lab ID #2516 - 2° NELAP Accreditation -
  Drinking Water, Wastewater, Solids, and Air
  Lab ID #2557 - 1° NELAP Accreditation for EPH and VPH and PFAS
- Rhode Island and Providence Plantations, Department of Health, Analytical Laboratory Certification (Certification # LA000112)
- Vermont Lead Regulatory Program, Vermont Department of Health – License # LL015036
- Vermont Department of Health Drinking Water –
  Lab ID# VT-255716 (PFAS and Lead and Copper)
- New Jersey, Department of Environmental Protection,
  Lab ID # MA007 - 1° and 2° NELAP
  Clean Air Program (CAP) – Atmospheric Organics, Atmospheric Inorganics (Non-Metals) and DW PFAS
- North Carolina (State of), Department of the Environmental and Natural Resources
  Lab ID # 652 – Wastewater and Solids and Hazardous Waste

- North Carolina Department of Health and Human Services,
  Lab ID #25703 – DW lead and Copper only

- Florida, Department of Health,
  Lab ID # E871027 - 2° NELAP Accreditation
  Air and Emissions

- State of Maine Certification Program
  Lab ID #MA00100
  Certificate #2011028
  Drinking Water, Wastewater, and Solids

- Commonwealth of Virginia Department of General Services Division of Consolidated Laboratory Services
  Lab ID #460217 - 2° NELAP Accreditation
  Certificate #1827
  Drinking Water, Wastewater, Solids, and Air

- Commonwealth of Pennsylvania Department of Environmental Protection
  Lab ID #68-05812 – 2° NELAP Accreditation
  - Drinking Water PFAS only
  - Non-Potable Water and Solids – PCB's only

- Michigan Department of Environment, Great Lakes, and Energy (EGLE)
  Lab ID 9100
  -Potable Water PFAS EPA 537.1 only

3.3.4.2 Participation in Proficiency Sample Programs

In the maintenance of certification and accreditation in the applicable areas, Con-Test participates in a wide range of environmental laboratory proficiency programs in which Con-Test's expertise is demonstrated through the analysis of proficiency samples. Proficiency samples are managed, analyzed, and reported in the same manner as real environmental samples. They utilize the same staff and methods as used for routine analysis of that analyte as well as procedures, equipment, facilities and frequency of analysis. Dilutions are performed following the same protocols as for samples and if multiple analysts analyze the same test method, they will rotate who runs each PT round.

Those proficiencies which are regularly participated in include the following:

- New York State DOH Proficiency Studies (two potable and two non-potable rounds per year)
- DMR QA Studies (performed annually)
- AIHA-LAP, LLC Proficiency Analytical Testing (IHPAT) Program (four rounds per year)
- AIHA-LAP, LLC Environmental Lead Proficiency Analytical Testing (ELPAT) Program (four rounds per year)
- Commercial Vendor ("Environmental Resource Associates" (ERA)) WP, WS, AE, and Soil studies

Selection of Proficiency vendors is based on Vendors accreditation status. They must have ISO/IEC 17025:2017, ISO/IEC 17043:2010, and ISO/IEC Guide 34:2009 or ISO 17034:2016 accreditation. We have evaluated the following PT providers and found they have the above stated criteria; therefore, we have approved the use of them:

1) **ERA**
2) **Phenova**
3) **Absolute Standards**
4) **NSI**
5) **AIHA-PAT Program**
6) **NYSDOH**

An Internal QC program is run for AIHA-LAP, LLC Fields of Testing not covered by the AIHA-LAP, LLC proficiency studies (total/respirable dust, Hg in Air, TO-11, TO-15, and TO-10A). Twice annually, the laboratory shall prepare a minimum of 4 independently prepared blind samples at varying levels, as well as a blank, with the resulting data treated as it would be in a round robin program. These blind samples are made up and spiked by either that department supervisor (technical manager), or by the QA Officer.

Acceptance criteria for results are from the laboratory-generated control limits (which have been established by the control charting program, and are generated and reviewed annually).

The QA Officer and Technical Director carefully review results of Proficiency tests when available. Any unacceptable result will immediately initiate a corrective action, and a "root cause" investigation will begin. The original runs and paperwork are reviewed with the analyst to determine possible root causes. Corrective actions, including additional maintenance of equipment, quality control sample analysis, or modifications to

SOPs are implemented when necessary. A make-up proficiency sample is ordered and analyzed and licensing authorities are notified in a report, if appropriate, of corrective actions.

Additional details on Proficiency Testing can be found in SOP PT Samples Document #305.

3.3.4.3 Use of External Laboratories

When samples are received for an analysis which is not performed by the laboratory, a qualified outside laboratory is found to perform the analysis. Only outside laboratories that have demonstrated proficiency in the analysis requested are selected. Laboratories are deemed proficient if they are:

1) Accredited by AIHA-LAP, LLC
2) Certified by a state or recognized "Quality" agency
3) Accredited under NELAP for any part of the testing covered under NELAP.

The laboratory shall advise the client in writing of its intention to subcontract any portion of the testing to another party and the written approval from the client will be retained. The laboratory shall retain records demonstrating that these two requirements have been met.

Only laboratories following approved and standard methods will be used for outside work. When work is placed with a NELAP laboratory, the final report cover sheet will indicate the laboratory's NELAP id.

For AIHA-LAP, LLC and NELAP analyses, written pre-approval from the client is required. This may include "blanket" approval for any current or future projects.

Con-Test Analytical Laboratory is responsible to the client for subcontractors' work, except in the case where the client or a regulatory authority specifies which subcontractor is to be used.

Communication to the subcontracting laboratory of any special report requirements, like immediately notifying Con-Test of MCL drinking water exceedances is facilitated by the Chain of Custody. The following is stamped on all subcontracting chain of custodies: "Subcontracted lab must notify Con-Test Analytical Lab of any MCL exceedance within 24 hours of obtaining valid data".

Con-Test Analytical Laboratory requires each of our subcontracting laboratories to provide current copies of all the certificates they hold for each state they are certified in. In addition, Con-Test Analytical reserves the right to audit any subcontracting laboratory that we send large volumes of business. A qualified representative from Con-Test Analytical will perform this on-site inspection.

Additional information on subcontracting samples can be found in Con-Test SOP Subcontracting, document #239.

3.3.4.4 Non-Routine Industrial Hygiene Samples

New analytical procedures for the laboratory and or non-routine samples require special attention. Validation of method by a three-step process is required. This includes the determination of single-operator precision and bias, analysis of independently prepared unknown samples, and determination of method ruggedness.

Method development includes determination of recovery and stability of analyte on the medium, precision and accuracy of analytical measurement. Clients are informed of the non-routine, non-regulatory nature of these special tests. Incompletely developed, qualitative tests are reported as "estimated" or "semi-quantitative" with appropriate notes or qualifiers.

4.0 Internal Quality Control Checks and Frequency

Con-Test employs a wide range of quality control checks adapted to specific situations and methodology in the assessment of data quality thus ensuring production of data of known precision and bias. Record generation for quality control begins when the samples arrive in the laboratory, continues through analysis and evaluation and ends with the plotting of quality control results on X bar and R charts. Each project is unique and therefore in each work plan, the numbers and types of blanks, references, duplicates, and spiked samples (etc.) will vary. Minimum frequencies are specified below.

Due to the inherent variability and substantial number of distinct methodologies and applicable Quality Control measures only a generalization of QC measures and frequency by major department is offered below.

4.1 Blanks

For all analytical determinations, blank analyses are performed as a routine procedure when samples are analyzed. Blank determinations are analysis specific and are subjected to the same preparation methodology as regular samples. Blank analysis determines when background peaks or materials are sufficiently low (or absent) to permit the analysis of samples to proceed.

If satisfactory blanks are not obtained in these steps, additional steps are taken to determine cause and to eliminate the source of contamination.

At Con-Test one or more of the following types of blanks is analyzed individually or multiply throughout an analysis run.

4.1.1 Reagent Blanks

A reagent blank consists of laboratory pure water and any reagents added to the sample during analysis or straight solvent.

Reagent blanks are run for use in monitoring baseline correction and are inserted at regular intervals during large batches of samples to check for carryover contamination and/or instrument baseline drift.

4.1.2 Method Blanks

A method blank must be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination or background resulting from the analytical process.

At least one method blank is analyzed for each applicable analysis batch. One method blank is analyzed per batch of twenty samples or less. Results from method blanks are not subtracted from corresponding sample results but are reported along with samples for evaluation by the data user.

4.1.3 Trip Blanks

Trip blanks are analyzed for determination of contamination attributable to shipping and handling procedures. This type of blank is especially useful in documenting contamination of volatile organics samples. Trip blanks are analyzed when applicable.

4.1.4 Holding Blanks

Holding blanks are kept in the volatile organics refrigerator and analyzed periodically to determine contamination from sources also being held for analysis in the refrigerator. Holding blanks are analyzed every two weeks or when contamination is suspected.

4.2 Calibration

4.2.1 The laboratory shall establish and maintain metrological traceability of its measurement results by means of a documented unbroken chain of calibrations, each contributing to the measurement uncertainty, linking them to an appropriate reference.

4.2.2 The laboratory shall ensure that measurement results are traceable to the International System of Units (SI) through:

a) Calibration provided by a competent laboratory; or
b) Certified values of certified reference materials provided by a competent producer with stated metrological traceability to the SI; or
c) Direct realization of the SI units ensured by comparison, directly or indirectly, with national or international standards.

4.2.3 When metrological traceability to the SI units is not technically possible, the laboratory shall demonstrate metrological traceability to an appropriate reference, e.g.:

a) Certified values of certified reference materials provided by a competent producer;

b) Results of reference measurement procedures, specified methods, or consensus standards that are clearly described and accepted as providing measurement results fit for their intended use and ensures by suitable comparison.

4.2.4 Verification and/or validation of equipment, such as balances, thermometers, and spectrophotometers, shall be performed with National Institute of Standards and Technology (NIST) traceable standards. Calibration certificates must indicate NIST Traceability along with the measurement results and the associated uncertainty and/or a statement of compliance with an identified metrological specification, such as tolerance. External services used for calibration of weights, NIST thermometers and Eppendorf's must be accredited to ISO/IEC 17025:2017 by a recognized accreditation body. Reference standards, such as Class S weights and NIST traceable thermometers, are used for calibration only and shall be calibrated by an organization that can provide traceability to NIST and be accredited to ISO/IEC 17025:2017 by a recognized accreditation body. NIST Digital thermometer is sent out annually for calibration. Long stem NIST traceable thermometers are purchased annually. Reference weights and reference thermometers are re-calibrated every year. Analytical balances must be checked each day of use with a minimum of two ASTM Class 1 weights, in ranges appropriate to the laboratory's weighing needs. Measurements produced in the laboratory are based upon comparison to analyzed standards. The reference standard results are utilized to generate calibration curves, which are then used in the quantification of sample results. Eppendorf pipettes are calibrated annually by an outside vendor, and on a weekly basis they are verified by the analyst to ensure that they remain within specifications. Laboratory staff performing in-house calibrations and verifications shall have received documented training.

Refer to manufacturer's instructions for procedures on how to transport and store measuring equipment and reference standards.

4.2.4 Instrument Calibration

All instruments are calibrated using standard solutions of known concentrations. The standards are either purchased Certified Reference Materials (CRM's) that are traceable to NIST, ISO/IEC 17025 and ISO Guide 34/ISO Guide 17034, when they are available, or carefully prepared by the laboratory. Major analytical equipment calibrated with standard materials includes: GC, GC/MS, LC/MS/MS, IC, Discrete Gallery, ICP, ICP/MS, UV-VIS spectrophotometer, and analytical balances.

4.2.4.1 Initial Calibration

Initial calibration of any analytical instrument is instrument, as well as methodology, dependent. Calibration normally consists of use of several levels of a reference standard and a blank.

Generally, instrument standard calibration (and therefore sample quantification) in the Organics department is based on calibration curves comprised of 3-5 standards of known concentration; for the Metals department, 2-5 standards; and for Wet Chemistry, 3-5 standards. All the above are excluding the calibration blank, if required. The minimum number of standards used is often dictated by the SOP or method.

Sufficient raw data are retained to reconstruct the calibration used to calculate the sample result. Calibration standards include a concentration at or below the regulatory/decision level but above the laboratory's detection limit. Reporting limits are not less than the lowest calibration standard.

For AIHA-LAP, LLC samples a RL verification is analyzed with each batch of samples. This is a standard spiked at the reporting limit. Annually a matrix matched reporting limit (RL) verification needs to be analyzed.

Results of samples must be within the calibration range (bracketed by standards) or the results must be flagged as having less certainty, unless reported to the MDL and qualified with a "J" flag at the request of the client. Results over calibration for will not be reported unless requested by the client.

Note: Due to CT RCP requirements to report two dilutions, clients requesting to follow CT RCP protocols will be requesting to report data over the calibration with "E" qualifiers if applicable.

If calibration parameters are outside of method specified performance criteria, data will be flagged as estimated or not reported until a valid calibration is obtained.

4.2.5 Calibration Validation through use of Laboratory Control Samples (LCS's) and/or Reference Materials

All calibrations must be verified by a second source of material which is independent from the calibration standards. They consist of either a laboratory control matrix spiked with analytes representative of the target analytes (LCS) or certified material (Reference) or ICV standard.

All calibrations must be validated by this second source material prior to sample analysis. Reference materials are traceable to NIST, ISO/IEC 17025 and ISO Guide 34/ISO Guide 17034, when available.

4.2.6 Calibration Check Samples

Calibration Check Standards are utilized to determine the stability of calibration of an instrument between periodic re-calibrations, or for assessment of linearity agreement between subsequent calibration standards and corresponding curves.

The Organics department analyzes one or more check standards consisting of all required compounds when validating use of a previously calculated calibration curve. With longer analysis runs throughout the laboratory these samples are run periodically to verify continuous instruments calibration stability and ensure consistent performance of the method.

Where traceability to the SI is not technically possible or reasonable, the laboratory shall use certified reference materials provided by a competent supplier (refer to ISO/IEC 17025 4.6.4), or use specified methods and/or consensus standards that are clearly described and agreed to by all parties concerned. A competent supplier is an NMI or an accredited reference material producer (RMP) that conforms with ISO guide 34/ISO Guide 17034 in combination with ISO/IEC 17025, or ILAC Guidelines for the Competence of Reference Material Producers, ILAC G12. Conformance is demonstrated through accreditation by an ILAC recognized signatory.

4.3 Laboratory Instruments/Equipment, Maintenance Logs, and Reference Standards and Materials

4.3.1 The laboratory shall have access to equipment (including, but not limited to, measuring instruments, software, measurement standards, reference materials, reference data, reagents, consumables, or auxiliary apparatus) that is required for the correct performance of laboratory activities and that can influence the results.

4.3.2 When the laboratory uses equipment outside its permanent control, it shall ensure that the requirements for equipment of the ISO17025:2017 and 2005 standards are met.

4.3.3 The laboratory has procedures for handling, transport, storage, use and planned maintenance of equipment in order to ensure proper functioning and to prevent contamination or deterioration.

4.3.4 The laboratory shall verify that equipment conforms to specified requirements before being placed or returned to service.

4.3.5 The equipment used for measurement shall be capable of achieving the measurement accuracy and/or measurement uncertainty required to provide a valid result.

4.3.6 Measuring equipment shall be calibrated when:

4.3.6.1 The measurement accuracy or measurement uncertainty affects the validity of the reported results, and/or

4.3.6.2 Calibration of the equipment is required to establish the metrological traceability of the reported results.
Note: Types of equipment having an effect on the validity of the reported results can include:
-those used for the direct measurement of the measurand, e.g. use of a balance to perform a mass measurement;
-those used to make corrections to the measured value, e.g. temperature measurements;
-those used to obtain a measurement result calculated from multiple quantities.

4.3.7 The laboratory shall establish a calibration program, which shall be reviewed and adjusted as necessary in order to maintain confidence in the status of calibration.

4.3.8 All equipment requiring calibration or which has a defined period of validity shall be labelled, coded or otherwise identified to allow the user of the equipment to readily identify the status of calibration or period of validity.

4.3.9 Equipment that has been subjected to overloading or mishandling, gives questionable results, or has been shown to be defective or outside specified requirements, shall be taken out of service. It shall be isolated to prevent its use or clearly labelled or marked as being out of service until it has been verified to perform correctly. The laboratory shall examine the effect of the defect or deviation from specified requirements and shall initiate the management of nonconforming work procedure. (See section 3.2.2.6).

4.3.10 When intermediate checks are necessary to maintain confidence in the performance of the equipment, these checks shall be carried out according to a procedure.

4.3.11 When calibration and reference material data include reference values or correction factors, the laboratory shall ensure the reference values and correction factors are updated and implemented, as appropriate, to meet specified requirements.

4.3.12 The laboratory shall take practicable measures to prevent unintended adjustments of equipment from invalidating results.

4.3.13 Records shall be retained for equipment which can influence laboratory activities. The records shall include the following, where applicable:

- **4.3.13.1** the identity of equipment, including software and firmware version;
- **4.3.13.2** the manufacturer's name, type identification, and serial number or other unique identification;
- **4.3.13.3** evidence of verification that equipment conforms with specified requirements;
- **4.3.13.4** the current location
- **4.3.13.5** calibration dates, results of calibrations, adjustments, acceptance criteria, and the due date of the next calibration or the calibration interval;
- **4.3.13.6** documentation of reference materials, results, acceptance criteria, relevant dates and the period of validity;
- **4.3.13.7** the maintenance plan and maintenance carried out to date, where relevant to the performance of the equipment;
- **4.3.13.8** details of any damage, malfunction, modification to, or repair of, the equipment.

4.3.14 The laboratory shall be furnished with all items of equipment (including reference standards and materials) required for the correct performance of tests for which accreditation is sought. In those cases, where the laboratory needs to use equipment outside its permanent control it shall ensure that the relevant requirements of this standard are met.

4.3.15 Equipment, Reference Materials, and Reference Standards are transported, stored, maintained, inspected, and cleaned according to the manufacturer's instructions. Any defective item of equipment is clearly marked and taken out of service until it has been shown to perform satisfactorily.

4.3.16 Each item of equipment, reference standard, or reference material is labeled to show its calibration status. As a mechanism for tracking instrument performance, logbooks are provided for each instrument (GC, GC/MS, LC/MS/MS, ICP, ICP/MS, IC, Thermo Discrete Gallery, UV/VIS Spectrophotometers, microscopes, balances, TOC analyzer, and incubators). Equipment, reference materials, and reference standard records include:

1) Name of item of equipment or reference model
2) Manufacturer, identification, model number, serial number
3) Date of installation and dates of service
4) Current location
5) Condition when received
6) Copy of manufacturer's instructions or manuals
7) Dates and results of calibrations/verifications and date of next calibration/verification
8) Details of maintenance carried out to date, and planned for the future
9) History of any damage, malfunction, modification, or repair
10) Software and Firmware Versions

4.3.17 The laboratory supervisors are responsible for this data and periodically examine all these books. Any significant change in a critical parameter triggers further examination and possible instrument service.

These books along with preventative maintenance act as an operational tool for minimizing instrument down time, and maintaining them in optimum condition.

