

LABORATORY QUALITY ASSURANCE PLAN

SOP #: Lab QA Plan

REVISION #: 8.1

DATE: September 2022

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MassDEP

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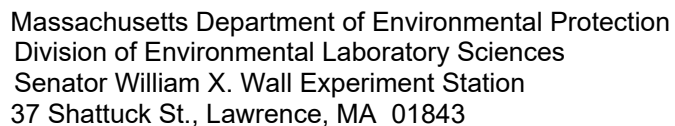
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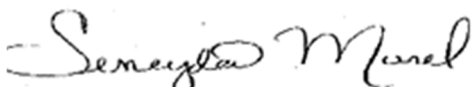
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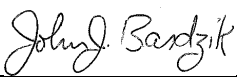
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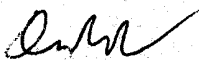
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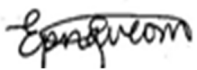
Environmental Laboratory Scientist Reviews

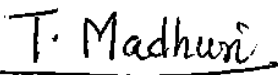
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LIST OF REVISIONS

Rev. #	Date	Description of Revision	Section #
0	March 1999	None	
1.0	December 2000	Extensive revisions/updates throughout document	
2.0	December 2003	Extensive revisions/updates throughout document	
2.5	August 2004	Extensive revisions/updates throughout document in response to U.S. EPA on-site audit of DEA/WES Laboratories, March 25, 2004	
3.0	December 2005	Extensive revisions/updates throughout document	
3.5	May 2007	Added procedure for monthly testing of germicidal effectiveness of UV lamp used for sanitation. Added clarification regarding the replacement of thermometers that have greater than 1°C correction from the NIST-traceable thermometer. Added maintenance procedures for the Quebec colony counter and dissecting microscope. Added required procedure for autofluorescence testing of each lot of bottles used in enzymatic assays (SM 9223). Added required procedure to check the measured volume accuracy of each lot of disposable pre-sterilized pipettes used in microbiological analyses. Added requirement to label each bottle of media with the date received and date opened.	7.4.3.2 7.4.5.1 7.4.7.1 & 7.4.7.2 7.4.8.3 7.4.10 7.4.12.2



Rev. #	Date	Description of Revision	Section #
		Revised procedure for checking the sterility of dilution/rinse water (i.e., inoculated broth is incubated for 48 hours rather than just 24 hours).	7.4.14
		Added format used for technical SOPs.	8.9
		Added required procedure for comparison of colony counts between analysts for each bacterial enumerative method performed each month.	10.1
		Added statement indicating that all PTs for all DEA/WES Laboratories must be analyzed in a manner identical to field samples.	10.2.1
4.0	January 2008	Updated administrative chain-of-command for DEA/WES. Figures 3 through 7 and Table 1 – Added Ann Marie Allen as Acting DEA/WES Deputy Director, and QA Manager. Added labeling information for standard and reagent solutions. Added new procedure for maintaining traceability of standards/reagents to specific analytical QC batches. Updated procedure for analytical records storage and retention. Forms 1 through 11 – Removed from the Laboratory QA Plan and provided links to the separate stand-alone documents. Other minor revisions/updates throughout document.	1.2 & 3.1 3.2.2 & 20.0 7.3.4 7.3.5 18.0 20.0
4.1	April 2008	Figures 1 & 2 – Updated organizational charts. Table 8 – Updated List of SOPs	20.0 20.0
5.0	August 2010	Major revisions/updates throughout document Figures 1 & 2 – Updated organizational charts Figures 3 through 7 – Deleted, same information found elsewhere in the document Tables 1 through 6 – Updated Tables 8 through 12 – Updated	20.0 20.0 20.0 20.0
5.1	October 2012	Figure 1 and 2 – Updated Org Chart Table 1 – Updated Laboratory Equipment List Table 3 – Updated Laboratory Equipment List Table 6 – Changes to equipment calibration procedure Table 7 – Changes to instrument maintenance procedures Table 8 – Added several SOPs Table 9 – Added 2 methods to the Potable Source Water and Not Potable Water Samples Section that were missing in previous versions. Also, sample temperature requirement changed from < 10°C to < 8°C in same section. Other minor revisions/updates throughout document	20.0 20.0 20.0 20.0 20.0 20.0 20.0
5.2	December 2012	Changes throughout document to reflect transition from using EPA Method 524.2 to EPA Method 524.3	