4.3.18 Support equipment is calibrated/ verified annually using NIST traceable references over the range of use. Balances, ovens, refrigerators, freezers, incubators, and water baths are checked with NIST traceable references and recorded. The accuracy of all thermometers, are verified annually by comparison with a certified NIST traceable thermometer, applying any correction factors stated on the NIST Traceable thermometer certificate of calibration. IR temperature guns and dial thermometers must be calibrated quarterly. All thermometers are compared at the temperature of their use during the verification. Additional monitoring as prescribed by the test method SOP is recorded. Eppendorf pipettes are calibrated on an annual basis by an outside vendor, and verified weekly by the analyst to ensure that it remains in specifications. External services used for calibration of weights, certified thermometers and Eppendorf's must be accredited to ISO/IEC 17025:2017 by a recognized accreditation body.

4.3.19 The sterilization temperature and cycle times of each autoclave run for biological tests are recorded by use of appropriate chemical or biological sterilization indicators. A maximum-temperature registering thermometer is used with each autoclave run, to ensure that the sterilization temperature of each cycle is reached. Spore suspensions are used weekly to verify the autoclave operation. The autoclave timer is checked quarterly by a stopwatch and recorded. Autoclave tape is only used as an indicator that each batch has been exposed to the sterilization process.

4.3.20 Refrigerator and freezer temperatures are recorded twice daily, with acceptance criteria of 4°C $\pm$ 2°C for refrigerators and less than 0° C for freezers. Incubator temperatures are recorded twice daily (with readings separated by at least 4 hours), with acceptance ranges of 35.0°C $\pm$ 0.5°C (for total coliform and HPC), 44.5°C $\pm$ 0.2°C (for fecal coliform), 41°C $\pm$ 0.5°C (for Enterococci) and 20.0°C $\pm$ 1°C (for BOD).

4.3.21 Equipment List

The following is a list of commonly utilized major analytical equipment. Please note this is not a complete listing.

Equipment	Number	Make and Model
Gas Chromatographs	18	Agilent/Hewlett Packard – 5890/6890/7890 2-PID-FID 3-FID-FID 10-ECD-ECD 2-TCD-FID
GC/MS	19	Agilent/Hewlett Packard – MSD 5970/5972/5973/5975 7-Purge and Trap – EST 6-Direct Inject 5-Air Entech Auto samplers
LC/MS/MS	2	Agilent G6470A with Infinity II Triple Quadrupole LC/MS system
Concentration Workstations	10	4-N EVAP 7-Buchi Syncore Turbovaps 2-S EVAP
TCLP Extractors	4	80 station capacity
Sonic dismembrator	1	Fisher Model 500
Microwave Extractor/Digester	2	MARS Xpress

Equipment	Number	Make and Model
Mercury Analyzer System	1	Perkin Elmer FIMS 100
Ion Chromatograph	2	Dionex ICS 2000
ICP	3	Perkin Elmer – Optima 4300 Dual View Simultaneous
ICP-MS	2	Perkin Elmer ELAN 9000 Agilent7800/7900 ICP-MS

Digestion Block	2	SPC Science Digi-Prep MS
Spectrophotometer	2	ThermoSpectronic Genesys 20
	1	ThermoSpectronic Genesys 30
	1	ThermoSpectronic 10S UV-/Vis
Discrete Gallery	1	ThermoFisher Scientific
Kjeldahl Apparatus	1	FOSS Tecator Digester
NH3/TKN Distillation Unit	1	FOSS Kjeltec8100 Distillation Unit
Flashpoint Apparatus	1	1-Koehler closed cup
Microscopes	3	Olympus (BH2)
pH/ Ion Meter	4	1-Thermo Orion-Versa Star pro 1-Orion EA 920 1-ThermoElectron Orion 420A+ 1-Accumet AB15
Conductivity Meter	1	Thermo Fisher Orion Versa Star Pro Multi Parameter Bench top Meter with Conductivity Probe
TOC analyzer	1	Teledynde Lotix TOC Combustion Unit
BOD auto analyzer	1	Skalar Model 21088903-01 BOD analyzer
Turbidimeter	2	1-VWR Model 46210-200 1-Intertek WTW Turb 550
Beckman Centrifuge	1	Beckman Model J6-HC
ENCON Evaporator System	1	Model DE4-B
Soxhlet Extractors	225	Soxhlet glassware and heating mantles
Analytical Balances	17	

4.3.22 Annual Preventative Maintenance

In order to maintain instruments in optimum working condition, minimize instrument down time and delayed results, Con-Test maintains service contracts with regularly scheduled preventative maintenance guidelines. Service contracts and preventative maintenance schedules are standard for sophisticated and vital equipment such as GC's, GC/MS, IC, ICP, ICP-MS, UV-VIS Spectrophotometer, Thermo Discrete Gallery, and the TOC analyzer. In the event of unavoidable down time Con-Test has alternate methods of analysis for most analytes.

Common routine maintenance activities should be performed according to the following schedule.

Instrument	Method	Activity	Frequency
GC/MS VOA-Purge and Trap	624 8260	Check Gas System Bake Replace Septa Clean/Replace Liner Change Column Change Ferrules Replace Trap Change Vacuum Pump Oil	Daily Daily As Needed As Needed As Needed As Needed As Needed Twice Per Year
GC/MS Semi-VOA	625 8270	Check Gas System Bake Replace Septa Replace Glass Wool Clean/Replace Liner Change Column Change Ferrules Change Vacuum Pump Oil	Daily Daily Daily Daily As Needed As Needed As Needed Twice Per Year
GC	608, 8081, 8082 602, 8015, 8100	Check Gas Replace Septa Replace Glass Wool Clean/Replace Liner Change Column Change Ferrules	Daily Daily As Needed As Needed As Needed As Needed
Eppendorf Pipettes		Calibration/Verification	Annual by vendor Weekly by Analyst

Instrument	Method	Activity	Frequency
Infrared Thermometer Gun		Calibration/Verification	Quarterly
ICP	6010 200.7	Check/Change Pump Tubing Change Capillary Tubing Clean Nebulizer Clean Spray Change Clean Torch	Daily As Needed Monthly/ As Needed Monthly/ As Needed As Needed
ICP-MS	6020 200.8	Check/Change Pump Tubing Change Torch Change Injector Clean Gem Cone Tips Clean Scott Spray Chamber	Daily As Needed As Needed As Needed As Needed
Mercury Cold Vapor	7470 7471 245.2 NIOSH 6009	Clean Cell Clean Windows Change Tubing	Monthly Monthly As Needed
Thermo Discrete Gallery Nitrate and Nitrite	NECi Nitrate Reductase/ NECi N07-0003	Rinse/Flush System	Daily
pH/Ion Meter & Electrodes	SM 4500 H-B SW-846 9040	Rinse/Clean Electrodes	Daily
Conductivity Meter	SM 2510B	in-house Calibration Calibration by vendor	Daily Annual
UV Lamp (Microbiology)	SM 9223	Clean with Ethanol with cloth	As Needed

4.4 **Surrogate Additions**

Surrogates are organic compounds added to a sample, which are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which are not formally found in environmental samples.

Surrogate additions are regularly utilized in the organics section of the laboratory. Organic compounds are added to a sample just before processing so that the overall efficiency of a method can be determined. Surrogate spikes and their recovery are used

to create control charts for the organics section. If the surrogate recovery is outside of the control limits, the data is considered questionable and the sample is re-analyzed to confirm possible matrix interference, spiking procedure problems, or reported as estimated data.

4.5 **Duplicate Analysis**

Laboratory duplicates (smallest number of replicates) are two sample aliquots split in the laboratory from the same container and analyzed independently under identical conditions. From the analysis of duplicates a measure of precision or repeatability associated with the laboratory procedure can be obtained. The comparison of results for duplicate samples to what has been previously achieved provides assurance that the methodology is performing within establishing limits of precision. A large number of data points are usually needed to calculate control limits representative of analyzed data.

It is standard practice in the Wet Chemistry and Metals laboratories to prepare and analyze one duplicate for each 10-20 samples or one per batch analyzed. Samples selected for duplicate analysis are at random on this basis. The number of duplicate samples performed may be more frequent if dictated by the method, SOP, or statement of work.

4.6 **Sample Matrix Spikes (MS)**

A matrix spike is an aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A sample matrix spike is usually utilized to provide a means of assessing accuracy for the method used on a specific sample matrix. The recovery of the spiked analyte is expressed as a percent of the amount of target analyte added to the sample. The purpose of this procedure is to evaluate the consistent deviation of measured values from the true value as a result of systematic errors and to determine if sample matrix composition has any effect on analyte recovery. This procedure facilitates the identification of possible method interfering substances (matrix bias) which may be present in the spiked sample so that appropriate action can be taken. This enables the laboratory to ensure methodology is performing with established limits of accuracy.

It is standard practice in the laboratory to prepare and analyze one matrix spike for each 10-20 samples or one per batch analyzed. The number of spiked samples performed can be more frequent if dictated by the method, SOP, or statement of work.

4.7 Sample Matrix Spike Duplicates (MSD)

Matrix spike duplicates, as defined in SW-846: "Intra-laboratory split samples spiked with identical concentrations of target analyte, which undergo the same processes". Matrix spikes and matrix spike duplicates are routinely analyzed periodically in the accumulation of precision and accuracy data or when conditions exist where matrix applicability is questionable or matrix interferences are suspected.

4.8 Laboratory Fortified Blanks (LFB) and LFB Duplicates

It is standard practice in the laboratory to prepare and analyze one duplicate for each 10-20 samples or one per analytical batch. LFB's reflect achieved accuracy under ideal conditions for a methodology and analysis procedure but do not provide an indication of system or method accuracy with respect to bias associated with a given sample matrix. Laboratory Fortified Blanks may be also known as Blank Spikes (BS) or Laboratory Control Samples (LCS).

4.9 Method Detection Limits (MDL)

The MDL has been determined by the laboratory and documented for each analyte where spiking solutions are available.

Revised MDL procedure from 2016 MUR Revision 2 for all drinking water and wastewater certified analyses, including Lead:

1) The MDL procedure now uses method blanks to calculate an MDL, in addition to the spiked samples that have always been used to calculate the MDL. The new Definition is "The method detection limit (MDL) is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results" The value calculated from the spike samples is called the MDL_s. The MDL_s calculation is the same as the MDL calculation in Revision 1.11. The method blank samples are used to calculate the MDL_b, which is a very similar calculation that also calculates 99% confidence level that the result is derived from the sample rather from contamination/noise. The MDL is the higher of the two values (either the MDL_s calculated using spiked samples or the MDL_b, calculated using method blanks). EPA considers this change important because as detector sensitivity improves, the background contamination of the laboratory, consumable supplies, and equipment can be more important in determining the detection limit than the sensitivity of the instrument.
2) The MDL now requires that the samples used to calculate the MDL are representative of laboratory performance throughout the year, rather than on a single day. (Con-Test has always performed over at least three days).

3) A laboratory has the option to pool data from multiple instruments to calculate one MDL that represents multiple instruments.
4) Additionally, a streamlined approach to determine whether a new instrument can be added to a group of instruments with an already established MDL, and Laboratory have the option to use only the last six months of method blank data or the fifty most recent method blanks, whichever yields the greatest number of method blanks to calculate the MDL value derived from method blanks (MDL_b)

5) After initial MDL is established, every year thereafter quarterly 2 RL/LOQ samples are performed. At the end of the year the 8 points are tabulated in an MDL-S, and compared to current MDL.

Other details:

1) Spike MDL at 2-10 times the estimated MDL
2) Run spiked replicates in at least 3 separate preparation and analysis batches.
3) Multiple instruments – At least 2 spike replicates on each instrument
4) If blanks give ND, MDL_B does not apply
5) Addendum for MDL determined on a specific matrix
6) No 10X rule
7) Use all method blanks unless batch was rejected

For wipe samples, the MDL shall be determined using wipe materials meeting ASTM E1792, "Standard Specification for Wipe Sampling Materials for Lead in Surface Dust", or with wipe materials meeting specifications issued by EPA (reference EPA publication," Interpretive Guidance for the Federal Program TSCA Sections 402/403", March 14, 2002 and/or subsequent EPA published guidance). The spiked media is at an estimated concentration between the actual MDL and 10X the actual MDL. The MDL is the product of 3.14 times the calculated standard deviation for 7 replicates. Under ideal conditions, the MDL should be about one-fifth the practical and routinely achievable detection level that can be reported with relatively good certainty that any reported value is reliable.

All data points produced in an MDL study must be used in the calculation, unless: 1) a point is a statistical outlier (outside 99% confidence limits), 2) a point (or a whole run, if a multiple point run, as with organics or metals analyses) is eliminated if suspect (e.g. incomplete analysis due to a leak or spill). Reasons for elimination must be documented.

MDL studies are run annually for all drinking water methods and all lead analyses. The wet chemistry department and the metals departments run MDL studies annually. The organics department, if it is not a drinking water method, will run a one-time MDL study and repeat if conditions change, receive new instrumentation or new methodology occurs.

4.9.1 Reporting Limit (RL) Verification

Reporting limits will not be less than the lowest calibration standard. For AIHA-LAP, LLC minimum reporting limits shall be established initially by analyzing media spiked samples, prepared at the desired minimum reporting limit concentration, and taken through the entire analytical process, including applicable steps of extraction, digestion, or distillation procedures. Individual methods will dictate limits of acceptability for the Reporting Limit (RL) verification. If a particular method does not prescribe RL/LOQ verification limits, then +/- 50% of the true value will be used for the acceptance limit, except for the metals department who go by +/- 10% for Lead. This procedure will be performed Quarterly.

For AIHA-LAP, LLC daily reporting limit verifications will be analyzed that is a standard spiked at the reporting limit. This has the same criteria as the Quarterly LOQ/RL verification.

4.10 Procurement

The objective of the procurement policy is to ensure purity & quality of reagents & consumables used in all laboratory procedures.

Department Supervisors are responsible for testing and reviewing consumables and reagents before analytical use & purchase. If all method standards are met, a purchase order is submitted to the administrative supervisor for purchase. The administrative supervisor maintains a list of preferred, approved vendors.

Any commercially prepared standards shall be accompanied by a certificate of analysis. Certificates are kept on file in the appropriate departments. Any commercial prepared standards should be accompanied by a certificate of analysis. Certificates are kept on file in appropriate departments. The QA office maintains a master binder of Vendor Certifications. Any hazardous materials should be accompanied with a material safety data sheet (MSDS) and stored in the appropriate department storage area. New consumable lot numbers and/or vendors are tested by analysts prior to analytical use and purchase.

The vendors that are selected to use are for various reasons, including some of the following reasons:
1- Pricing (Some offer Discounts)
2- Availability of Product
3- Good History
4-Has the proper certifications

For additional information, see Con-Test SOP on Evaluation of Vendors for Supplies, Document #231

4.11 Chemical Control Program

4.11.1 The laboratory shall ensure that only suitable externally provided products and services that affect laboratory activities are used, when such products and services:

a) are intended for incorporation into the laboratory's own activities;
b) are provided, in part or in full, directly to the customer by the laboratory, as received from the external provider;
c) are used to support the operation of the laboratory.

4.11.2 the laboratory shall have a procedure and retain records for:

a) defining, reviewing and approving the laboratory's requirements for externally provided products and services;
b) defining the criteria for evaluation, selection, monitoring of performance and re-evaluation of the external providers;
c) ensuring that externally provided products and services conform to the laboratory's established requirements, or when applicable, to the relevant requirements of this document, before they are used or directly provided to the customer;
d) taking any actions arising from evaluations, monitoring of performance and re-evaluations of the external providers.

4.11.3 the laboratory shall communicate its requirements to external providers for:

a) the products and services to be provided;
b) the acceptance criteria;
c) competence, including any required qualification of personnel;
d) activities that the laboratory, or its customer, intends to perform at the external provider's premises.

4.11.4 All Reagents, Chemicals, and Standards are received in the Inventory Storage Department. An employee of that department checks the packing slip (if provided) against the material in the package. Any discrepancy is reported to the Inventory Supervisor.

4.11.5 When a material is accepted, the packing slip gets stamped and noted with the employee receiving the delivery along with the date, employee who checked delivery with date, the Element Order number (If applicable), date material is entered into Element Inventory (consumables) System, and the Element ID (if applicable).

4.11.6 Most standards are received and delivered directly to the appropriate department. All other chemicals/reagents are given Element ID's and labeled with that ID. They are then stored in the Inventory Storage Area. Element maintains each materials' chemical name, description, receipt date, expiration date, lot number, manufacturer, and volume received.

4.11.7 Traceability of standards and standard materials are also documented. Tracking of standards (stock, intermediate or working) is accomplished by the use of a Standard Log or Element. Certificates of analysis for purchased standards and information on laboratory manufactured standards are also kept in either the Standard Log or Element.

4.11.8 The laboratory maintains reagent grade type, deionized water, using a Nano-pure water system. This water is available for use in reagents and standards as well as in analysis determinations.

4.11.9 Additional information of Chemical and reagent receipt can be found in SOP Chemical receipt, Document #114. Additional information on using approved vendors can be found in SOP for Evaluation of Vendors for Supplies, Document #231.

4.11.10 The quality of the reagent water is tested routinely. It must meet the following criteria for microbiology testing (as defined in Table 9020I of SM 9000):
NOTE: If all media is purchased the following tests do not need to be conducted as the reagent water is not utilized.

TEST	MONITORING FREQUENCY	LIMIT
Chemical Tests:		
Conductivity	Continuously, or with each use	>0.5 mega ohms resistance, or <2 umhos/cm at 25°C
pH	With each use	5.5 - 7.5
Total Organic Carbon	Monthly	<1.0 mg/L
Heavy Metals, single (Cd, Cr, Cu, Ni, Pb, and Zn)	Annually (or more frequently if a problem arises)	<0.05 mg/L
Heavy Metals, totals	Annually (or more frequently if a problem arises)	$\leq$ 0.1 mg/L
Ammonia/Organic Nitrogen	Monthly	< 0.1 mg/L
Total Residual Chlorine	Monthly, or with each use	<DL
Bacteriological Tests:		
Heterotrophic Plate Count (SM 9215)	Monthly	<500 CFU/mL (Per 310 CMR 42.08(5)(c)(12d)

4.11.11 Microbiology Media must have both positive and negative cultures analyzed for each new low number, to determine performance compared to a previously acceptable lot. "Quanti-Cult" kits (Idexx/Remel) are used, and contain the following organisms:

Escherichia coli	(T. coliform + and E. coli +)
Klebsiella pneumonia	(T. coliform + and E. coli -)
Pseudomonas aerugonosa	(T. coliform – and E. coli -)

4.11.12 Industrial Hygiene sampling media lots (filters, wipes, tubes) need to be tested prior to analysis, to ensure there is no contamination. Results of such testing must be maintained in each department.

Industrial Hygiene sampling media are supplied to the client, who is responsible for collecting samples.

4.11.13 The Deionized (DI) (Millipore Milli Q) reagent water used in the lab for analysis is tested daily for conductivity using the Thermo Fisher Orion Versa Star Pro Multi Parameter Benchtop meter with conductivity probe. The in-line bench top meter with conductivity probe is calibrated daily with standards by the analyst before use and annually it is calibrated by Alert Scientific. Certification certificates are stored with the QA department.

4.12 Laboratory Environment

4.12.1 The facilities and environmental conditions shall be suitable for the laboratory activities and shall not adversely affect the validity of results.

Note: Influences that can adversely affect the validity of results can include, but are not limited to, microbial contamination, dust, electromagnetic disturbances, radiation, humidity, electrical supply, temperature, sound and vibration.

4.12.2 The requirements for facilities and environmental conditions necessary for the performance of the laboratory activities shall be documented.

4.12.3 The laboratory shall monitor, control and record environmental conditions in accordance with relevant specifications, methods or procedures or where they influence the validity of the results.

4.12.4 Measures to control facilities shall be implemented, monitored and periodically reviewed and shall include, but not be limited to:

4.12.4.1 Access to and use of areas affecting laboratory activities

4.12.4.2 Prevention of contamination, interference or adverse influences on laboratory activities

4.12.4.3 Effective separation between areas with incompatible laboratory activities.

4.12.5 When the laboratory performs laboratory activities at sites or facilities outside its permanent control, it shall ensure that the requirements related to facilities and environmental conditions of this documents are met.

4.12.6 Calibration and testing occur only within the laboratory, designed, built and maintained as laboratory space. All spaces are temperature controlled.

Electronic balances are located away from drafts and doorways and mounted on marble slabs in areas where their use would be affected by vibrations. Biological work areas are sterilized between uses. Neighboring test areas of incompatible activities are effectively separated. Specific work areas are defined and access is controlled. (Only authorized laboratory personnel and escorted visitors may enter the work area). Housekeeping is a major concern for the laboratory. Each employee is required to act in a manner that promotes neatness and cleanliness in following Good Laboratory Practices. All work areas are to be free of clutter and possible contaminants. The importance of maintaining clean work areas cannot be overemphasized. Smoking is prohibited on Con-Test property. Work areas include entries to the laboratory, sample receipt, sample storage, laboratory analysis, chemical and waste storage, and data handling and storage.

All equipment, reference standards, and reference materials required for the accredited tests are available in the laboratory. Records are maintained for all equipment, reference standards, and reference measurement materials, and services used by the laboratory. Reference materials traceable to national standards of measurement or to national standard reference materials are stored away from heavy use areas or major equipment that may affect the proper operation of the materials. Refer to manufacturer's instructions for the procedures for safe handling, transport, storage, use and planned maintenance of measuring equipment, reference materials, and reference standards to ensure proper functioning and in order to prevent contamination or deterioration. Certificates of Traceability are available for the reference thermometer and the Class S weights. The reference materials and standards are used only for calibration to maintain the validity of performance. Class "A" glassware will be used in the laboratory for any measurements being made.

4.13 Control of Contamination

Lead Wipe Sampling: Housekeeping shall be adequate to prevent contamination of samples (Dust, paint, etc.). Work areas have non-porous coatings to eliminate the possibility of prolonged counter contamination. In order to determine surface levels of lead in the Metals laboratory and therefore avoid possible contamination of samples, wipe sampling is performed on a regular basis. If any sample displays contamination (defined as a detected result at the reporting limit), clean area, re-sample, and re-test the contaminated site. Refer to SOP Internal Wipe Sampling, Document Number 32.

4.14 Total Quality Management (TQM)

Quality and turnaround ultimately determine the satisfaction of customers. Con-Test is not merely striving to meet client expectations but to constantly exceed them. Total Quality Management is an effective strategy for success by involving the entire resources of the organization. By tracking quality, educating and empowering employees, quality concerns can be addressed quickly and efficiently, while providing an opportunity for tomorrow's leaders to come forward.

Each project represents a problem to solve or an opportunity for improvement. The key to a quality improvement project is that the problem is scheduled for investigation and resolution. Quality Improvement follows the Define, Measure, Analyze, Implement, and Control Model.

4.15 Review of Requests, Tenders, and Contracts

4.15.1 The laboratory shall have a procedure for the review of requests, tenders, and contracts. The procedure shall ensure that:

a) the requirements are adequately defined, documented and understood;
b) the laboratory has the capability and resources to meet the requirements;
c) where external providers are used, the requirements of Sec 4.11 of this QAM are applied and the laboratory advises the customer of the specific laboratory activities to be performed by the external provider and gains the customer's approval;
d) the appropriate methods or procedures are selected and are capable of meeting the customer's requirements.

4.15.2 The laboratory shall inform the customer when the method requested by the customer is considered to be inappropriate or out of date.

4.15.3 When the customer requests a statement of conformity to a specification or standard for the test or calibration (e.g. pass/fail), the specification or standard and the decision rule shall be clearly defined. Unless inherent in the requested specification or standard, the decision rule selected shall be communicated to, and agreed with, the customer.

4.15.4 Any differences between the request or tender and contract shall be resolved before laboratory activities commence. Each contract shall be acceptable both to the laboratory and the customer. Deviations requested by the customer shall not impact the integrity of the laboratory or the validity of the results.

4.15.5 The customer shall be informed of any deviation from the contract.

4.15.6 If a contract is amended after work has commenced, the contract review shall be repeated and any amendments shall be communicated to all affected personnel.

4.15.7 The laboratory shall cooperate with customers or their representatives in clarifying the customer's request and in monitoring the laboratory's performance in relation to the work performed.

4.15.8 Records of reviews, including any significant changes, shall be retained. Records shall also be retained of pertinent discussions with a customer relating to the customer's requirements or the results of the laboratory activities.

4.15.9 Contract review is a primary function and integral part of the quality system at Con-Test. All contracts are reviewed and accepted only if the requirements are clearly understood, and the company has the capability and capacity to fulfill client expectations. Communication is maintained with the client from the time a request is processed through commencement of work. This includes informing the client of any deviation from the contract and obtaining approval to beginning testing. If a contract needs to be amended after work has commenced, it will be communicated to the client and the contract will be amended with a hand-filled in correction.

4.15.10 All new work is initiated by the Laboratory Management, delegating responsibilities for new work according to available resources. The staff meets prior to initiation of new work in order to determine if appropriate facilities and resources are available. The plan for any new testing shall be reviewed and approved by the Laboratory Director before commencing such work. After agreement is reached, facilities and resources are organized to efficiently perform the work. For any new testing requirements, the designated employee shall write a standard operating procedure based upon the appropriate reference method and demonstrate capability to perform those tests prior to reporting results. In addition, a Chain of Custody (COC) serves as another form of contract. This document serves as an order for work to be performed by Con-Test Analytical Laboratory. Unless otherwise governed under separate contract, by signing this document, the client agrees to the terms and conditions listed on the chain of custody. The SOP(s) shall be under document control and Demonstration of Capability Statement(s) must be on file. See SOP Review of Requests, Tenders, and Contracts, Document Number 29.

4.16 Quality Assurance Project Plan (QAPP)

4.16.1 After contracts are reviewed and mutually agreed upon between the client and the laboratory, a Quality Assurance Project Plan (QAPP) is developed. This is a written document outlining the procedures a monitoring project will use to ensure the data it collects and analyzes meets project requirements. It is an invaluable planning and operating tool that outlines the project's methods, storage and analysis.

4.16.2 Elements of a QAPP include:

4.16.2.1 Title and Approval Page
4.16.2.2 Table of Contents
4.16.2.3 Distribution List
4.16.2.4 Project/Task Organization
4.16.2.5 Problem Definition/Background

4.16.2.6 Project/Task Description
4.16.2.7 Data Quality Objectives for Measurement Data (DQOs) which includes:
- **4.16.2.7.1** Precision
- **4.16.2.7.2** Accuracy
- **4.16.2.7.3** Measurement Range (Required Reporting Limits)
- **4.16.2.7.4** Representativeness
- **4.16.2.7.5** Comparability
- **4.16.2.7.6** Completeness

4.16.2.8 Training Requirements/Certifications
4.16.2.9 Documentation and Records
4.16.2.10 Sampling Process Design
4.16.2.11 Sampling methods requirements
4.16.2.12 Sample Handling and Custody Requirements
4.16.2.13 Analytical Method Requirements
4.16.2.14 Quality Control Requirements
4.16.2.15 Equipment Testing, Inspection, and Maintenance Requirements
4.16.2.16 Instrument Calibration and Frequency
4.16.2.17 Inspection and Acceptance Requirements for Supplies
4.16.2.18 Data Acquisition Requirements
4.16.2.19 Data Management
4.16.2.20 Assessments and Response Actions
4.16.2.21 Reports
4.16.2.22 Data Review, validation and Verification Requirements
4.16.2.23 Validation and Verification Methods
4.16.2.24 Reconciliation with Data Quality Objectives

4.16.3 Typically, the client will provide the QAPP to Con-Test Analytical and we will go through to evaluate if all the needs can be met. Specific SOPs are provided, methods to be used determined and special handling requirements noted. Additionally, special project reporting limits and method detection limits will be evaluated along with required QA/QC. Con-Test determines all of its MDLs according to the new 2016 EPA procedure, “Definition and Procedure for the Determination of the Method Detection Limit”, Rev2. Annually reporting limits and method detection limits are evaluated, therefore can be subject to change.

If any element cannot be met, Con-Test Analytical Laboratory will discuss with the client to decide which course of action to take. If any changes arise during the life of the project, Con-Test Analytical Laboratory will inform the client and make any adjustments necessary. QAPPs are typically reviewed annually with client to determine any changes.

5.0 Information Management (Network Design/LIMS)

5.1 The laboratory shall have access to the data and information needed to perform laboratory activities.

5.2 The laboratory information system (LIMS) used for the collection, processing, recording, reporting, storage or retrieval of data shall be validated for the functionality, including the proper functioning of interfaces within the laboratory information management system by the laboratory before introduction. Whenever there are changes, including laboratory software configuration of modifications to commercial off-the-shelf software, they shall be authorized, documented, and validated before implementation.

5.3 The laboratory information management system shall:

a) be protected from unauthorized access;
b) be safeguarded against tampering and loss;
c) be operated in an environment that complies with provider or laboratory specifications or, in the case of non-computerized systems, provides conditions which safeguard the accuracy of manual recording and transcription;
d) be maintained in a manner that ensures the integrity of the data and information;
e) include recording system failures and appropriate immediate and corrective actions.

5.4 When a laboratory information management system is managed and maintained off-site or through an external provider, the laboratory shall ensure that the provider or operator of the system complies with all applicable requirements of the ISO17025:2017 and 2005 standard.

5.5 The laboratory shall ensure that instructions, manual, and reference data relevant to the laboratory information management system are made readily available to personnel.

5.6 Calculations and data transfers shall be checked in an appropriate and systematic manner.

5.7 For more efficient tracking of samples, processing of analysis data, and document control, Con-Test currently employs a Laboratory Information Management System or LIMS as well as a PC network. These systems provide authorized personnel with fingertip access to analysis information as well as user access to valuable organizational programs and applications.

By utilizing a media in which quality of data is easily controlled, the speed, efficiency and accuracy with which laboratory data is delivered is maximized.

5.8 Con-Test LIMS Definition:

The Con-Test LIMS is a file server PC Network based database that contains all information related to an analytical job that is received at the laboratory. All functions, including log-in, data transfer from instruments, billing, report generation, quality control and archive maintenance are handled by the system. The major benefits of the system are rapid report generation, standardization of report format, and minimization of human error due to inaccurate calculations, data transcriptions and misspellings.

Client specific information regarding fees, invoice history, and address are maintained in tables in the relational database. After an analysis passes quality control inspection, if all tests ordered at log-in for the job have been entered into the database the reports will be generated automatically by the LIMS. Reports are standardized in that long lists of compounds do not need to be reentered via a word processor with each analysis. Standard report elements including method references and limits of detection are maintained in files or tables that the report generator accesses. Invoice, Certificate of Analysis, Data Tabulations, and Quality Control Summary are generated at the same time and routinely are mailed together.

Data that is generated by computerized analytical instruments including Gas Chromatographs (GC), Gas Chromatograph/Mass Spectrometers (GC/MS), Inductively Coupled Plasma – Mass Spectroscopy (ICP/MS), and Inductively Coupled Plasma (ICP), is automatically transferred from the instrument into the database where the data is reviewed and edited by the analysts, only if necessary (ex. wrong file transferred). Any calculations that are required to determine the final analytical result are performed by the database and reviewed by the analyst. Transcription errors between instrument and report as well as calculation errors are virtually eliminated by this process.

All data relevant to an analytical job is maintained active on the file server for at least one year. After this time data is archived onto tapes from which it can be restored as needed. Hard copies of data including chain-of-custody documentation are maintained for 10 years in an archive storage building.

5.9 **Verification of Formulas and Automated Computations**

Extensive program validation is performed before the use of any automated system. Automated computations and systems are programmed and thoroughly reviewed by professionals and not utilized until the system has undergone and satisfactorily completed an extensive validation process in order to ensure accurate generation of data. Formulas for automated computations are verified initially and then locked so they cannot be changed.

6.0 Sample Control and Management - (Handling of test or calibration Items)

6.1 The laboratory shall have a procedure for the transportation, receipt, handling, protection, storage, retention, and disposal or return of test or calibration items (samples), including all provisions necessary to protect the integrity of the sample, and to protect the interests of the laboratory and the customer. Precautions shall be taken to avoid deterioration, contamination, loss or damage to the sample during handling, transporting, storing/waiting, and preparation for testing. Handling instructions provided with the item shall be followed.

6.2 The laboratory shall have a system for the unambiguous identification of test or calibration items. The identification shall be retained while the item is under the responsibility of the laboratory. The system shall ensure that items will not be confused physically or when referred to in records or other documents. The system shall, if appropriate, accommodate a sub-division of an item or groups of items and the transfer of items.

6.3 Upon receipt of the test or calibration item, deviations from specified conditions shall be recorded. When there is doubt about the suitability of an item for test or calibration, or when an item does not conform to the description provided (COC), the laboratory shall consult the customer for further instructions before proceeding and shall record the results of this consultation. When the customer requires the item to be tested or calibrated acknowledging a deviation from specified conditions, the laboratory shall include a disclaimer (qualifier) in the report indicating which results may be affected by the deviation.

6.4 When items need to be stored or conditioned under specified environmental conditions, these conditions shall be maintained, monitored and recorded.

6.5 Laboratory Couriers (Transportation of Samples)

Con-Test provides sample pick up and laboratory transportation service for regular clients with certain geographical and sample size limitations. This service is only available upon approval by Con-Test sample control personnel.

At the time of pick up, complete and proper documentation (chain of custody forms) must be signed and turned over to Con-Test Couriers.

6.6 Laboratory Sample Custody

6.6.1 Chain of Custody

Chain-of-custody documentation must be maintained for each transfer of sample. All individuals who handle samples will be required to sign and date paperwork.

6.6.2 Sample Receipt and Inspection

The laboratory receives samples by mail, courier pick-up, and by personal delivery. When samples arrive at the laboratory, the laboratory courier or client relinquishes custody of samples to the sample custodian with proper documentation of the transfer recorded on the chain of custody form.

Chain of custody documentation is required with all samples. The samples are then removed from the shipping or transportation containers and visually inspected for damage such as leakage, breakage, or contamination by one of the log-in staff.

The samples received are then compared with accompanying custody and analysis specification forms to make sure that the paperwork agrees with the labels on each sample container. The pH is taken on applicable samples and noted on the sample receipt checklist. Clients are encouraged to include a temperature blank in the cooler when samples are transported to the laboratory. Sample coolers that are carried by the laboratory couriers will contain a bottle of water that is used to monitor the temperature of the cooler. In all cases when a temperature blank is present, the temperature is recorded on the chain of custody and sample receipt form. If a temperature blank is not in the cooler, an Infra-Red thermometer gun is used to record the sample temperature. The accuracy of the Infra-Red thermometer gun must be verified quarterly. In cases where the temperature is not actually measured for any reason, a comment is put on the chain of custody form as to whether the samples were cold or at ambient temperature when received. Sample receipt form is documented with the procedure used for temperature measurement.

If samples are damaged or do not agree with the paperwork, then the Project Chemist is notified at once, and the appropriate action, listed below, is taken immediately to remedy the situation.

- Samples that are damaged upon receipt at the laboratory are immediately reported to the client so that a decision can be made by the client to void that particular sample or replace it.
- Incomplete sampling information on sampling sheets is brought to the attention of the client.
- Missing samples or missing paperwork is also brought to the attention of the appropriate person.
- Clients are advised of missed holding times and improper containers, temperatures, preservatives or the like.

In any case, clients shall be immediately notified of deficiencies or deviations for possible resolution. Decisions or comments made by the laboratory or client are documented on the chain of custody for future reference. See below for Sample Acceptance Policy:

Sample Acceptance Policy

Con-Test Analytical Laboratories' Sample Acceptance Policy is based on the requirements outlined in the NELAC standard. Samples not meeting the acceptance criteria will not be accepted by the laboratory or will be qualified on the final report. This policy will be available to clients along with sampling instructions, on-line on our company website www.contestlabs.com, and in our Quality Manual.

All samples submitted to Con-Test Analytical Laboratories must:

1) Be accompanied by a chain of custody with proper, full and complete documentation, including sample identification, location, state sample was collected in, date and time of collection, the collector's name, type of preservation (if any), type of sample (matrix), any special comments concerning the sample, tests requested, and desired turn-around time. It is the client's responsibility to communicate specific methods or required detection limits.
2) Be labeled appropriately with a unique sample identification written with indelible ink on water resistant labels. If the laboratory cannot determine identity of a sample, it will be rejected and the client will be contacted for further instructions or re-sampling.

3) Be in an appropriate sample container. If the container is inappropriate, the client will be contacted for further instructions or re-sampling. If analysis is possible, the final report will be qualified. Samples must be appropriately sealed to prevent leakage or cross-contamination.

4) Samples should be shipped in a manner to preserve the sample's safety, quality, and integrity. It is the client's responsibility to ship samples to the lab at the appropriate temperature for sample preservation. Sample temperature will be monitored upon receipt.

5) Adhere to specified holding times. If samples are received past the holding time or will expire before the analysis can commence, the client will be notified and asked how to proceed. If the samples are analyzed, they will be qualified in the final report.

6) Contain adequate sample volume to perform the necessary testing. If sufficient volume is not present, the client will be contacted for further instruction or re-sampling.

If samples show signs of damage, contamination or inadequate preservation, the client will be contacted. If analysis is performed, the final report will be qualified. If analysis can't be performed the client will be notified for further instructions or re-sampling.

6.6.3 Assignment of Laboratory Numbers

Each sample that meets the minimum acceptance requirements for receipt by the laboratory is assigned a unique identification number.

Laboratory sample numbers begin with the last two digits of the year in which the sample was logged in. Then, follows a letter which corresponds to the month the sample was received. “A” = January, “B” = February, “C” = March, etc.…

The following four-digit number specifies the work order number, followed by the 2-digit individual sample identification (20A0000-00) which is assigned in ascending order depending on the day and time of receipt.