Rev. #	Date	Description of Revision	Section #
		Table 5 – Updated for clarity	20.0
6.0	February 2016	Changes throughout document to reflect staff re-assignments, change of division name from Division of Environmental Analysis (DEA) to Division of Environmental Laboratory Sciences (DELS), and numerous other major changes to update document.	
7.0	February 2019	Numerous changes throughout to update document	
8.0	December 2020	Corrected the acceptance criteria for the balance weight deflection test <i>Klebsiella pneumoniae</i> changed to its new taxonomic nomenclature, <i>Klebsiella variicola</i> Numerous other changes throughout to update the document related to staff changes, instrumentation changes, and procedural changes related to switching from the previous LIMS (Sample Master) to new LIMS (WinLIMS).	7.4.6.3 7.4.12.7
8.1	September 2022	Moved document repository from W drive to WES-DELS SharePoint Simplified organizational structure Clarified use of qualifiers Clarified COC use Changed acceptable temperature for microbiology samples to 1 to < 10°C Clarified login procedure Added procedure to transfer samples to an outside laboratory Changed qualifier between MDL and MRL to “M” Updated SOPs Deleted QA Review SOP (See QA Plan Rev. 8.1, Section 9.2) Consolidated Training Forms Added COC SCRF WinLIMS SOP Added Login Preservation Check Form Added Preservation Bench Sheet Form	Throughout 1.3 4.4 5.2.6 6.2.3 6.2.9 6.6 9.2.8 TABLE 8 FORMS and REPORT



1.0 INTRODUCTION

1.1 History of the Wall Experiment Station (WES)

The Massachusetts Department of Environmental Protection's (MassDEP's) historic Senator William X. Wall Experiment Station (WES), formerly the Lawrence Experiment Station, was founded in 1887 by the Massachusetts State Board of Health to conduct research leading to the development of practical methods for treating sewage, industrial wastes, and public drinking water supplies. The research conducted at WES laid the foundation for modern methods of wastewater treatment and drinking water purification (1-3). The Station is internationally recognized as one of the first laboratories in the world and the first in North America dedicated to environmental research. In 1975, WES was designated a National Historic Civil Engineering Landmark by the American Society of Civil Engineers.

1.2 Current WES Mission & Programs

WES houses the state environmental reference laboratory for the Commonwealth of Massachusetts. The Station is also designated as the state principal drinking water laboratory as required for primacy under the Safe Drinking Water Act. Massachusetts and other states with federally delegated authority under the Act are required to establish and maintain a state principal laboratory.

A 13,000 square foot laboratory wing, completed in 2011, has been added to the original 22,000-square foot WES facility that was built in 1952 and was completely renovated in 2011. The facility located along the Merrimack River in the heart of Lawrence at 37 Shattuck Street, houses 40 scientists, engineers, and support personnel in two organizational units of the MassDEP – i.e., the Division of Environmental Laboratory Sciences (DELS) under the Bureau of Planning and Evaluation, and the Air Assessment Branch (MassDEP AAB) under the Bureau of Air and Waste. The facility also houses OSHA Consultation Program staff of the Massachusetts Department of Labor Standards (Mass DLS), including the Consultation Program's Industrial Hygiene Laboratory.

The primary mission of WES is to provide technical and laboratory support to all MassDEP programs. WES scientists and engineers analyze water, wastewater, air, soil, hazardous wastes, fish, and other samples for all the important environmental contaminants in support of MassDEP's resource protection, waste prevention, and waste site cleanup programs. Environmental monitoring data generated by WES are used across all MassDEP programs to: 1) Make operational and programmatic decisions; 2) Directly support major criminal and civil enforcement actions; 3) Support investigations which result in the identification of pollution sources which then become the subject of enforcement; and 4) Measure the success and environmental impact of protection efforts.

1.3 Division of Environmental Laboratory Sciences (DELS)

The DELS is organized into three laboratories [i.e., Environmental Microbiology and Toxicology Laboratory (EMTL), Environmental Inorganic Chemistry Laboratory (EICL), and Environmental Organic Chemistry Laboratory (EOCL), the Laboratory Certification Program, and the Laboratory Quality Assurance & Data Management Program. The approximately 15,000 laboratory analyses performed by DELS annually are largely associated with enforcement cases and special environmental monitoring studies managed by MassDEP regional and program staff. DELS's laboratory and other technical support play a critical role in the Environmental Strike Force's investigation and prosecution of environmental crimes, in water quality assessments conducted by the MassDEP Division of Watershed Management, and in investigations and cleanup of hazardous waste sites and landfills.