6.6.4 Internal Sample Tracking & Analysis Scheduling

After assigning individual laboratory identification number the sample custodian records the appropriate information on the chain of custody. The sample custodian then enters the information for each sample into the Laboratory Information Management System (LIMS).

This includes but not limited to; requested analysis, sample ID, log-in date and time, submitter ID, laboratory due date and priority, date sampled, sample matrix, container, preservative, date received, receiver, and other appropriate laboratory identifications.

Upon completion of data entry, the LIMS generates the appropriate forms which are utilized to initiate and track the samples through the laboratory process. The original chain of custody record is scanned into LIMS so it may be viewed by analysts to get required information. The original chain of custody is then attached to a cover sheet and forwarded to a project manager for review.

A work order summary is generated by the LIMS for each work order to ensure tests have been logged in correctly. The work order summary is compared to the chain of custody for each sample.

Samples are then transferred into the appropriate laboratory section, preserved if necessary, and moved into one of the sample storage area refrigerators (pending analysis). Samples remain there until the analysis is to be performed. The requested analysis is then scheduled to be performed by the appropriate analyst or supervisor noting the holding time of the samples.

6.6.5 Log Out and Storage of Samples

Samples are stored in defined, secure areas at all times. Samples are removed from pending analysis storage to pending disposal storage when samples have been analyzed and applicable reports completed and issued.

Aqueous samples are stored for a minimum of one month, soil samples for a minimum of two months before characterization and disposal or can be returned to clientele upon request. Clients may request longer retention times.

A locked storage area will be provided should the client require secure storage for samples which require special handling due to legal proceedings.

6.6.6 Disposal of Samples and Wastes

Appropriate samples and wastes are characterized and disposed of according to the appropriate Federal, State, & local regulations. Whenever possible, non-hazardous waste is recycled. Hazardous wastes are disposed of through Licensed Hazardous Waste Firms.

7.0 Data: Generation, Verification & Approval, Reports, Reduction & Storage

7.1 Technical Records

7.1.1 The laboratory shall ensure that technical records for ach laboratory activity contain the results, report and sufficient information to facilitate, if possible, identification of factors affecting the measurement result and its associated measurement uncertainty and enable the repetition of the laboratory activity under conditions as close as possible to the original. The technical records shall include the date and the identity of personnel responsible for each laboratory activity and for checking data and results. Original observations, data and calculations shall be recorded at the time they are made and shall be identifiable with the specific task.

7.1.2 The laboratory shall ensure that amendments to technical records can be tracked to previous versions or to original observations. Both the original and amended data and files shall be retained, including the date of alteration, an indication of the altered aspects and the personnel responsible for the alterations.

7.2 Data Generation

Upon notification of the analysis from sample queries, the analyst or technician responsible for the analysis or preparation collects the sample(s) from cold storage and using standard operating procedures, completes the preparation and subsequent analysis under specified, controlled conditions (including the appropriate QA/QC measures). Before the analysis of any sample, it is the responsibility of the project manager to verify that all information was correctly recorded into LIMS and matches the chain of custody.

Errors which are detected are brought to the attention of project managers and corrected before analysis begins. Upon completion of the analytical run, the analyst or technician makes the appropriate calculations, verifies quality control data, completes bench-sheets, and any other accompanying paperwork, and organizes the data (logs all information into the specified permanently bound data book or creates a data printout package).

From this point, the analyst/technician enters into the LIMS and batches or selects the samples which were analyzed in their analytical run. The LIMS assigns the group a unique batch identification number which is used for efficient tracking.

Raw data can be entered into the LIMS in two ways. LIMS has the capability of accepting raw data directly downloaded from analytical equipment or excel spreadsheets or if the data is not downloaded, it can be entered manually. Once the raw data is entered, the analyst/technician must enter his/her initials and date of analysis along with any factors associated with the sample, which must be taken into account for calculations to achieve the desired sample result or concentration. This may include sample volume or weight, final volume of preparation, dilution factor, concentration factor, air volume, square feet or the like.

Upon entering all required data, the LIMS performs the needed calculations. The analyst/technician checks the LIMS calculated values for the samples against his/her calculated values to ensure there have been no errors (transcription, calculation etc.…). The analyst/technician then saves the data which was previously entered into memory and exits the system. All data is entered into the LIMS. The data and paperwork is then submitted to quality control for approval. When raw data is being evaluated, at least three significant figures is used. Data reported to client gets reported to two significant figures.

7.3 Data verification and Approval

Appointed and trained data review personnel are responsible for verifying all data entries before it is released to clients. The initial demonstration of capability (IDOC) represents the validation of the analytical method. After the generation and reduction of data by the analyst/technician, analysis documentation, chromatograms, printouts,

and any and all other pertinent data acquired are submitted for Data Quality Review. Data reviewers are specified and trained for each analytical procedure.

Data verification includes examination of calibrations, spike recoveries and sample duplicates against benchmark limits as well as checking for transcription errors and spot-checking for calculation errors. Instrument printouts are also examined and transcriptions verified.

If at any time the data submitted by an analyst/technician does not meet specified quality requirements or is considered questionable, the data is rejected and returned to the analyst/technician for review and reanalysis, if necessary. The new data must be then approved in the same manner. Quality control personnel also verify that appropriate data flags, comments, and narratives are added when needed.

Once these verifications have been made, the data is QC approved in the LIMS and automatically is moved into the report generation phase of the LIMS.

7.4 Report Generation and Management Review of Reports

The Laboratory Information Management System (LIMS) automatically organizes data once it has been approved into several predefined formats dependent on several factors including; the sample type, parameters, and number of samples. Laboratory deliverable packages have been designed to include all required information as well as additional valuable details on the total quality of information. Report formats are easily interpretable because they are provided in a form which is clear and concise. Data is presented in a means which does not require knowledge of statistics or major data manipulations or conversions in order to be easily utilized by data users.

Final reports are first thoroughly reviewed and then signed by designated personnel before release to clients. If samples or reports are involved in litigation, it is the policy of the laboratory to follow the advice and direction of the court regarding records that are subpoenaed or samples that are impounded.

Final test reports contain the following information: The first page contains Con-test's address, fax and phone number, client name, client address, project location, client job number, project number, laboratory work order number, signature of project manager, and report date. The next section contains PO number (if applicable), summary of analyses found in report along with client sample ID, laboratory ID # and matrix, case narrative summary, signature of person signing off the report with the following statements that include: "The results of analyses reported only relate to samples submitted to the Con-Test Analytical Laboratory for testing" and "I certify that the analyses listed above, unless specifically listed as subcontracted, if any, were performed under my direction according to the approved methodologies listed in this document, and based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge

and belief, accurate and complete". Then the results for each test are given, which include results, RL, MDL (if applicable), units, dilution factor, any data flags, method, date prepared, date/time analyzed, analyst, project location, date received, field sample #, sample ID #, sample matrix and date sampled. The next section of the report contains sample extraction data. This includes for each test method that is applicable, the lab ID, batch number, initial volume, final volume, and date prepared. Next is the Quality Control Section which includes for each batch for each test method the results for the Blank, LCS, LCS Dup, sample duplicates, matrix spikes, and any other reported QC that is applicable to the analysis being performed. This section is followed by the Flag/Qualifier summary section which gives the definition of each data flag used in the final test report. The next section is the Certifications summary which states for each compound/analyte found in the report, what states we are certified for that particular method. Then we have a listing of all certifications/accreditations we hold and when each expires along with the certification number. Lastly, the chain of custody and sample receiving checklist are included. Each report is paginated along with work order ID and final test report date and time, so that each page is easily identifiable.

7.4.1 Reporting Statements of Conformity

7.4.1.1 When a statement of conformity to a specification or standard is provided, the laboratory shall document the decision rule employed, taking into account the level of risk (such as false accept and false reject and statistical assumptions) associated with the decision rule employed, and apply the decision rule.

7.4.1.2 The laboratory shall report on the statement of conformity, such that the statement clearly identifies:

a) to which results the statement of conformity applies;
b) which specifications, standards or parts thereof are met or not met;
c) the decision rule applied (unless it is inherent in the requested specification or standard).

7.4.2 Reporting Opinions and Interpretations

7.4.2.1 When opinions and interpretations are expressed, the laboratory shall ensure that only personnel authorized for the expression of opinions and interpretations release the respective statement. The laboratory shall document the basis upon which the opinions and interpretations have been made.

7.4.2.2 The opinions and interpretations expressed in reports shall be based on the results obtained from the tested or calibrated item and shall be clearly identified as such.

7.4.2.3 When opinions and interpretations are directly communicated by dialogue with the customer, a record of the dialogue shall be retained.

7.4.3 Amendments to reports

7.4.3.1 When an issued report needs to be changed, amended or re-issued, any change of information shall be clearly identified and, where appropriate, the reason for the change included in the report.

7.4.3.2 Amendments to a report after issue shall be made only in the form of a further document, or data transfer, which includes the statement, "Amendment to report, serial number (or as otherwise identified)", or an equivalent form of wording.

7.4.3.3 When it is necessary to issue a complete new report, this shall be uniquely identified and shall

7.5 Procedures and Format for Reporting Data to State, Local, and/or Federal Officials

Deliverables can include complete state and federal regulatory compliance forms, if required. All data reported is organized in a standard laboratory format unless otherwise requested, specified, or required by client and/or by a governing agency such as the United States Environmental Protection Agency or State Department of Environmental Protection. Con-Test's general analysis format includes all information required by Laboratory certifying agencies.

In certain situations, {such as reporting results for Agency Proficiencies or under the Safe Drinking Water Act (SDWA)} special forms are required for the reporting of data. The format dictated by the applicable forms is completed by the Laboratory and submitted to the appropriate individual or organization. Records of the results in the required formats are archived as normal formatted data.

7.6 Data Reduction

The following equations are commonly utilized in the reduction of analysis data and are perfomed by either Chemstation or equivalent instrument software or by the LIMS Element:

Precision Chart Limit Calculations performed by Element:

a) Calculate R

R = R/n where: n = total number of R values

b) Determine the Standard Deviation (S_R) for R

$$S_R = \frac{(R - RI)^2}{n-1} \text{ for } n < 25$$

c) Calculate the Upper Control Limit for R

$UCL_R = R + 3 (S_R)$

d) Calculate the Upper Warning Limit for R

$UWL_R = R + 2 (S_R)$

Accuracy Chart Limits Calculations performed by Element:

a) Calculate X

$X = X/n$ where: n = Total number of X values

b) Determine the Standard Deviation (S_X) for X

$$S_X = \frac{X - Xi)^2}{n-1} \quad \text{for } n < 25$$

use n in place of n-1 for n >/= 25

c) Calculate the Upper Control Limit for X

$UCL_X = X + 3 (S_X)$

d) Calculate the Upper Warning Limit for X

$UWL_X = X + 2 (S_{X)}$

e) Calculate the Lower Warning Limit for X

$LWL_X = X – 2 (S_X)$

f) Calculate the Lower Warning Limit for X

$LCL_X = X – 3 (S_X)$

Percent Recovery Calculation performed by Element:

The following equation is used to compute percent recovery (%R). The value of %R is then compared to the laboratory established control limits to determine bias and associated interferences.

$\%R = (x1 – x2)/x3 \times 100$

Where:
x1 = measured value for spiked sample
x2 = measured value for un-spiked sample
x3 = known value of the spike in the sample

Relative Percent Difference Calculation performed by Element:

The following equation is used to calculate Relative Percent Difference (RPD):

RPD = [V1 – V2]/ V3 x 100

Where: [V1 – V2] = Absolute difference between the two values
V3 = Average of the two values

Range: Based on Recovery

Recovery Value for X_1 = $\frac{X_{1R}}{X_{1S}}$

Recovery Value for X_2 = $\frac{X_{2R}}{X_{2S}}$

Range, R = $[X_1 – X_2]$ [Absolute Value]

Where: X_{1R} = mg reported
X_{1S} = mg spiked on media
X_{2R} = mg reported
X_{2S} = mg spiked on media

Mean Recovery Value, X = $\frac{X_1 + X_2}{2}$

External Standard Calibration

The ratio of the detector response to the amount (mass) of analyte in the calibration standard is defined as the calibration factor (CF). The CF can also be calculated using the concentration of the standard rather that the mass in the denominator of the equation.

CF = $\frac{\text{Peak Area (or Height) of the Compound in the Standard}}{\text{Mass of the Compound Injected}}$

Internal Standard Calibration performed by Chemstation or equivalent

For each of the initial calibration standards, calculate the RF values for each target compound relative to one of the internal standards as follows:

$$RF = \frac{A_S \times C_{IS}}{A_{IS} \times C_S}$$

Where:

A_S = Peak Area (or height) of the analyte or surrogate
A_{IS} = Peak Area (or height) of the internal standard
C_S = Concentration of the analyte or surrogate, in ug/L
C_{IS} = Concentration of the internal standard, in ug/L

Note that in the equation above, RF is unit less, i.e., the units from the two area terms and the two concentration terms cancel out. Therefore, units other than ug/L may be used for the concentrations of the analyte, surrogate, and internal standard, provided that both C_S and C_{IS} are expressed in the same units. The mass of the analyte and internal standard may also be used in calculating the RF value.

Linear Calibration Using Response Factors performed by Chemstation or equivalent

To evaluate the linearity of the initial calibration, calculate the mean CF (external standard calibration) or RF (internal standard calibration), the standard deviation (SD), and the RSD as follows:

$$\text{Mean CF} = \overline{CF} = \frac{\sum_{I=1}^{n} CF_I}{n} \qquad \text{Mean RF} = \overline{RF} = \frac{\sum_{I=1}^{n} RF_I}{n}$$

$$SD = \sqrt{\frac{\sum_{I=1}^{n} (CF_i - \overline{CF})^2}{n-1}} \qquad SD = \sqrt{\frac{\sum_{I=1}^{n} (RF_I - \overline{RF})^2}{n-1}}$$

$$RSD = \frac{SD}{CF} \times 100 \qquad RSD = \frac{SD}{RF} \times 100$$

Where n is the number of calibration standards and RSD is expressed as a percentage (%). If the RSD of the calibration or response factors is less than or equal to 20% over the calibration range, then linearity through the origin may be assumed, and the average calibration or response factor may be used to determine sample concentrations.

Non-linear Calibration performed by Chemstation or equivalent Instrument software

In situations where the analyst knows that the instrument response does not follow a linear model over a sufficiently wide working range, or when the other approaches described here have not met the acceptance criteria, a non-linear calibration model may be employed.
NOTE: It is not EPA's intent to allow non-linear calibration to be used to compensate for detector saturation at higher concentrations or to avoid proper instrument maintenance.

Thus, non-linear calibration should not be employed for methods or instruments previously shown to exhibit linear calibration for the analytes of interest.

When using a calibration model for quantitation, the curve must be continuous, continuously differentiable and monotonic over the calibration range. The model chosen should have no more than four parameters, i.e., if the model is polynomial, it may be no more than third order, as in the equation:

$y = ax^3 + bx^2 + cx + d$

The statistical considerations in developing a non-linear calibration model require more data than the more traditional linear approaches described above. Whereas SW-846 methods employ five standards for a linear (first order) calibration model, a quadratic (second order) model requires six standards, and a third order polynomial requires seven standards.

Most curve fitting programs will use some form of least squares minimization to adjust the coefficients of the polynomial (a, b, c, and d, above) to obtain the polynomial that best fits the data.

The "goodness of fit" of the polynomial equation is evaluated by calculating the weighted coefficient of the determination (COD).

$$COD = \frac{\sum_{i=1}^{n} (y_{obs} - \bar{y})^2 - (n-1) \sum_{i-1}^{n} (y_{obs} - y_I)^2}{(n-p)} \Bigg/ \sum_{i=1}^{n} (y_{obs} - \bar{y})^2$$

Where:

y_{obs} = Observed response (area) for each concentration from each initial calibration standard

$\bar{y}$ = Mean observed response from the initial calibration

Y_I = Calculated (or predicted) response at each concentration from the initial calibration(s)

n = Total number of calibration points (i.e., 6 for a quadratic model; 7 for a third order model)

p = Number of adjustable parameters in the polynomial equation (i.e., 3 for a third order; 2 for a second order polynomial)

Under ideal conditions, with a "perfect" fit of the model to the data, the coefficient of the determination will equal 1.0. In order to be an acceptable non-linear calibration, the COD must be greater than or equal to 0.99.

7.7 Data Storage

Con-Test Analytical Laboratory takes a layered approach to ensure the preservation of our hard copy and electronic laboratory records. Hard copy data includes log books, data and analysis books, instrument printouts and raw data. These records are kept in paper form at the laboratory until archiving is required. Throughout the year, hard copy data is transferred to an on-site storage facility. This secure, permanent storage is organized and accessible through coded file boxes. We additionally have older data stored off site at a document storage facility (Meyer Records Management) for years 2009-2013.

The Quality Assurance is responsible for overseeing the Data Archiving process. A team approach (Department Analyst/Employee, Manager/Supervisor, and Quality Control) is required to transfer printed documents from both facilities (Laboratory and

Administration) to Archives. The person packing each box is responsible to put content information on both ends of the box along with dates so the Quality Assurance department can catalog contents. The Quality Assurance department is responsible for cataloging, indexing, labeling and assigning a location in the archive storage building for each box. The QA department will maintain a spreadsheet to track all this information on the Q:/Archiving folder. Any person requesting archived data will need to go through the QA department to handle request. The QA department will quarterly ascertain what documents can be destroyed. For additional information on archiving, see SOP Archiving data, document #358.

In most cases, an instrument's raw data has also been electronically stored into our LIMS (Laboratory Information Management System) database. This data is organized and accessible through our database server (SQL2014PRI). Final reports (including chain of custody documents) are also stored on this server. SQL2014PRI, along with our domain controller, benefit from a nightly backup routine (Monday - Friday). This practice is facilitated through the use of tape media. Backup and restoration procedures are guided with the use of current IT standard operating procedures.

At the close of each month, electronic data is preserved onto CD/DVD-ROM (Read Only Memory). By request, preserved CD/DVD-ROM data can be restored for client inquiry or quality control purposes. In all cases, the above-mentioned records will be retained for a period of ten years. The only exception to this rule is Lead and Copper potable water records needs to be stored for a period of 12 years. The hardcopy record is kept for 10 years and the electronic copy is kept for at least 12 years. Clients will be notified prior to facility closing, and records will be transferred according to their instruction.

7.8 Quality Record Storage

Quality records, which consist of internal audits, corrective actions/preventative actions, proficiency testing results, certificates of accreditation, Standard Method books, AIHA-LAP, LLC modules, the TNI standard, other miscellaneous methods, and calibration records for thermometers, balances, weights, spectrophotometers, Eppendorf pipettes, and conductivity meter are kept in the Quality Assurance office. They are stored in file cabinets and book shelves, which the Quality Assurance Officer maintains. Other Quality records, such as individual Initial Demonstrations of Capabilities, personnel training files, and controlled documents are stored in an auxiliary room, in locked file cabinets. These records can only be accessed by the QA Officer and Technical Director.

In all cases, the above-mentioned records will be retained for a period of at least ten years. Clients will be notified prior to facility closing in the event the laboratory will no longer be conducting business, and records will be transferred according to the client's instruction. Refer to Con-Test Analytical Laboratory's "records matrix", controlled document #387, for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records.

8.0 Document Control

All Con-Test Laboratory documentation is carefully controlled by the Lab Director and Quality Assurance Officer. This includes the Con-Test Laboratory Quality Assurance Manual, standard methods, and standard operating procedures. The responsibility for maintaining and approving documents falls directly upon the Lab Director and Quality Assurance Officer. Under the authority of top management, it is required that all personnel concerned with testing and calibration activities within the laboratory familiarize themselves with the quality documentation and implement the policies and procedures in their work.

After final approval of documentation by the Laboratory Director, the documents are placed in the controlled document program, distributed through “checkwriters” where personnel view an unprintable pdf copy and “E-sign” that they have read and understood the latest version, and are made readily available, to those individuals and/or companies whom those changes affect directly or indirectly. Clients receive “Non-Controlled” pdf copies. All documents are password protected and are “Read-Only”. All Con-Test personnel may view “Controlled” pdf copies on the F:/drive, which are not printable. If anyone needs to print out a copy, they must contact the QA department and be assigned the copy. This is tracked through an excel spreadsheet. This copy must be returned back to the QA department. All documents are uniquely identified, including a controlled document number, effective date, revision number, page numbering, the total number of pages, and the issuing authorities.

The Controlled Document Program is described in detail in the “Controlled Document” SOP, document #83.

To ensure utilization and proper representation of the Laboratory Quality Assurance Program, the QA Manual is reviewed, updated as needed, and then approved by the management annually. Interim additions or revisions may be affixed as the occasion arises. Also, included on the master list of controlled documents are all logbooks, manuals, checklists, instructions, chains of custodies, and guidance documents. All SOP’s are reviewed at least annually. If any SOP has not been reviewed during the current year, it will be passed out to the applicable reviewer during the annual SOP review. This takes places at the end of every year.

8.1 Availability to Laboratory Personnel

The Con-Test Laboratory Quality Assurance Manual, Standard Methods and Procedures are in the controlled document program and are available to all personnel on the F: Drive/Administration/QC1/controlled documents in pdf format Folder. These SOP’s are not able to be printed. If anyone needs to print out a copy, they must contact the QA department and be assigned the copy. This is tracked through an excel spreadsheet. This copy must be returned back to the QA department. Under, the authority of top management, it is required that all personnel concerned with testing and calibration activities within the laboratory familiarize themselves with the quality documentation and implement the policies and procedures in their work.

8.2 Client Availability

Con-Test documents are updated and revised on a regular basis to reflect current procedure and policy. Those changes or revisions are readily available to clients upon request and/or in periodic client updating.

8.3 Corrections to Documents and Data

Log books, forms, data sheets, and chains of custody are formal laboratory records and need to be treated as such. Records shall be made in indelible ink, black is preferred. There are to be no omissions in the data. Erasures, “white-outs”, removal of pages, and scribbling over are not acceptable ways of correcting errors.

Corrections should be kept to a minimum by exercising caution when transcribing data. Unfortunately, errors cannot be avoided completely and when they occur, they should be corrected according to the following procedures:

- Draw a single line through the incorrect entry, insert the correct entry into the closest space available and initial and date the correction.
- Groups of related errors on a single page should have one line through the entries and should be initialed and dated with a short comment on reason of deletion of data.

In order to establish a clear audit trail and to avoid any uncertainty about how and why specific procedures were followed in the laboratory, when a run is repeated or something occurs that is not routine, a note explaining this must be made on the cover sheet or bench sheet.

8.4 SOP Revision, Adoption of New Procedures & Departure from Existing Procedures

Standard Operating Procedures are reviewed and updated to reflect current methodology and procedure on at least an annual basis. SOP’s are typically laboratory derivations of approved methodology. (Ex. Standard Methods, SW-846, EPA, NIOSH, and ASTM methods) Laboratory methods are continuously monitored for durability and credible agency endorsement.

Periodically methods may be reevaluated with support or approval revoked or other methods could be deemed acceptable alternatives.

Methodology is to reflect current needs and whenever possible it should be approved by a reputable organization. New methods or procedures may be adopted as necessary.

Interim procedures may be appended to documents on approval by laboratory management.
Departures from documented procedures must be approved by management and/or Quality Control Department, depending on the nature of the departure. Documentation of variance from procedure should be on data and in the final report to the client, if the data is affected by the variance. The chain-of-custody form and laboratory bench sheets may also need to contain the documentation in some cases.

8.5 Complete Listing of Standard Operating Procedures

Note: for current revision and dates of review see master list of controlled documents, maintained by the QA department and available upon request.

Wetchemistry

SOP	Document #	SOP Title
SOP Autoclave	88	Autoclave Procedure
SOP ALK	2	Total Alkalinity
SOP NH3	3	Ammonia
SOP Balance-CAL	6	Balance Calibration
SOP BOD	47	Biological Oxygen Demand (BOD)
SOP COD	55	Chemical Oxygen Demand (COD)
SOP Chloride	58	Chloride
SOP TRC/FRC	43	Chlorine, Total and Free Residual
SOP Color	18	Color
SOP COND	44	Conductivity
SOP Cyanide	59	Cyanide
SOP DO	98	Dissolved Oxygen
SOP Dust	37	Dust, Total & Respirable
SOP FeIron	92	Ferrous Iron
SOP FOG1664	93	Method 1664B
SOP Flashpoint	60	Flashpoint, Pensky-Martins Closed Cup Method
SOP Fluoride	17	Fluoride

SOP Gallery NH3	533	Ammonia EPA 350.1 by Discrete Gallery
SOP Gallery NO2	534	Nitrite by Discrete Gallery Analysis – By NECi Method N07-0003 (NPW) and NECi Nitrate-Reductase (PW)
SOP Gallery NO3 and NO3/NO2	535	Nitrate-Nitrogen and Nitrate/Nitrite combined by Discrete Gallery Analysis – By NECi Method N07-0003 (NPW) and NECi Nitrate-Reductase (PW)
SOP Gallery SO4	536	Sulfate by Discrete Gallery ASTM D516
SOP Glassware Wetchem	71	Glassware Washing: Wet Chemistry Dept.
SOP HARD	63	Total Hardness
SOP Ignitibility	103	Ignitibility
SOP Cr+6	70	Hexavalent Chromium
SOP MICRO	96	Microbiological Analysis of Water
SOP NO2	42	Nitrite – Manual Method
SOP ODOR	91	Odor
SOP Paint Filter	126	Paint Filter by Method 9095B
SOP pH	64	pH
SOP Phenol	65	Total Phenolics
SOP Phos	10	Phosphate, Total & Ortho
SOP RXT	87	Reactivity
SOP SOLPER	9	Solids – Percent Solids (Total Solids in Solid and Semisolid Samples)
SOP SOLVOL&FIX	115	Solids – Volatile Solids – Fixed Solids
SOP SOLPER VOL/FIX	8	Solids – Percent Volatile Solids/Fixed Solids (Fixed & Volatile Solids in Solid & Semisolid Samples)
SOP SOLSETT	24	Solids – Settleable Solids
SOP TDS	23	Solids – Total Dissolved Solids
SOP TS	21	Solids – Total Solids
SOP TSS	5	Solids – Total Suspended Solids
SOP Sulfate	66	Sulfate

SOP Sulfide	67	Sulfide
SOP TKN	68	Total Kjeldahl Nitrogen (TKN)
SOP TURB	69	Turbidity
SOP TOCWater 3510B	99B	Total Organic Carbon – Method SM 5310B
SOP TOC Solid	376	Total Organic Carbon in Solid Samples by SW-846 9060A and Lloyd Kahn
SOP ORP	273	Oxidation Reduction Potential (ORP)
SOP Persulfate	275	Persulfate Anion (Groundwater)
SOP Pipet	11	Pipette Washing Protocol
SOP IC300.0	73	Determination of Inorganic Anions by IC (Method EPA 300.0)

Metals Department

SOP	Document #	SOP Title
SOP DIGIPREP	57	Digiprep Jr. Digestion Apparatus
SOP Hotblock Cal	542	Digiprep Digestion Hot Block Temperature Calibration
SOP Glassware Metals	28	Washing Glassware Standard Procedure
SOP TurbMet	16	Metals Turbidity Screening Determination
SOP ICP200.7	22	ICP (Inductively Coupled Plasma Optical Emission Spectroscopy, 200.7, Potables and Wastewaters)
SOP ICP6010	72	ICP (Inductively Coupled Plasma Optical Emission Spectroscopy, 6010C, Non-Potables and Solids)
SOP AirsMetals	40	Metals in Air
SOP 3050B	29	Acid Digestion of Solid Materials (Soils, Sediments, Solids, Sludge/Wipes/Lead in Paint)
SOP MetalsMicrowave	135	Method 3051A and 3015A: Microwave Assisted Digestion of Waters and Soils, Sediments, Sludge's, and Oils
SOP INT Wipe	32	Internal Wipe Sampling
SOP Hg	27	Mercury (Cold Vapor Technique) EPA 245.1, SW-846 7470A/7471B
SOP Hg in Air	131	Mercury in Air – Method NIOSH 6009
SOP MetalsWaters	39	Preliminary Treatment for Water Matrix Metals

SOP 200.8	112	ICP-MS EPA 200.8
SOP 6020A	113	ICP-MS SW-846 6020A
SOP Dissolved Metals Prep	394	Dissolved Metals Prep
SOP MetalsAirFilter	247	Determination of Metals in Suspended Particulate Matter (40 CFR App G) Air Filter

Organics/Air Lab

SOP	Document #	SOP Title
SOP RSK-175	140	Sample Prep and Calculations for Dissolved Gas Analysis in Water Samples Using a GC Headspace Equilibrium Technique
SOP Glassware/Ext	97	SOP for Washing Organics/Extractions Glassware
SOP CIP	86	Chromatographic Integration Procedures
SOP 504.1	75	EPA 504.1: 1,2-Dibromoethane (EDB) & 1,2-Dibromo-3-Chloropropane (DBCP)
SOP 524.2	34	Volatile Organics by GC/MS (Method EPA 524.2)
SOP 602	116	Volatile Organics by GC (Method EPA 602)
SOP 608	33	Organochlorine Pesticides & PCB's (EPA 608)
SOP 624	35	Volatile Organics by GC/MS (Method EPA 624)
SOP 625	20B	Semi-Volatile Organics (Method EPA 625)
SOP PM-10PM2.5PEM	250	Determination of Particulate Matter as PM-10, PM-2.5, and IP-10A – Determination of Fine Particulate Matter in Indoor Air Using Size Specific Impaction
SOP PCB OIL	26	PCB's in Oil (Method EPA 600/4-81-045)
SOP PCB Shake and Shoot	453	Shake and Shoot PCB Screen Method 3580A Modified
SOP 8082	51	Polychlorinated Biphenyls (PCB's) by GC Method SW-846 8082A
SOP 8081	53	Organochlorine Pesticides by GC Method SW-846 8081B
SOP 8260	50	Volatile Organics by GC/MS (Method SW-846 8260 B/C)
SOP 8270	20	Analytical Analysis of Semi-Volatile Organics (Method SW-846 8270D)
SOP Method3C	80	EPA Method 3C – Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources
SOP TO13A	77	Compendium Method TO-13A – Determination of Polycyclic Aromatic Hydrocarbons (PAHs) In Ambient Air Using GC/MS

SOP TO14A	46	Compendium Method TO-14 – Determination of Volatile Organic Compounds (VOC's) in Air Collected in Specially Prepared Canisters and Analyzed by GC/MS
SOP TO15	45	Compendium Method TO-15 – Determination of Volatile Organic Compounds (VOC's) in Air Collected in Specially Prepared Canisters and Analyzed by GC/MS
SOP TO17	49	Compendium Method TO-17 – Determination of Volatile Organic Compounds (VOC's) in Air Using Active Sampling onto Sorbent Tubes and Analyzed by GC/MS
SOP APH	110	Air-Phase Petroleum Hydrocarbons by GC/MS Method MADEP APH
SOP 3510CWaterExt	403	Water Extraction Procedure Method SW-846 3510C
SOP 3546 Microwave	100	Method 3546 Microwave Extraction Procedure
SOP 8015_8100	25	Total Petroleum Hydrocarbons(GC/FID)Methods SW-846 8100M/8015C/D
SOP Deter of Form in Air	228	Determination of Formaldehyde Air Collected in Specially prepared Canisters and Analyzed by GC/MS
SOP EPH	102	Analytical Analysis of Extractable Petroleum Hydrocarbons MA EPH by GC/FID
SOP GRO	105	Gasoline Range Organics (GRO) EPA 8015C/D
SOP VPH	101	Volatile Petroleum Hydrocarbons (VPH) Mass DEP VPH Method
SOP TCLP Ext	89	Extraction Procedure for Toxicity Characteristic Leaching Procedure
SOP PCB NIOSH 5503	109	Polychlorinated Biphenyls (PCB's) in Air NIOSH 5503
SOP Can Cleaning	111	Can Cleaning Procedure
SOP CTETPH	54	CT ETPH: Analysis of Extractable Petroleum Hydrocarbons (ETPH) using Methylene Chloride, GC/FID
SOP 8151A	255	Chlorinated Herbicides by Gas Chromatography Using Methylation Derivatization SW-846 8151A
SOP Florisil 3620C	251	Method 3620C Florisil Cleanup of Pesticides
SOP Copper Cleanup	395	Removal of Sulfur via Activated Copper SW-846 3660B
SOP TVOC	120	Determination of Total Volatile Organic Compounds (TVOC) in air Collected in specially Prepared canisters and analyzed by GC/MS
SOP 3540CSOXHLET	127	Method 3540C – Soxhlet Extraction Procedure For Polychlorinated Biphenyls (PCB's)
SOP SPLPmod	138	Extraction Procedure for Synthetic Precipitation Leaching Procedure Modified ZHE Procedure for 8260 Analysis

SOP SPLP	137	Extraction Procedure for Synthetic Precipitation Leaching Procedure Method 1311
SOP PCB Homolog	285	SOP for the Determination of PCB Homologues In Air by GC/MS by EPA Method 680
SOP Congener	289	Determination of PCB Congeners by GC/MS
SOP 6200	270	Volatile Organics by GC/MS – Method SM (20^{th}) 6200B
SOP Air Order Completion	279	Summa Canister Air Order Completion
SOP Flow Controller Log Air	281	Flow Controller Logbook – Air Department
SOP Summa and Flow Controller Evaluation	282	Summa Canister and Flow Controller Evaluation Air Department
SOP TO-4A/TO-10A	311	Compendium Method TO-4A/TO-10A by ASE Extraction (Method 3545) and Soxhlet extraction (Method 3540C)
SOP TO-11A	295	Determination of Formaldehyde and Other Carbonyl Compounds in Ambient Air Using Adsorbent Cartridge Followed by HPLC (Compendium Method TO-11A)
SOP ALC/GLY	122	Alcohols/Glycols by GC/FID Method SW846 8015C/D
SOP 1,4-Dioxane8270	314	Low Level 1,4-Dioxane by8270 GC/MS (SIM) Using Large Volume Injection/Programmable Temperature Vaporization Inlet
SOP 1,4-Dioxane8260	121	1,4-Dioxane in water by Heat Purge & Trap, GC/MS (Method 8260B/C Sim)
SOP 8315A	301	Method 8315A: Determination of Formaldehyde & Carbonyl Compounds by High Performance Liquid Chromatography (HPLC) for Liquid & Solid Samples
SOP Airlab TICs	81	Tentatively Identified Compounds in Air
SOP Solvent Distillation	353	Solvent Distillation
SOP Ext Lot Check	396	Extraction Glassware Lot Check
SOP Ext Shift Transition	450	Extractions Shift Transition SOP
SOP Compositing Samples	347	Compositing Samples
SOP PFAS	434	Determination of Selected Perfluorinated Alkyl Acids) PFAS) by Solid Phase Extraction & Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS) in Non-Potable Water (Modification of Methods EPA 537.1, EPA 537 and SW-846 8327
SOP PFAS Water Isotope Dilution	454	Determination of Selected Per- and polyfluorinated Alkyl Substances (PFAS) by Solid Phase Extraction & Isotope Dilution by Liquid Chromatography /Tandem Mass Spectrometry (LC/MS/MS)
SOP 465 PFAS Soil	465	Determination of Selected Perfluorinated Alkyl Acids) PFAAs) for Soil/Solid By Solid Phase Extraction & Liquid

		Chromatography/Tandem Mass Spectrometry (LC/MS/MS)
SOP 466 PFAS Soils Isotope Dilution	466	Determination of Selected Perfluorinated Alklyl Acids (PFAAs) Soil/Solid Samples Isotope Dilution by Liquid Chromatography/ Tandem Mass Spectrometry (LC/MS/MS)
SOP 574 PW PFAS	574	Determination of Selected Perfluorinated Alkyl Acids (PFAS) by Solid Phase Extraction & Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS) In Potable Water (Method EPA 537.1, EPA 537 and ISO 25101)
SOP 587 EPA 533PFAS PW Isotope Dilution	587	Determination of Selected Per- and polyfluorinated Alkyl Acids (PFAS) in Drinking Water by Solid Phase Extraction & Isotope Dilution by Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)
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General

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BiSulfateVialPrep

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9.0 Internal Performance, Systems Audits, Management Review and Corrective/Preventative Actions

Performance and Systems Audits are a valuable tool in evaluating procedures and identifying current and potential problems thus allowing for immediate corrective/preventative actions and "root cause" analyses to begin.

Performance and Systems audits are an important part of monitoring laboratory adherence to established policy and procedure. Various internal performance and systems audits are conducted routinely throughout the year.

Management Review – The overall objectives shall be established, and shall be reviewed during management review. The quality policy statement is issued under the authority of top management. The following overall objectives are found throughout the Quality Assurance Manual, including Section 1.0:

- The laboratory management's commitment to good professional practice and to the quality of testing and calibration in servicing clients
- Con-Test's standard of service
- The purpose of the management system related to quality

- The requirement, that all personnel concerned with testing and calibration activities within the laboratory familiarize them-selves with the quality documentation and implement the policies and procedures in their work.
- The laboratory management's commitment to comply with the ISO: IEC 17025:2017 standard and to continually improve the effectiveness of the management system.

Annually the laboratory's top management shall conduct a review of the laboratory's management system and testing/calibration activities to ensure their continuing suitability and effectiveness, and to introduce necessary changes or improvements. The elements of the review include:

1) The overall objectives as discussed above and in section 1.0
2) The suitability of policies and procedures
3) Reports from managerial and supervisory personnel, including QA Officer's monthly reports.
4) Outcome of recent internal audits
5) Corrective and Preventative actions
6) Assessments by external bodies (audits by MA, AIHA-LAP, LLC, NELAC, client audits)
7) Results of inter-laboratory comparisons or proficiency tests (PT results)
8) Changes in the volume and type of work
9) Customer feedback (client surveys)
10) Complaints
11) Recommendations for improvement
12) Other relevant factors, e.g. QA/QC activities, resources, and staff training

Results from the management review feed into the laboratory planning system and include the goals, objectives and action plans for the coming year. Findings from the management reviews and the actions that arise from them shall be recorded. The management shall ensure that those actions are carried out immediately and within appropriate time frame. Managerial reviews must include identification and signature of the author as well as be paginated.