DELS is also heavily involved in the development and validation of new analytical methods that better characterize the environment and are more protective of the environment and public health. For example, the Massachusetts Volatile Petroleum Hydrocarbon (VPH) and Extractable



Petroleum Hydrocarbon (EPH) Methods were developed by DELS and are now used by Massachusetts and numerous other states and Canadian provinces to more accurately assess petroleum-contaminated water and soil. DELS also conducts basic and applied research dealing with the elucidation of the fate and impacts of contaminants in the ecosystems of Massachusetts and with environmental performance testing of new innovative technologies proposed for use in Massachusetts.

It should be noted that, in Massachusetts, the bulk of environmental samples are collected and analyzed by contractors working for those who are regulated by MassDEP. Unlike state principal laboratories in many other states, MassDEP/DELS-WES does not usually analyze routine compliance monitoring samples from public water supplies and other facilities. Instead, MassDEP/DELS-WES certifies commercial and municipal laboratories to perform the routine compliance analyses and focuses its own analytical capabilities on enforcement and other critical samples. The MassDEP Laboratory Certification Program, which certifies commercial and municipal environmental laboratories, is the largest such program among the New England states. Over 90 laboratories in Massachusetts and other states are certified by DELS-WES for chemical and/or microbiological analyses of potable and/or non-potable water. Through the Laboratory Certification Program, educational outreach, and other activities, DELS-WES plays an important role in ensuring that contractors collecting and analyzing environmental samples are producing high-quality monitoring data.

2.0 PURPOSE OF PLAN

The purpose of this laboratory quality assurance (QA) plan is to document and describe the analytical and QA procedures that the DELS-WES laboratories use to produce scientifically valid and legally defensible data. The QA plan references all the analytical and other standard operating procedures (SOPs) used by the three DELS-WES laboratories, and it addresses all elements of the analytical process from sample collection to sample analysis. This QA plan does not apply to the activities of MassDEP AAB or Mass DLS.

3.0 LABORATORY ORGANIZATION AND PERSONNEL RESPONSIBILITIES

3.1 Introduction

This section describes the organization of DELS-WES, and the background and responsibilities of DELS-WES technical personnel. The DELS-WES Director reports to the Director of the MassDEP Office of Research and Standards who, in turn, reports to the Assistant Commissioner for the MassDEP Bureau of Planning and Evaluation (BPE). The Assistant Commissioner for BPE reports to the Deputy Commissioner for Policy and Planning who, in turn, reports directly to the MassDEP Commissioner. The organizational chart for the Division of Environmental Laboratory Sciences (DELS), Wall Experiment Station (WES) is included in Figure 1.

3.2 Personnel

A list of all DELS-WES technical staff with educational background, present specialty, and principal responsibilities is provided in Table 1.

4.0 QUALITY ASSURANCE OBJECTIVES

4.1 Introduction

The DELS-WES QA program has been designed to ensure full compliance with USEPA protocols and procedures. The quality assurance plan for DELS-WES lists the laboratory's standard operating procedures, and analytical methodologies and procedures, required sample volumes, and holding times. The DELS-WES quality assurance plan addresses the required elements in the USEPA *Manual for the Certification of Laboratories Analyzing Drinking Water* (5th edition) as well as those in the USEPA *Quality Assurance Project Plans for Environmental Data Operations* (EPA



QA/R-5). The DELS-WES quality assurance plan will be continuously updated to reflect new changes in analytical methodologies that are promulgated by the U.S Environmental Protection Agency.

4.2 Objectives

DELS-WES has developed the following quality assurance objectives as part of its quality assurance program for environmental analytical testing:

- 4.2.1 Use approved methods for the analysis of drinking water, wastewater, hazardous waste, and air samples, and other matrices.

When requested for health and safety emergency purposes, DELS-WES may run a modified method. In these cases, the modifications are documented in the final report.

When developing new methods or non-standard testing for emerging contaminants, DELS-WES incorporates QC consistent with similar methods which have been approved by the U.S. EPA or other regulatory bodies.

When similar approved methods do not yet exist, DELS-WES incorporates QC consistent with laboratory industry standards or peer-reviewed published literature.

- 4.2.2 Ensure sample integrity and chain of custody.