Corrective Actions/Preventative Actions are instituted immediately when nonconforming work or departures from policies and procedures in the management system or technical operations have been identified.

9.1 Performance Audits (Internal)

Internal Performance Audits are designed to measure the consistency, efficiency, and proficiency of the laboratory in obtaining the known true value of prepared samples, submitted as analyst blinds, for one or various tests. The Quality Assurance Officer administers performance audits and results are presented to the Laboratory Director for review and possible corrective actions.

Internal audits are performed according to a schedule that is made each January. The QA Officer ensures adherence to the schedule. All methods and the Quality and Management Systems are internally audited once a year according to the schedule. This assures all elements of the Quality system and testing activities are addressed.

Immediate corrective action is taken when audit findings cast doubt on the correctness or validity of the calibrations or test results. A corrective action will be initiated as soon as possible with a two-week due date. A follow-up date of 30 days will be assigned after the corrective action is completed, to verify the effectiveness of the corrective action taken after the internal audit. Clients will be notified within 48 hours unless further investigation is needed, by email or phone call, when their work is affected by the findings of the internal audit that casts doubt on the validity of the results.

9.2 System Audits

System audits are intensive laboratory system inspections evaluating laboratory adherence to approved procedure. These inspections are performed either by internal or external laboratory (regulatory agency) personnel at regular scheduled intervals.

Annually, the laboratory must conduct an internal audit which is compliant with AIHA-LAP, LLC and NELAC requirements: the purpose of this audit is to verify that laboratory operations continue to comply with the requirements of ISO/IEC 17025:2017 and the AIHA-LAP, LLC program requirements. The latest AIHA-LAP, LLC site assessor's checklist and latest NELAC assessor's checklist shall be used for this internal systems audit, to ensure that all elements are evaluated.

9.2.1 Internal Quality and Management Systems Audit

The Quality Assurance Officer, Laboratory Manager, Laboratory Technical Director or other trained staff may perform internal Quality and Management Systems Audits. All discrepancies and deviations are immediately documented for review and subsequent correction by internal administration and personnel through the corrective action program. It is the intention of laboratory management to perform internal Quality and Management Systems Audits annually.

9.2.2 Internal Method Audits

The Quality Assurance Officer, Laboratory Manager, Laboratory Technical Director or other trained staff may perform internal method audits. All discrepancies and deviations are immediately documented for review and subsequent correction by internal administration and personnel through the corrective action program. It is the intention of laboratory management to audit

each method annually. These internal method audits ensure that methods are being followed, SOPs are up to date, each method gets data validated, and also incorporate data integrity checks. These audits consist of both quality control and quality assurance review.

9.2.3 External Audits

In the maintenance of certification and accreditation, external laboratory agencies require system audits by agency personnel to be performed. Upon issuance of a system audit report by said agencies to the Quality Assurance Officer, the laboratory shall be required to correct cited audit deficiencies. Continued certification and accreditation normally is based upon fulfillment of audit corrective actions to cited deficiencies.

9.2.4 Audit Findings and Corrective Action

Upon completion and issuance of audit reports to the Quality Assurance Officer, audit deficiencies and findings are codified per major laboratory area. The findings are then presented to the Laboratory Director for review, evaluation, and formulation of corrective action implementation strategies.

9.3 Corrective actions/Preventative Actions

Outline for Corrective/Preventative Actions:

1) Discovery/identification
2) Determination of root cause(s) via root cause analysis
3) Identify potential corrective action(s)
4) Choose according to the magnitude and risk of the problem
5) Implement the corrective action(s)
6) Monitor

For more details regarding the Corrective Action/Preventative Action Program, refer to SOP Corrective Actions/Preventative Actions, document number 84.

9.3.1 A problem with the management system or with technical operations may be identified through a variety of activities, including nonconforming work, internal/external audits, QA & management reviews, customer feedback/inquiries, and from staff observations. This is the discovery/identification step of the corrective/preventative action process.

A corrective action will be initiated as soon as possible with a due date of 2 weeks. More complex corrective actions will be assigned an appropriate longer time frame. A follow-up will then take place a month after the corrective action is completed.

9.3.2 The procedure for corrective action shall start with an investigation to determine the root cause(s) of the problem. Each investigation (root cause analysis) is different based upon the type of nonconformance, complexity of the problem, and range of impact. The points to take in to consideration when doing a root cause analysis are: personnel, samples, methods, controls and data. For details on each point, refer to SOP Corrective Actions/Preventative Actions, document number 84.

9.3.3 The laboratory documentation and records of all non-conforming events requiring corrective action shall include the determined cause(s) and corrective action taken. Where corrective action is needed, the laboratory shall identify potential corrective actions. It shall select and implement the action(s) most likely to eliminate the problem and prevent recurrence. Corrective actions shall be appropriate to the magnitude and risk of the problem.

9.3.4 After the best corrective/preventative action is chosen, it will be implemented immediately and monitored for effectiveness through follow-up investigations and if warranted put into the policing program. If deemed necessary, an internal audit will be conducted in that area of activity the issue occurred as soon as possible. Any training provided during the corrective action process must be documented either in an attendance sheet, a signed training memo, or some other means to record the training.

9.3.5 Preventative actions are defined as a change implemented to address a weakness in the management system that is not yet responsible for causing non-conforming work. Its main focus is to avoid creating non-conformances and commonly include improvements in efficiency. Any time a more efficient way is found in the lab a preventative action should be filed.

9.4 Risks and opportunities

9.4.1 The laboratory shall consider the risks and opportunities associated with the laboratory activities in order to:

a) give assurance that the management system achieves its intended results;
b) enhance opportunities to achieve the purpose and objectives of the laboratory;
c) prevent, or reduce, undesired impacts and potential failures in the laboratory activities;
d) achieve improvement.

9.4.2 The laboratory shall plan: actions to address these risks and opportunities; and how to integrate and implement these actions into its management system; and evaluate the effectiveness of these actions.

9.4.3 Actions taken to address risks and opportunities shall be proportional to the potential impact on the validity of laboratory results.

9.4.4 Risks and opportunities are assessed with each new bid, contract, QAPP, change of vendor, new employee hire or any new situation encountered by Con-Test by the applicable management personnel.

9.5 Improvements

9.5.1 The laboratory shall identify and select opportunities for improvement and implement any necessary actions. Opportunities for improvement can be identified through the review of the operational procedures, the use of the policies, overall objectives, audit results, corrective actions, management review, suggestions from personnel, risk assessment, analysis of data, and proficiency testing results.

9.5.2 The laboratory shall seek feedback, both positive and negative, from its customers. The feedback shall be analyzed and used to improve the management system, laboratory activities and customer service. Examples of types of feedback include customer satisfaction surveys, communication records and review of reports with customers.

9.5.3 Con-Test sends out a survey with each final report to the client and additionally conducts an annual survey. Client services management uses the results of the survey to make improvements to the company.

10.0 Analytical Methods

10.1 Selection and verification of methods

10.1.1 The laboratory shall use appropriate methods and procedures for all laboratory activities and, where appropriate, for evaluation of the measurement uncertainty as well as statistical techniques for analysis of data.

10.1.2 All methods, procedures and supporting documentation, such as instructions, standards, manuals and reference data relevant to the laboratory activities, shall be kept up to date and shall be made readily available to personnel.

10.1.3 The laboratory shall ensure that it uses the latest valid version of a method unless it is not appropriate or possible to do so. When necessary, the application of the method shall be supplemented with additional details to ensure consistent application.

10.1.4 When the customer does not specify the method to be used, the laboratory shall select an appropriate method and inform the customer of the method chosen. Methods published either in international, regional or national standards, or by reputable organizations, or in relevant scientific texts or journals, or as specified by the manufacturer of the equipment, are recommended. Laboratory-developed or modified methods can also be used.

10.1.5 The laboratory shall verify that it can properly perform methods before introducing them by ensuring that it can achieve the required performance.

Records of the verification shall be retained. If the method is revised by the issuing body, verification shall be repeated to the extent necessary.

10.1.6 When method development is required, this shall be a planned activity and shall be assigned to competent personnel equipped with adequate resources. As method development proceeds, periodic review shall be carried out to confirm that the needs of the customer are still being fulfilled. Any modifications to the development plan shall be approved and authorized.

10.1.7 Deviations from methods for all laboratory activities shall occur only if the deviation has been documented, technically justified, authorized, and accepted by the customer.

10.2 Validation of Methods

10.2.1 The laboratory shall validate non-standard methods, laboratory-developed methods and standard methods used outside their intended scope or otherwise modified. The validation shall be as extensive as is necessary to meet the needs of the given application or field of application.

10.2.2 When changes are made to a validated method, the influence of such changes shall be determined and where they are found to affect the original validation, a new method validation shall be performed.

10.2.3 The performance characteristics of validated methods, as assessed for the intended use, shall be relevant to the customers' needs and consistent with specified requirements.

10.2.4 The laboratory shall retain the following records of validation:

a) The validation procedure used;
b) Specification of the requirements;
c) Determination of the performance characteristics of the method;
d) Results obtained;
e) A statement on the validity of the method, detailing its fitness for the intended use.

10.2.5 The validation study is to include 30 spiked samples (from at least 9 different sites): 10 at the LOQ, 10 at the mid-level and 10 at high level and analyzed using the modified procedure. The lab must also run duplicate aliquots using the approved procedure (10 at the LOQ, 10 at mid-level, and 10 at high level). The results (recoveries) are to be compared to determine if the modified procedure is equivalent to or better than the approved procedure.

10.3 The following is a listing of analytical methods commonly utilized by Con-Test Analytical Laboratory. Deviations from tests and calibration methods shall occur only if the deviation has been documented, technically justified, authorized, and accepted by the client. Deviations will be noted on the final report.

Please note: This is not a complete listing of analytical method. For information concerning other utilized analytical methods contact one of our project chemists.

Analytical Methodology
Water/Wastewater

Bacteriological Analyses	**Method Number**	**Reference**
Coliform, Total	SM 9222B	8
	SM 9223 (Colisure)	8
	SM 9223B-Colilert	8
Coliform, Fecal	SM 9222D	8
	SM 9223B-Colilert18	8
E.coli	SM 9223B-Colilert	8
Enterococci	SM 9223 (Enterolert)	8
Heterotrophic Plate Count (HPC)	Simplate	8

Inorganic Mineral Analyses	**Method Number**	**Reference**
Alkalinity (Titrimetric)	SM 2320 B	8
Chloride (Argentometric)	SM 4500-Cl B	8
Chloride (IC)	EPA 300.0	21
Chromium, Hexavalent	SM 3500-Cr B	8
(Manual, Colorimetric)	SW-846 7196 A	3
Conductivity	SM 2510 B	8
Dissolved Oxygen	SM 4500-O G	8
(Membrane electrode method)		
Ferrous Iron (Spectrophotometric)	SM 3500-Fe D	8
Fluoride (Ion Selective Electrode)	SM 4500-F C	8
Fluoride (IC)	EPA 300.0	21
Hardness (Titrimetric, EDTA)	SM 2340 C	8
pH (Electrode)	SM 4500-H B	8
	SW-846 9040 B	3
Solids, Total	SM 2540 B	8
Solids, Total Dissolved	SM 2540 C	8
Solids, Total Suspended	SM 2540 D	8
Solids, Settleable	SM 2540 F	8

Sulfate (Turbidimetric)	ASTM D516	15
Sulfate (IC)	EPA 300.0	21
Sulfide (Iodometric Back Titration)	SM 4500-S^2 F	8

Nutrient Analyses	**Method Number**	**Reference**
Ammonia-N	SM 4500-NH_3 C -titration	8
Ammonia-N	EPA 350.1 Semi-Automated	27
Nitrite-N (Manual Spectrophotometer)	SM 4500-NO_2 B	8
Nitrite (IC)	EPA 300.0	21
Nitrate-N and Nitrite (Discrete Gallery)	NECi Nitrate Reductase (PW)	26
Enzymatic Reduction	NECi Method N07-0003 (NPW)	
Nitrate (IC)	EPA 300.0	21
Total Kjeldahl Nitrogen (Organic N) (Titrimetric)	SM (19-21) 4500-N_{org} B, C	8
Phosphate, Ortho (Colorimetric)	SM 4500-P E	8
Phosphate, Ortho (IC)	EPA 300.0	21
Phosphate, Total (Colorimetric)	SM 4500-P E	8

Demand Analyses	**Method Number**	**Reference**
BOD (5 day) (Dissolved Oxygen Consumption)	SM 5210 B	8
CBOD (5 day) (Carbonaceous DO Consumption)	SM 5210 B	8
COD (Colorimetric)	EPA 410.4	1
Chlorine, Total Residual (Colorimetric)	SM 4500-Cl G	8
TOC (Total Organic Carbon)	SM 5310 B	8

Physical Analyses	**Method Number**	**Reference**
Color (Visual Comparison)	SM 2120 B	8
Odor (Threshold Odor)	SM 2150 B	8
Turbidity (Nephelometric)	EPA 180.1	1

Other	**Method Number**	**Reference**
Bromide (IC)	EPA 300.0	21
Oil and Grease (FOG) (Hexane Extraction)	SW-846 1664B	22
Phenols (Colorimetric)	EPA 420.1	1
Cyanide, Total (Manual Spectrophotometer)	SM 4500-CN E SW-846 9014	8 3
Physiologically Available Cyanide (Manual Spec.)	SW-846 9014	16

Volatile Organics	**Method Number**	**Reference**
Purgeable Aromatics (GC)	EPA 602	4
Purgeables (GC/MS)	EPA 624.1	4
Drinking Water Purgeables (GC/MS)	EPA 524.2	5
EDB/DBCP	EPA 504.1	5

Semi-Volatile Organics	**Method Number**	**Reference**
Base/Neutrals & Acids	EPA 625.1	4
Priority Pollutants Pesticides/PCB's	EPA 608.3	4
CT Extractable Petroleum Hydrocarbons	CT ETPH	12
MA Volatile Petroleum Hydrocarbons	MA VPH	13
MA Extractable Petroleum Hydrocarbons	MA EPH	14

Other Organics	**Method Number**	**Reference**
PFAS (LC/MS/MS)	EPA 537.1	23
PFAS (LC/MS/MS)	ISO 25101	24
PFAS (LC/MS/MS)	EPA 533	28

Metals Analyses

Waters, soils and other materials may be analyzed for metals by Inductively Coupled Argon Plasma – Atomic Emission Spectroscopy (ICP) and/or Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Non-aqueous samples are generally treated as a solid waste and SW-846 methods are applied.

Analyte	Water/ Wastewater (Ref 3, 18, 20)	Drinking Water (Ref 18, 20)	Non-Aqueous (Solids/Wastes) (Ref 3)
Aluminum (Al)	200.7/6010D 6020B	200.7	6010D/6020B
Antimony (Sb)	200.7/6010D 200.8/6020B	200.8	6010D/6020B
Arsenic (As)	200.7/6010D 200.8/6020B	200.8	6010D/6020B
Barium (Ba)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Beryllium (Be)	200.7/6010D 200.8/6020B	200.8	6010D/6020B
Boron (B)	200.7/6010D	200.7	6010D
Cadmium (Cd)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Calcium (Ca)	200.7/6010D	200.7	6010D
Chromium (Cr)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Cobalt (Co)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Copper (Cu)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B

Iron (Fe)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Lead (Pb)	200.7/6010D 200.8/6020B	200.8	6010D/6020B
Magnesium (Mg)	200.7/6010D	200.7	6010D
Manganese (Mn)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Mercury (Hg)	245.1/7470A	245.1	7471B
Molybdenum	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Nickel (Ni)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Potassium (K)	200.7/6010D	200.7	6010D
Selenium (Se)	200.7/6010D 200.8/6020B	200.8	6010D/6020B
Silver (Ag)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Sodium (Na)	200.7/6010D	200.7	6010D
Thallium (Tl)	200.7/6010D 200.8/6020B	200.8	6010D/6020B
Tin (Sn)	200.7/6010D	200.7	6010D
Vanadium (V)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B
Zinc (Zn)	200.7/6010D 200.8/6020B	200.7/200.8	6010D/6020B

Note: EPA Method 200.7 and SW-846 Method 6010D are “Inductively Coupled Plasma – Atomic Emission Spectroscopy” (ICP) methods.

Note: EPA Method 200.8 and SW-846 Method 6020B are “Inductively Coupled Plasma Mass Spectrometry” (ICP-MS) methods.

Analytical Methodology
Test Methods for Evaluating Solid Wastes; SW-846

Waste Evaluation	Method Number	Reference
Paint Filter Liquids Test	SW-846 9095A	3
Corrosivity (pH solid)	SW-846 9045	3
Flashpoint	SW-846 1010A/B	3
Ignitability	SW-846 1030	3
Reactivity: Cyanide and Sulfide	SW-846 Chapter 7.3.3.2	3
TCLP (Toxicity Char. Leaching Procedure)	SW-846 1311	3
SPLP (Synthetic Precipitation Leaching Procedure)	SW-846 1312	3
PCB in Oil	EPA 600/4-81-045 SW-846 8082A	17 3
Total Organic Carbon (TOC)	SW-846 9060A	3
Cyanide	SW-846 9014	3
Hexavalent Chromium (FCr+6)	SW-846 7196A	3

Sample Preparation Methods

Inorganic Prep Techniques	Method Number	Reference
Acid digestion of Aqueous samples	3005A/3010C	3
Acid digestion for Oils, Greases, and Waxes	3051A	3
Acid digestion of Sediments and Sludges	3050B	3
Microwave Extraction	3051A 3015A	3 3

Organic Prep Techniques	Method Number	Reference
Separatory Funnel Liquid-Liquid Extraction	3510C	3
Sonication Extraction	3550B	3
Pressurized Fluid Extraction	3545	3
Microwave Extraction	3546	3
Soxhlet Extraction	3540C	3
Organic Analytical Methods	**Method Number**	**Reference**
Priority Pollutant Pesticides/PCB's	8081B/8082A	3
GC/MS Method for Volatile Organics	8260D	3
GC/MS Method for Semi-Volatile Organics	8270E	3
Fuel Hydrocarbons	8015M	3*
Fuel Hydrocarbons	8100M	3*
GRO and DRO	8015C/D	3
Herbicides	8151A	3
CT Extractable Petroleum Hydrocarbons	CT ETPH	12
Volatile Petroleum Hydrocarbons	MA VPH	13
Extractable Petroleum Hydrocarbons	MA EPH	14

M = Modified * = In-house Standard Operating Procedure

Environmental Lead
Commonly Utilized Methodology

Air	NIOSH 7303, Lead ICP-AES
Paint	SW-846 Modified Method 6010D (3050B), Lead ICP-AES
Dust Wipes	SW-846 Modified Method 6010D (3050B), Lead ICP-AES
Soil	SW-846 Method 6010D (3050B), Lead ICP-AES

Analytical Methodology – Air

Analyte	Collection Media	Method No.
Metals:		Modified NIOSH
Arsenic (As)	37 mm Cassette w/MCE Filter	7303 (6)
Beryllium (Be)	37 mm Cassette w/MCE Filter	7303 (6)
Cadmium (Cd)	37 mm Cassette w/MCE Filter	7303 (6)
Chromium (Cr)	37 mm Cassette w/MCE Filter	7303 (6)
Copper (Cu)	37 mm Cassette w/MCE Filter	7303 (6)
Lead (Pb)	37 mm Cassette w/MCE Filter	7303 (6)
Nickel (Ni)	37 mm Cassette w/MCE Filter	7303 (6)
Zinc (Zn)	37 mm Cassette w/MCE Filter	7303 (6)
Metals by ICP	37 mm Cassette w/MCE Filter	7303 (6)

Note: Only the most commonly requested Air Analyses Methods are listed. Other analytes and alternative methods are available. Please check with project chemist for more details.

Note: It is required that a blank be submitted for all wipe and air analyses

Analytical Methodology – Air

Analyte	Collection Media	Method No.
Dust, Total	37 mm Cassette w/PVC Filter	0500 (6)
Dust, Respirable	37 mm Cassette w/PVC Filter	0600 (6)
PCB'S in Air	Florisil Sorbent Tubes	5503 (6)
Hg in Air	Hopcalite Sorbent Tube	6009 (6)
TO-4	PUF	10
TO-10A	PUF	10
TO-13A	PUF	10
TO-14/TO-15	Summa Canister	10
APH	Summa Canister	11
Method 3C (Fixed Gases)	Summa Canister	9
TO-17	Sorbent Tube	10

References

1.0 USEPA – "Methods for Chemical Analysis of Water and Wastes" – EPA 600/4-79-020, Revised 1983.

2.0 APHA – "Standard Methods for the Examination of Water and Wastewater", 17th edition, 1989.

3.0 USEPA – "Methods for Evaluating Solid Waste, Physical/Chemical Methods", 3rd edition, USEPA November, 1986 (SW846), and updates. (Update V, Rev 5, July 2014) (Update VI) (Update VII)

4.0 "Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act", 40CFR Part 136.

5.0 USEPA – "Methods for the Determination of Organic Compounds in Drinking Water", EPA 600/4-88/039, December 1988, and updates.

6.0 NIOSH Manual of Analytical Methods

7.0 OSHA Manual of Analytical Methods

8.0 APHA – "Standard Methods for the Examination of Water and Wastewater", 18th, 19th, 20th, 21st, 22nd, 23rd Editions

9.0 EPA Technology Transfer Network Emission Measurement Center. CFR Promulgated Test Methods http://www.epa.gov.ttn/emc/promgate.html

10.0 Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air.

11.0 Method for the Determination of Air-Phase Petroleum Hydrocarbons (APH). Public Comment Draft 1.0, Massachusetts DEP, ORS, BWSC. February 2000.

12.0 Analysis of Extractable Petroleum Hydrocarbons (ETPH) Using Methylene Chloride GC/FID. University of Connecticut ERI. March 1999.

13.0 Method for Determination of Volatile Petroleum Hydrocarbons (VPH). Massachusetts DEP, ORS, BWSC. Rev 2.1, February 2018.

14.0 Method for the Determination of Extractable Petroleum Hydrocarbons (EPH). Massachusetts DEP, ORS, BWSC. Revision 2.1, December 2019.

15.0 ASTM, "American Society of Testing and Materials", 2002, 2011, 2016

16.0 "Method for the Determination of Physiologically Available Cyanide (PAC)", Massachusetts DEP, ORS, BWSC, August 2004.

17.0 "The Determination of PCB's in Transformer, Fluid and Waste Oils", USEPA Method EPA 600/4-81-045, September 1982.

18.0 USEPA Supplement 1 of "Methods for the Determination of Metals in Environmental Samples", EPA 600R-94-11, May 1994, Method EPA 200.7, Rev 4.4. EMMC Version 1994.

19.0 USEPA Supplement 1 of "Methods for the Determination of Metals in Environmental Samples", EPA 600R-94-11, May 1994, Method EPA 245.1, Rev 3.0 EMMC Version 1994.

20.0 USEPA Supplement 1 of "Methods for the Determination of Metals in Environmental Samples", EPA 600R-94-11, May 1994, Method EPA 200.8, Rev 5.4. EMMC Version 1994.

21.0 USEPA "Methods for Determination of Inorganic Substances in Environmental Samples", EPA 300.0 (Determination of Inorganic Anions by Ion Chromatography"), Rev 2.1, August 1993.

22.0 "Method 1664, Revision B: 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; PB99-121949, February 2010.

23.0 EPA Method 537 and EPA 537.1, "Determination of Selected Perfluorinated Alkyl acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)", Version 1.1, September 2009 (EPA 537) and Version 1.0 November 2018 (EPA 537.1)

24.0 Method ISO 25101:2009, "Determination of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) – Method for unfiltered samples using solid phase extraction and liquid chromatography/mass spectrometry", April 30, 2009.

25.0 "TNI NELAC Standard", The NELAC Institute, Rev 2009 and Rev 2016.

26.0 NECi Method N07-0003 Rev. 9, March 2014 and NECi Nitrate Reductase Method Rev 1.0, February 2016

27.0 40 CFR 136 – Table of approved EPA methods

28.0 EPA Method EPA 533, "Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry", EPA Document #815-B-19-020, Nov 2019.

11.0 Sampling and Preservation Requirements

Information shall be available to clients through Con-Test Analytical Laboratory. Con-Test Analytical Laboratory will assist clients in obtaining information regarding recommended procedure, sampling materials, sampling containers, preservatives, and shipping instructions. This includes laboratory request for client submittal of field blanks or blank sampling media. Con-Test will also direct clients to the appropriate agencies (Federal, State, Local Officials, Field Services, and Consulting Services, etc.) or channels when information is unavailable through the laboratory. This information is available upon request, through our project chemists. Multiple tests may be able to be combined in one container as long as sufficient sample amount is submitted or method dictates otherwise. Please consult the laboratory on which ones.

Sampling and Preservation Requirements

Water

Key:

Holding Time = Time allowable between time of sampling and before specified analysis begins.

Parameter = Test	*mL = Milliliters*	*P = Polyethylene Container*
G = Glass Container	*P/G = Either P or G*	*HNO_3 = Nitric Acid*
H_2SO_4 = Sulfuric Acid	*NaOH = Sodium Hydroxide*	*$Na_2S_2O_3$ = Sodium Thiosulfate*

Parameter	Container	Preservative	Holding Time
Alkalinity	100 mL P/G (Needs its own container with no headspace)	Cool to 4°C	14 Days
Ammonia (as N)	100 mL P/G	Cool to 4°C, H_2SO_4 to pH<2	28 Days
Bacteria Tests (T.Coliform) And Enterococci	100 mL P Bacteria cup	0.008% $Na_2S_2O_3$ Cool to 4°C	30 Hours
Fecal Coliform	100 mL P Bacteria cup	0.008% $Na_2S_2O_3$ Cool to 4°C	8 Hours
Biological Oxygen Demand (BOD)	1000 mL P/G	Cool to 4°C	48 Hours
Carbonaceous BOD	1000 mL P/G	Cool to 4°C	48 Hours
Chemical Oxygen Demand (COD)	50 mL P/G	Cool to 4°C, H_2SO_4 to pH<2	28 Days
Chloride	200 mL P/G	None required	28 Days
Chlorine, Residual	100 mL P/G	None required	Analyze Immediately or by 24 hours
Color	100 mL P/G	Cool to 4°C	48 Hours
Cyanide, Total and Amenable	500 mL P/G	Cool to 4°C NaOH to pH>12 0.6g Ascorbic[1]	14 Days[2]
PAC	500 mL G	NaOH to pH>12	14 Days
Ferrous Iron	500 mL P/G	HNO_3 to pH<2	6 months (48 hrs. if Unpreserved)

Fluoride	100 mL P	None required	28 Days
Hardness	100 mL P/G	HNO_3or H_2SO_4 to pH<2	6 months
Ignitability	50 mL P/G	Cool to 4°C	ASAP/7 days
Metals 500 mL P(A)/G(A)	HNO_3 to pH<2	6 months	
Chromium, Hexavalent	200 mL, P(A)/G(A) MCP soils need Its own container	Cool to 4°C	24 Hours
Mercury	200 mL, P(A)/G(A)	HNO_3 to pH<2	28 Days
TKN	200 mL P/G	H_2SO_4 to pH<2	28 Days
Nitrate/Nitrite as N	50 mL P/G	Cool to 4°C H_2SO_4 to pH<2	28 Days
Nitrate as N	50 mL P/G	Cool to 4°C	48 Hours
Nitrite as N	50 mL P/G	Cool to 4°C	48 Hours
Odor	200 mL G only	Cool to 4°C	Analyze Immediately
Oil and Grease	1 Liter G only	Cool to 4°C H_2SO_4 to pH<2	28 Days
Total Organic Carbon (TOC)	25 mL P/G or 40mL VOA vial	Cool to 4°C H_2SO_4 or HCL to pH<2	28 Days
Orthophosphate	100 mL P(A)/G(A)	Cool to 4°C	48 Hours Field Filtered within 15 minutes
Dissolved Oxygen	300 mL G	None required	Analyze Immediately
pH	30 mL P/G	Cool to 4°C	Analyze Immediately
Total Phenol	500 mL Amber G	Cool to 4°C H_2SO_4 to pH<2	28 Days
Total Phosphate	100 mL P/G	Cool to 4°C H_2SO_4 to pH<2	28 Days
Settleable Solids	1000 mL P/G	Cool to 4°C	48 Hours
Total Solids (TS)	100 mL P/G	Cool to 4°C	7 Days
Total Suspended Solids (TSS)	100 mL P/G	Cool to 4°C	7 Days
Total Dissolved Solids (TDS)	100 mL P/G	Cool to 4°C	7 Days
Specific Conductance (Conductivity)	100 mL P/G	Cool to 4°C	28 Days
Sulfate	250 mL P/G	Cool to 4°C	28 Days

Sulfide	100 mL P/G	Cool to 4°C Add 4 drops of 2N Zinc acetate, NaOH pH>9	7 Days
Surfactants (MBAS)	500 mL P/G	Cool to 4°C	48 Hours
Turbidity	50 mL P/G	Store in a dark place Cool to 4°C	48 Hours

[1] Should only be used in the presence of residual chlorine.
[2]Maximum holding time is twenty-four hours when sulfide is present. Optionally, Sulfide can be removed by the Addition of cadmium nitrate (etc.) powder before preservation until a negative spot test is obtained on lead acetate test paper.

Parameter	**Container**	**Preservative**	**Holding Time**
Volatile Organics (602, 624.1)	(2) 40 mL VOA Vials w/Teflon lined lid	Cool to 4°C HCL to pH<2, Zero headspace	14 Days
Base Neutral/Acid extractables (625.1)	(2) Liter amber G, w/Teflon lined lid	Cool to 4°C	7 Days until extraction 40 Days after ext.
Pesticide extraction (608.3/8081B)	(2) 1 Liter amber G, w/Teflon lined lid	Cool to 4°C pH 5-9	7 Days until extraction 40 Days after ext.
Herbicide extraction	(2) 1 Liter amber G,	Cool to 4°C	7 Days until extraction 40 Days after ext.
EDB/DBCP (504.1)	(2) 40 mL VOA Vials w/Teflon lined lid	Cool to 4°C HCL to pH<2, Zero headspace	28 Days
Polychlorinated Biphenyls (PCBs) (608.3/8082A)	(2) 1-Liter amber G, w/Teflon lined lid	Cool to 4°C	CT – 7 Days until ext. MA – 1 yr. until ext. 40 Days after ext. NO HT under SW-846
Purgeable Aromatic Hydrocarbons (602)	(2) 40 mL VOA Vials w/Teflon lined lid	Cool to 4°C HCL to pH<2, Zero headspace	14 Days
Benzene, Toluene, Xylene (BTEX, 602)	(2) 40 mL VOA Vials w/Teflon lined lid	Cool to 4°C HCL to pH<2, Zero headspace	14 Days
Total Organic Halogens (TOX)	250 mL amber G, w/Teflon lined lid	Cool to 4°C Zero headspace	14 Days
Total Petroleum Hydrocarbons (TPH)	1 Liter amber G, w/Teflon lined lid	Cool to 4°C H_2SO_4 to pH<2	14 Days
PFAS (EPA 537.1)	250 mL Polypropylene bottle With polypropylene screw cap	Cool to 4°C	14 days to extract 28 days from ext
PFAS (EPA 533)	250 mL Polypropylene bottle With polypropylene screw cap	Cool to 4°C	28 days to extract 28 days from ext

Sampling and Preservation Requirements
Solids

Parameter	Container	Preservative	Holding Time
Volatile Organics (8260C/D)	(1) 8 oz. Amber G, w/Teflon lined lid	Cool to 4°C	14 Days
Volatile Organics (8260C/D with 5035)	(3) 40 mL VOA Vials w/Teflon lined lid	Cool to 4°C (2) vials preserved w/ Na Bisulfate (1)vial preserved w/ methanol	14 Days
Base Neutral/Acid Extractables (8270D/E)	(1) 8 oz. G w/Teflon lined lid	Cool to 4°C	7 Days until ext. 40 Days after ext.
Herbicides (8151A)	(1) 8 oz. G w/Teflon lined lid	Cool to 4°C	14 Days
Pesticides (8081B)	(1) 8 oz. G w/Teflon lined lid	Cool to 4°C	7 Days until ext. 40 Days after ext.
PCB (8082A)	(1) 8 oz. G w/Teflon lined lid	Cool to 4°C	CT – 7 Days until ext. MA – 1 year until ext. 40 Days after ext. No HT under SW-846
Benzene, Toluene, Xylenes (BTEX)	(1) 8 oz. G w/Teflon lined lid	Cool to 4°C	14 Days
Total Petroleum Hydrocarbons (TPH)	(1) 8 oz. G w/Teflon lined lid	Cool to 4°C	14 Days
Cyanide	20 Grams P/G	Cool to 4°C	N/A
Metals, Total	(1) 8 oz. G w/Teflon lined lid	Cool to 4°C	6 Months
TKN	20 Grams P/G	Cool to 4°C	N/A
Total Organic Carbon (TOC)	10 Grams P/G	Cool to 4°C	N/A
pH	50 Grams P/G	Cool to 4°C	N/A

Hazardous Waste Characterization

TCLP Metals
Reactivity PCB's
Volatile Organics
Corrosivity
Reactivity
-Cyanide
-Sulfide

(2) 8 oz. glass containers with a Teflon lined lid is sufficient sample amount to perform Hazardous Waste characterization

EPA Method 1311 – TCLP Sampling Requirements

Aqueous Liquid Samples (approx. 100% liquid)

Volatile Organics: (2) 40 mL VOA vials with no head space
8 RCRA Metals: (1) 500 mL Nalgene Bottle
BNA's: (2) One-liter amber wide mouth glass bottles with Teflon lined lid
Pesticides/Herbicides: (2) One-liter amber wide mouth glass bottles with Teflon lined lid

Solid Samples (approx. 100% solid or paint)

(1) 8 oz. wide mouth glass jar with Teflon lined cap packed tightly

Mixed Samples (solid mixed with water or mostly water)

Please contact laboratory as to the nature of the material so that appropriate sample amounts will be provided.

Non-Aqueous Liquid (mostly solvent)

(1) 4 oz. wide mouth glass jar (with Teflon lined cap)

Note: TCLP analysis is generally inappropriate; sample will be run to determine percent of suspected solvents.

12.0 Personnel Qualifications: Training

12.1 Personnel

Con-Test is committed to producing and utilizing technically competent, well trained individuals. Each new analyst undergoes a Quality Assurance/Control Policy Orientation and reads the current copy of the Quality Assurance Manual. They must sign off that they have read the current QA Manual as well as any other appropriate controlled SOP's. Analysts will also read any applicable method that corresponds to the SOP's they've read. A Data Integrity and Ethics class is provided which they will have annual refreshers of and they will receive any needed supplies.

12.1.1 All personnel of the laboratory, either internal or external, that could influence the laboratory activities shall act impartiality, be competent and work in accordance with the laboratory's management system.

12.1.2 The laboratory shall document the competence requirements for each function influencing the results of laboratory activities, including requirements for education, qualification, training, technical knowledge, skills and experience.

12.1.3 The laboratory shall ensure that the personnel have the competence to perform laboratory activities for which they are responsible and to evaluate the significance of deviations.

12.1.4 The management of the laboratory shall communicate to personnel their duties, responsibilities and authorities.

12.1.5 The lab has procedures and retains records for:

- **12.1.5.1** Determining the competence requirements (see section 2.0)
- **12.1.5.2** Selection of personnel
- **12.1.5.3** Training of personnel
- **12.1.5.4** Supervision of personnel
- **12.1.5.5** Authorization of personnel
- **12.1.5.6** Monitoring competence of personnel

12.1.6 The laboratory shall authorize personnel to perform specific laboratory activities, including but not limited to, the following:

- **12.1.6.1** Development, modification, verification and validation of methods
- **12.1.6.2** Analysis of results, including statements of conformity or opinions and interpretations
- **12.1.6.3** Report, review, and authorization of results.

12.2 Employee Training

It is the responsibility of the Laboratory Director to ensure that the staff is competent to perform laboratory analysis. Laboratory staff is trained by experienced analysts and supervisors in techniques where proficiency has been demonstrated by past performance. New analysts continue to perform under the supervision and direction of experienced analysts until sufficient information is obtained for an Initial Demonstration of Capability (IDOC). See section 12.6.

AIHA-LAP, LLC IHLAP/ELLAP trainees must have a training period of 20 business day's duration, prior to completing a DOC and working independently on client samples. This 20-day period must be clearly documented on the IDOC training form.

A Demonstration of Capability must be performed prior to using any test method, and any time there is a change in instrument type, personnel, or method. The laboratory, through QC charting, has historical data adequately demonstrating current analyst capability to meet laboratory generated acceptance criteria.

Where the analyst has demonstrated capability through analysis and QC charting of Laboratory Control Samples with acceptable results, this procedure for demonstrating continued proficiency to perform the test method will be used for the DOC Certification Statement. All new analysts will perform an initial DOC. Continued proficiency can also be demonstrated through acceptable performance on proficiency samples.

Laboratory staff performing in-house calibrations and verifications shall have received documented training. This includes in-house verifications of thermometers and

Eppendorf's. All personnel concerned with testing and calibration activities within the laboratory will familiarize themselves with the quality documentation and implement the policies and procedures in their work.

Annually, an on-going demonstration of capability must be performed to document the quality of the data produced. On-going data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance standards for the method.

In general, this demonstration does not test the performance of the method in real world samples, but in applicable and available clean matrix (a sample of a matrix in which no target analytes or interferences are present at concentrations that impact the results of a specific test method or a proficiency test sample can be used). Refer to specific method requirements.

All demonstrations shall be documented through the use of the CDOC form, which also lists SOP, method associated with the test, certification statement, and authorized signatures. See section 12.6 for CDOC form.

12.3 Training Documentation

Laboratory personnel performance is documented throughout training and the time spent at Con-Test. Employees are evaluated on a regular basis and their performance on external and internal proficiency samples documented.