- 4.2.3 Continuously assess the quality of data generated by the laboratory.

- 4.2.4 Maintain the overall quality of laboratory performance by the use of quality control checks (i.e., spikes, duplicates, blanks, calibration standards, and performance evaluation samples).

- 4.2.5 Reject and re-evaluate data that fall outside of control limits.

- 4.2.6 Maintain accurate records of analysis.

- 4.2.7 Maintain a record of instrument performance as a basis for validating data.

- 4.2.8 Produce analytical results that can withstand legal scrutiny.

- 4.2.9 Adhere strictly to the principles of good laboratory practice.

- 4.2.10 Consistently develop, maintain, update, and use standard operating procedures (SOPs).

4.3 Definitions

- 4.3.1 Quality Assessment: Procedure for determining the quality of laboratory measurements by use of data from internal and external quality control measures.

- 4.3.2 Quality Assurance: A definitive plan for laboratory operation that specifies the measures used to produce data of known precision and bias.

- 4.3.3 Quality Control: Set of measures used within an analytical method to assure that the process is in control.



4.4 Data Qualifications

DELS-WES maintains a wide range of qualifier codes to use when qualifying data. The purpose of the extensive list of codes is to provide data users with sufficient information in a standardized format for data validation decisions.

- When required, DELS-WES attaches the qualifier code to the field sample result.
- When a QC sample result does not meet acceptance criteria, DELS-WES adds the appropriate qualifier to the associated field samples. The associated field samples are those samples on the same analytical batch that are not bracketed by other QC of the same type that are within acceptance limits.
- When a matrix spike or duplicate sample does not meet acceptance criteria, only the associated parent/original sample is qualified.

As new technologies are implemented or as new method requirements are published, DELS-WES will add new standardized codes as needed.

A glossary of all DELS-WES active qualifiers is included at the end of every final report. Examples of the Glossary of Qualifier Codes can be found at the end of the final reports included as Report 1 and Report 2.

5.0 SITE SELECTION AND SAMPLING PROCEDURES

Laboratory personnel at the Wall Experiment Station are not directly involved with sampling and site selection. MassDEP personnel, subcontractors, or scientists associated with MassDEP projects are directly involved in the selection of sampling sites and analytical parameters. Laboratory analysts are aware of the potential quality control problems that may arise as result of improper selection of sampling and analytical methods. The laboratory encourages communication between laboratory and field personnel to design, develop, and implement correct sampling, preservation, and analysis procedures prior to initiating field activities.

5.1 Sample Collection Procedures

Sampling procedures include charts, maps, sample tables, designated sampling equipment and locations. Procedures also address the frequency of sample collection, the total number of samples to be collected, the number of quality control samples, and site-specific decontamination procedures. Method or matrix specific sample handling requirements are reviewed during the initial communication, and subsequently as needed.

- DELS-WES uses a cloud/web-based LIMS, called WinLIMS, from Quality Systems International Corporation, Ramsey, NJ, to manage samples from pre-log through results reporting. When DELS-WES provides a customer with sample containers and coolers prior to collection, a MassDEP sample label is affixed to each sample container.
- For non-pre-logged samples, the information required on the sample label are the Client ID, the Client Sample ID, and sufficient information from the Client Sample Description to uniquely identify each sample within the login batch.
- For pre-logged samples, the minimum required information is the Client ID, the Client Sample ID, and the WinLIMS generated Login #, Sample ID.
- Other pertinent sample tracking and identification data are recorded by field personnel on the MassDEP Sample Tracking/Chain-of-Custody Form (COC). See Form 1 for an



example of a blank COC used for non-pre-logged batches. See Form 2 for an example of a COC for a pre-logged batch as generated from WinLIMS.

5.2 Sample Containers, Holding Times, and Preservation Procedures

DELS-WES requires the use of the correct, pre-cleaned, single-use sample containers, and preservation reagents as part of a valid sample collection protocol. Samples are collected in the container (plastic or glass) specified in the SOP of the analytical method. The laboratory analyzes samples within the holding times established by the respective U.S. EPA program or by the U.S. EPA-approved analytical method (see Tables 9-12).

5.2.1 Sample Handling Protocol, Wall Experiment Station

The following briefly outlines current procedures for scheduling sample analysis at DELS-WES; distribution of sample containers and sampling supplies to the regions/programs; and transportation of collected samples back to DELS-WES for analysis. These procedures are updated as necessary as the MassDEP Laboratory Information Management System (LIMS) is more fully integrated into the department's programs.

5.2.2 Scheduling of Sample Analysis

When possible, requests for scheduling of analytical services should be made to DELS-WES well in advance of the sampling event. Requests for analysis should be communicated to the appropriate laboratory supervisor(s). If needed, DELS-WES staff are available to discuss aspects of sampling project plans, but all clients are asked that all formal requests for analyses be made via e-mail. All requests should include: the project name/site where applicable, the number of samples to be collected, the sample analytes, the sample matrix, the projected sampling dates, and if the project is to be charged to any account. DELS-WES laboratory supervisors will confirm via email that their laboratory has the capacity to accept the samples based on the client's projected schedule.

If the projected sampling schedule would result in samples arriving at WES when the sample holding time has elapsed or when the DELS-WES laboratory would not be able to complete the analysis without exceeding the prescribed holding time, DELS-WES will assist the client in transferring the sample(s) to a qualified laboratory for analysis within the holding time.

DELS-WES must identify holding time issues and communicate with its clients as early as possible to allow time for samples to be sent to another laboratory for analysis before the expiration of the sample holding time. Where possible, sample holding time issues are to be identified before sample delivery to DELS-WES so that the samples can be delivered directly to another qualified laboratory. The client has the option to request that DELS-WES continue to process the samples even though the results will be qualified for exceeding holding time. This request needs to be in writing either via email or noted on the COC before the samples are received.

5.2.3 Sampling Supplies

When requested, DELS-WES will provide appropriate pre-cleaned sample containers, disposable sampling equipment, sample preservation reagents, cold-packs, coolers, sample tracking/chain-of-custody forms, and sample labels (see Sample Custody). All necessary supplies will be sent to the regions or other client specified location by



MassDEP courier or commercial delivery service. If convenient, supplies can also be picked up at WES by field personnel. Personal protective equipment (PPE) is the responsibility of field personnel.

5.2.4 Sample Custody

DELS-WES is using a Sample Tracking/Chain-of-Custody form (see Form 1 and Form 2 for examples) that has been distributed to the MassDEP Boston and regional offices electronically. The form and the sample labelling procedures described in 5.1, are used to maintain proper sample custody, and must be completed for all sampling events. Careful completion of the form is important.

5.2.5 Sample Transport

Samples can be transported to WES by the sample collector, by courier, or by a commercial overnight delivery service. If overnight delivery service is required, DELS-WES will provide a FEDEX or UPS number and pay for the cost of delivery. Arrangements for sample delivery to DELS-WES should be made during sampling plan development and confirmed with DELS-WES when requests for analytical services are made. Samples for bacterial analysis, other than for finished drinking water, must be analyzed within 8 hours of sample collection (usually 6-hour field holding time + 2 hours in the laboratory for filtration/preparation and incubation).

5.2.6 Sample Handling Procedures for Environmental Strike Force and Other Enforcement Samples

Environmental Strike Force (ESF) or Other Program/Region - Sample collector needs to:

1. Where the samples are not pre-logged, place labels on bottles and bottle lids prior to collection; write in the information described in Section 5.1 on the bottle label and corresponding lid label. Where the samples are pre-logged, prior to collection, place preprinted labels on both the bottle and the bottle lid. In both cases, once the bottles are appropriately labeled; place samples in plastic baggie.
2. Place any extra unused labels in a separate baggie in the cooler for return to WES to be reused.
3. Fill the cooler with one large liner size baggie, place the bagged samples, the bagged tags, and plastic packing material to prevent bumping of bottles inside the cooler.
4. If the samples are to be delivered by someone other than the sample collector, use custody seal tape on the outside lid of the cooler to secure the samples inside.
5. Complete the "Relinquished By" section on the Chain-of-custody form.
6. Deliver samples directly to DELS-WES or bring the samples to the MassDEP Boston or regional office mailroom on the day of courier service to Lawrence. Coordinate the schedule with the courier to ensure that the samples arrive at WES within appropriate holding time and appropriately cooled.

Mail Courier



1. Complete the "Received By" section, including the date and time, on the chain-of-custody form (when samples are received).
2. Deliver the cooler to the Wall Experiment Station (WES).
3. Sign off as "Relinquished By" on the chain-of-custody form, (when samples are turned over to DELS-WES).
4. After DELS-WES removes samples from cooler, take the cooler back to the MassDEP Boston or regional office.
5. Upon return to the MassDEP Boston or regional office, call the Environmental Strike Force or other program to have cooler picked up.