The laboratory will maintain a training file, which contains:

1) A statement from each employee that they have read, understood, and is using the latest version of the laboratory Quality Assurance Manual and SOP's. The statement will be signed and dated.
2) A statement from each employee that they have read acknowledged and understood their personal ethical and legal responsibilities including the potential punishments and penalties for improper, unethical, or illegal actions. The statement will be signed and dated.
3) A Demonstration of Capability (DOC) for each employee for each accredited method.
4) Documentation of any training courses, seminars, and/or workshops.
5) Documentation of each employee's continued proficiency to perform each test method by one of the following annually:

    a) Acceptable performance of a blind sample (single blind to the analyst) for each method;
    b) Another Demonstration of Capability;

c) Successful analysis of a blind performance sample on a similar test method using the same technology (e.g. GC/MS volatiles by purge and trap for Methods 524.2, 624.1, or 8260) would only require documentation for one of the test methods;

d) At least four consecutive Laboratory Control Samples with acceptable levels of precision and accuracy;

e) If a-d cannot be performed, analysis of authentic samples that have been analyzed by another trained analyst with statistically indistinguishable results.

6) Be sure to evaluate the method blank submitted with the raw data and be sure passes method criteria.

12.4 Metals Analysis Training Program (As required per ELLAP)

Environmental Lead Analysis

Prospective analysts for Lead in environmental samples shall have training and aptitude in chemistry, biology, physics, or a related physical science. Analysts receive specific training in the techniques required for analysis either formally from an instrument manufacturer, an educational institution or on-the-job (in house).
In house (on-the job) training proceeds as follows:

New analysts are required to read the instrument manual regarding operation of the instrument, calibration, hardware and software. The analyst is also required to read the relevant Laboratory Standard Operating Procedures and review reference methods in the appropriate methods manuals. This is done under the supervision of the metals section supervisor.

After a mandatory QA orientation, each analyst is then taught, one-on-one, the daily operating procedures for the respective methods concerning preparation of standards, order of analysis, QC criteria, operation of the instrument from start-up to shut-down, as well as the operation of any auxiliary software for the calculation of results. Conditions for data rejection are discussed along with the proper procedure to be followed when an out of control event occurs.

Each analyst is required to run external reference samples to determine his/her proficiency in the operation of the instrument before he/she is allowed to do sample determinations. Sample preparation personnel must be trained in the proper use of the analytical balance, preparation of glassware, and volumetric techniques. Previous training is acceptable as long as the metals section supervisor evaluates the performance of the prospective analyst through observation and comparison of standard reference preparations with known values. Analysts and technicians are trained using AIHA-LAP, LLC Policy:

All analysts and technicians shall be trained with the SOP's in use in the laboratory and with the instrument and equipment operation manuals. All analysts and technicians shall complete a minimum of four (4) independent test runs of sample preparation and/or instrumental analysis ***for each matrix****.*

Independent runs are defined as analytical runs consisting of at least five (5) samples of known content, one of which is a certified reference material (CRM) or proficiency testing material, separated by a period of time sufficient to evaluate the performance of any previous independent run. For sample preparation training, the recoveries of the associated reference materials or proficiency training samples for each run must be within ± 20% of the certified value, 100% of the time. For instrumental analysis training, the recoveries of the associated reference materials or proficiency training samples for each run must be within ± 10% of the certified value, 100% of the time. The reference/proficiency test samples utilized shall be representative of the matrices and mass ranges that the analyst will encounter during routine sample analysis.

Training checklists are completed for each person by the metals supervisor to ensure competency of individuals in each applicable area. This documentation is to be kept in the laboratory records.

The minimum total experience required before complete independent operation is allowed (i.e. absence of the instructor or immediate supervisor >30% of the time during work operations) is listed below.

Sample Preparation:	3 Months per method
Sample Analysis:	6 Months per instrument

12.5 Education and Training in Ethical and Legal Responsibilities Including the Potential Punishments and Penalties for Improper, Unethical, or Illegal Action

An employee handbook (controlled document #349) is distributed to each employee upon hire; ethical and legal responsibilities are addressed within. New employees are trained in the Laboratory Ethics and Data Integrity policy as specified in Section 3.2.2 of this manual.

12.6 Procedure for Demonstration of Capability

A demonstration of capability (DOC) must be made prior to using any test method, and at any time there is a significant change in instrument type, personnel, or test method.

In general, this demonstration does not test the performance of the method in real world samples, but in applicable and available clean matrix (a sample of a matrix in which no target analytes or interferences are present at concentrations that impact the results of a specific test method), e.g. water, solids, biological tissue and air. However, before any results are reported using this method, actual sample spike results may be used to meet this standard, i.e. at least four consecutive matrix spikes within the last twelve months. In addition, for analytes, which do not lend themselves to spiking, e.g. TSS, the demonstration of capability may be performed using quality control samples.

All demonstrations shall be documented through the use of the form in section 12.6.1.

The following steps, which are adapted from the EPA test methods published in 40 CFR Part 136, Appendix A, shall be performed if required by mandatory test method or regulation. Note: for analytes for which spiking is not an option and for which quality control samples are not readily available, the 40 CFR approach is one way to perform this demonstration. It is the responsibility of the laboratory to document that other approaches to DOC are adequate; this shall be documented in the laboratory's Quality Manual.

a) A quality control sample shall be obtained from an outside source. If not available, the QC sample may be prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.

b) The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified, or if unspecified, to a concentration approximately 10 times the method-stated or laboratory-calculated method detection limit.

c) At least four aliquots shall be prepared and analyzed according to the test method either concurrently or over a period of days.

d) Using all of the results, calculate the mean recovery (x) in the appropriate reporting units (such as ug/L) and the standard deviations of the population samples (n-1) (in the same units) for each parameter of interest.

e) When it is not possible to determine mean and standard deviations, such as for presence/absence tests and logarithmic values, the laboratory will assess performance against established and documented criteria.

f) Compare the information from (d) above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria (if there are not established mandatory criteria). If all parameters meet the acceptance criteria, the analysis of actual samples may begin.

g) If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

h) When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to 1) or 2) below.

1) Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with c) above.

2) Beginning with c) 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 c).

12.6.1 Certification Statement

The following certification statement shall be used to document the completion of each demonstration of capability. A copy of the certificate statement shall be retained in the personnel records of each affected employee.

See next page for IDOC

CON-TEST ANALYTICAL LABORATORY
TRAINING and IDOC (Initial Demonstration of Capability)
(Must be completed BEFORE any client samples are analyzed)

Analyst: _____
Analyte/Method Reference: _____
ex. Metals ICP EPA 200.7, Sulfide SM4500 S^2 E,VOA EPA 624

Matrix: _____

The analyst attests that they have read, understood, and/or performed the following:

	Initial and date as reviewed
SOP _____ Rev# __	_____
Method Reference(s):	
(Example: SW846 8260C)	Initial and date as reviewed
_____	_____
_____	_____
_____	_____
_____	_____
Instrument Manual(s):	
_____	_____
_____	_____
_____	_____
MA DEP CAM (if any)	
_____Rev# ____	_____
CT RCP (if any)	
_____Ver# ____	_____

On-the-Job Training (provide dates: minimum 20-business-days for IHLAP/ELLAP)
_____
_____

We, the undersigned, CERTIFY that:
The analyst identified above, using the cited test method(s), which is in use at this facility for the analyses of samples under the NELAP program, have met the Demonstration of Capability.
The test method(s) was performed by the analyst identified on this certification.
A copy of the test method(s) and the laboratory-specific SOPs are available for all personnel on-site.
The data associated with the demonstration of capability are true, accurate, complete and self-explanatory.
All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized assessors.

Method-Specific IDOC (attached and completed with reduced data) OR **4 LFBs** (attached and completed with reduced data)

ANALYST SIGNATURE: _____ _____
Analyst has reviewed all checked materials SIGNATURE Date

SUPERVISOR APPROVAL: _____ _____
signature authorization date

LAB. DIRECTOR APPROVAL: _____ _____
signature authorization date

QA OFFICER APPROVAL: _____ _____
signature authorization date

CDOC Form

CON-TEST ANALYTICAL LABORATORY
DOC (Demonstration of Capability)

Analyst: _____

Analyte/Method Reference: _____
ex. Metals ICP EPA 200.7, Sulfide SM4500 S^2 E, VOA EPA 624

Matrix: _____

The analyst attests that they have read, understood, and/or performed the following:

Check off as reviewed

SOP _____ **Rev#** __ _____

Method Reference(s):
(Example: SW846 8260C) **Check off as reviewed**

_____ _____
_____ _____
_____ _____
_____ _____

Instrument Manual(s):

_____ _____
_____ _____
_____ _____

MA DEP CAM (if any)
_____Rev# ____ _____
CT RCP (if any)
_____Ver# ____ _____

On-The-Job Training has been completed for analyst, and has been filed with training file.

Method-Specific DOC (attached and completed with reduced data) **OR 4 LFBs** (attached and completed with reduced data) **OR Passing Proficiency**

ANALYST SIGNATURE: _____ ____ _____
Analyst has reviewed all checked materials SIGNATURE Date

SUPERVISOR APPROVAL: _____ _____
SIGNATURE AUTHORIZATION DATE

LAB. DIRECTOR APPROVAL: _____ _____
SIGNATURE AUTHORIZATION DATE

QA OFFICER APPROVAL: _____ _____
SIGNATURE AUTHORIZATION DATE

13.0 Other Quality Considerations

13.1 Communication with Clients

Effective communication between the laboratory and its clients is of crucial importance to our ability to generate quality results. Con-Test will immediately notify clients of any problems when and if they arise.

Con-Test also encourages clients to contact the laboratory for technical assistance and to evaluate Con-Test services rendered, as a part of our continuous improvement (TQM) policy.

Any drinking water analysis where the amount detected exceeds the regulatory level (MCL) needs to be reported to the project chemist immediately, that is, as soon as realized by the analyst, for client notification, which must occur within 24 hours of obtaining the valid data. The laboratory must identify, in writing, those samples needing special reports (MCL exceedance) when the laboratory subcontracts with another laboratory. All reports, with the exception of reports submitted to the EPA in a format approved by the Department, for finished drinking water analysis, must indicate the maximum contaminant level for each analyte measured where a maximum contaminant level has been established by the Department.

Communication to the subcontracting laboratory of any special report requirements, like immediately notifying Con-Test of MCL exceedances is facilitated by the chain of custody. For MCL exceedances, the following is stamped on all subcontracting chain of custodies: “Subcontracted lab must notify Con-Test Analytical Lab of any MCL exceedance within 24 hours of obtaining valid data”. Additional information can be found on Subcontracting, from Con-Test Analytical Laboratory SOP on Subcontracting, Document #239.

MCL exceedances and Data reporting must meet MA 310 CMR 42.13 (5) requirements:

“A certified laboratory shall be required to have current knowledge of all Federal and Massachusetts standards for all categories in which it has been certified or provisionally certified, and to report analytical results in a timely manner.

(a) Upon obtaining Valid data, a certified laboratory shall notify its clients of the results of all samples that exceed any EPA – or Department – established maximum contaminant level (MCL), maximum residual disinfection level or reportable concentration, or that identify the presence of regulated microbiological organisms in potable water. Notification must clearly indicate that a regulatory limit has been exceeded. The date, time, and manner of notification must be documented and kept on file.

(b) A laboratory that accepts potable water samples for analysis must notify its client public water system of the results of all samples that exceed a regulatory limit. Data indicating an exceedance of a regulatory limit must be

validated and the validated data reported as soon as possible, not to exceed 24 hours after the completion of sample analysis. Such notification must be given within 24-hours of the completion of the analysis of the sample whether or not the laboratory accepting the sample subcontracted the analysis to another laboratory.

(c) *Laboratories must identify, in writing, those samples needing special reports (e.g. MCL exceedance) when the laboratory subcontracts with another laboratory.*

(d) *Laboratories accepting samples to be analyzed for the purpose of determining regulatory compliance must ensure that analytical data are reported in a timely manner to meet their clients' reporting requirements. A laboratory that has had regulatory compliance samples subcontracted to it by another laboratory must release analytical data to the client laboratory within the timeline arranged by the laboratories.*

(e) *Laboratories must have written standard operating procedures to ensure that the requirements of 310 CMR 42.13 (5)(a)-(d) are met."*

CON-TEST PROCEDURE TO HANDLE THIS REQUIREMENT:

-Con-test ensures that once all known drinking water MA samples submitted for regulatory compliance have been analyzed, the data is reviewed (validated), and reported in a timely manner to meet the clients' needs, and any MCL exceedance is immediately relayed from the analyst to the Project manager as soon as sample is verified. The project manager then immediately contacts the client's public water system and client (within the 24-hour from analysis requirement), typically by email and relays the MCL exceedance. This email is retained to show date and time of the notification. Drinking water MA samples are not loaded onto instruments on Friday nights and over the weekend, as the process of notification is difficult. Special requests can be done with permission by supervisors. The client must supply contact information for the client and the clients' public water system that can be used over the weekend by the analyst if a notification is needed due to a MCL exceedance.

-Con-Test rarely sub contracts Drinking water MA samples for regulatory compliance, however if the situation comes up, Con-Test will relay to sub lab that MA 310 CMR regulations must be followed and have their data reported in a timely manner to meet our clients' needs as well as be given ample time to be able to let our clients know of a MCL exceedance in the required 24- hour time frame. This will be documented in the Project manager's email. Likewise, if another lab subcontracts to Con-Test we will ensure they have analytical results to report to their clients in a timely manner and within enough time to notify their client within 24 hours from analysis for any MCL exceedance.

When necessary the client is notified and work is recalled when any aspect of the testing and/or calibration work, or the results of the work, do not conform to the procedures or the agreed requirements of the client. Deviations from test and calibration methods shall only occur if the deviation has been documented, technically justified, authorized, and accepted by the client.

13.2 Communication with Regulatory Agencies

It is imperative to maintain effective communication with various Federal, State, and Local regulatory agencies. Con-Test maintains close contact and is constantly reviewing pertinent sources of information such as publications and periodicals etc. for changes in legislation and approved methodology.

13.3 Complaints/Client Inquiries/Comments

13.3.1 Client Inquiries about testing data are handled immediately. All inquiries are documented on Client Inquiry Forms by project chemists who have initial client contact. Any supporting data (e.g. final reports) are attached to the inquiry form, which is forwarded to the QA department for entry into a client inquiry tracking database. The QA staff assigns an investigator, who returns the form with a response.

13.3.2 The investigator checks all appropriate paperwork, computer printouts, log book entries, and calculations associated with the results in question. Sometimes the sample is reanalyzed.

13.3.3 If through the client inquiry investigation, there is an issue with the data, a corrective action is immediately initiated by the QA department. The corrective action shall start with an investigation to determine the root cause(s) of the problem. See section 9.3 and/or the Corrective/Preventative Action SOP for more detail on corrective actions.

13.3.4 The inquiry resolution after being signed off from the supervisor is forwarded back to the QA department where the resolution is logged into the client inquiry tracking database, and the form (with supporting data) is returned to the initiating project chemist. The client is then notified by the project chemist of the response.

13.3.5 If no errors or reasons to suspect the data are found and the sample has not been removed from the laboratory the sample may still be re-analyzed, at the request of the client. If the reanalysis yields substantially different results, there will be no charge for the entire test: otherwise the reanalysis will be charged to the client at the normal rate as a separate sample.

13.3.6 The laboratory shall have a documented process to receive, evaluate and make decisions on complaints.

13.3.7 A description of the handling process for complaints shall be available to any interested party upon request. Upon receipt of a complaint, the laboratory shall confirm whether the complaint relates to laboratory activities that is responsible for and, if so, shall deal with it. The laboratory shall be responsible for all decisions at all levels of the handling process for complaints.

13.3.8 The process for handling complaints shall include at least the following elements and methods:
a) description of the process for receiving, validating, investigating the complaint, and deciding what actions are to be taken in response to it;
b) tracking and recording complaints, including actions undertaken to resolve them;
c) ensuring that any appropriate action is taken.

13.3.9 The laboratory receiving the complaint shall be responsible for gathering and verifying all necessary information to validate the complaint.

13.3.10 Whenever possible, the laboratory shall acknowledge receipt of the complaint, and provide the complainant with progress reports and the outcome.

13.3.11 The outcomes to be communicate to the complainant shall be made by, or reviewed and approved by, individuals not involved in the original laboratory activities in question.

13.3.12 Whenever possible, the laboratory shall give formal notice of the end of the complaint handling to the complainant.

13.3.13 Any and all client complaints or comments are logged into excel spreadsheet database by the project manager of that client. All client complaints are handled immediately. If the issue is just a comment, it is simply logged and noted. If it is a complaint, the project manager will additional notify the QA department to initiate a corrective action. The corrective action shall start with an investigation to determine the root cause(s) of the problem. See section 9.3 and/or the Corrective/Preventative Action SOP for more detail on corrective actions. This notification will be noted in the client complaint/comment database. Routinely the client complaint/comment log is reviewed by client services manager and the QA department.

14.0 References

14.1 Code of Federal Regulations (CFR), Protection of Environment, Title 40, Section 136 & 141, Revised July 1, 1993, 94, 95, 2012, 2016.

14.2 USEPA – Supplemental I of "Methods for the Determination of Metals in Environmental Samples", EPA/600R-94-11, Revised May 1994.

14.3 USEPA – "Methods for Evaluating Solid Waste, Physical/Chemical Methods", Quality Control, 3rd Edition, USEPA November 1990 (SW846).

14.4 USEPA – "Methods for Evaluation Solid Waste, Physical/Chemical Methods", Quality Control, 3rd Edition Proposed Update, USEPA December 1987 (SW846)

14.5 USEPA, Good Automated Laboratory Practices, December 1990.

14.6 APHA – "Standard Methods for the Examination of Water and Wastewater", 1010, 1020, 1030, & 1040, 17th edition, 1989.

14.7 APHA – "Standard Methods for the Examination of Water and Wastewater", 18th, 19th, and 21st, 22nd, 23rd Editions, 1992, 1995, 2005, 2012, 2017.

14.8 AIHA-LAP, LLC Policy Modules reference, September 13, 2011, 2017 and July 2, 2018 updates.

14.9 ACIL Data Integrity Initiative, American Council of Independent Laboratories, January 2003.

14.10 NELAC 2003 Standard Quality Systems Section

14.11 Preventing Improper Laboratory Practices, Advanced Systems, Inc. September 2005.

14.12 ISO/IEC 17025:2017, "General Requirements for the Competence of Testing and Calibration Laboratories", Ref Number ISO/IEC 17025:2017(E), 3rd edition 11/2017.

14.13 ISO/IEC 17025 (2005), "General Requirements for the Competence of Testing and Calibration Laboratories", Ref Number ISO/IEC 17025:2005(E), 2nd edition 2005.

14.14 The NELAC Institute "TNI Standard – Volume 1: Management and Technical Requirements for Laboratories Performing Environmental Analysis", EL-V1-2009-ISO, 2009.

14.15 The NELAC Institute "TNI Standard – Volume 1: Management and Technical Requirements for Laboratories Performing Environmental Analysis", EL-V1-2016-Rev. 2.1, 2016.