Wall Experiment Station

1. Break the custody seal on the outside lid of cooler if present. If seal has been broken during shipment, please call the ESF or region/program immediately.
2. Measure the temperature of each cooler and record it on the chain-of-custody (COC) form.
 - a) A single login batch of samples may arrive in up to 4 different coolers.
 - b) At sample receipt, the coolers are arbitrarily designated as cooler 1, 2, 3, or 4.
 - c) The temperature of each cooler is taken and recorded on the COC.
 - d) Each cooler's designation is recorded on the samples removed from that cooler.
3. Remove the whole baggie full of bagged samples from the cooler.
4. Check samples against the (COC) form to confirm that the information on the bottle labels are correctly transcribed onto the COC; this includes confirming the # of samples, # of bottles per sample, and the preservation code. If possible, ask the sample relinquisher to address any issues or omissions at the time of delivery. If any discrepancies are identified that cannot be immediately resolved, call the ESF or region/program contact immediately. Note the discrepancies on the COC form, then sign the form, including the date and time.
5. Retain the COC form and return the cooler to the courier/relinquisher.
6. Assign a Login # and Samples IDs by entering the batch into WinLIMS. Record the Login # and respective Sample IDs on the COC and complete the COC form.
7. In WinLIMS, record the cooler designation and the cooler temperature for each sample.
8. A representative from each laboratory receiving samples completes the applicable section of the Sample Conditions Review Form (SCRF) which is then filed with the login batch. If any representative notices an issue with the samples, that representative should record the observations on SCRF Page 2, and check the 'Yes' box on Page 1 indicating notes were recorded. If no issues were identified by any representative, the last representative completing the form should check No on Page 1 indicating no notes were recorded.



9. Scan the completed COC and SCRF, then email the PDF scan to the ESF or region/program enforcement or project contacts.

5.2.7 Sample Containers

When requested, DELS-WES provides new certified pre-cleaned contaminant-free sample containers, either borosilicate glass, high-density polyethylene (HDPE), polypropylene, or sterile HDPE (for microbiological analyses), to all clients. All containers are purchased from vendors and used only once. All clients are instructed to only use new sample containers provided by DELS-WES or directly purchased from vendors specified by DELS-WES. The containers provided are of the appropriate size to obtain enough sample volume for performing the analysis and the associated QC procedures such as duplicates and matrix spikes. As a general rule, the field collector should collect 2.5 times the sample amount needed for the analysis. The collector should adhere to the following field sampling procedures, as well as to any additional method-specific sampling requirements:

1. Some samples must be collected in several containers as only one analysis is performed per container.
2. Samples for volatile organic analysis must be obtained in duplicate glass vials with a Teflon®-faced silicone cap liner and no headspace.
3. Non-volatile organics are collected in amber glass containers with a Teflon-lined cap or polypropylene containers.
4. Microbiological samples must be obtained in sterile containers.
5. Metals are normally collected in HDPE containers as glass can exchange out metals' ions. Mercury in elemental form will pass through the walls of an HDPE container and should be collected in glass.
6. PFAS samples must be collected and shipped under PFAS specific protocols, including being in shipped/transported in a separate PFAS only cooler.

5.2.8 Preservatives

When requested, DELS-WES provides preservatives in separate containers, pre-added to provided sample containers, or single sample ampoules to clients for all sampling events. Preservatives are used to maintain the integrity of target analytes in the sample. A common preservation practice is storage at cold temperature, normally $4 \pm 2^{\circ}\text{C}$. Storing the samples in a polyethylene ice chest with ice or frozen gel packs provides the necessary cold temperature. Most solid samples require only cooling as a preservative. Water samples are subject to a variety of specific preservation techniques, depending on the target analytes and analytical methods. Preservatives can consist of chemical additives, such as acids or bases added to control pH, ascorbic acid or thiosulfate added to reduce the effect of residual chlorine and other oxidizers, etc.

5.2.9 Holding Times

The holding time allowed until sample analysis is of critical analytical and regulatory importance. Even when samples are correctly preserved and stored, analytes can degrade and be lost if the sample holding time is exceeded. All analytes have required



holding times ranging from immediate analysis for dissolved oxygen to up to 6 months for metals (except 28 days for mercury).

6.0 CHAIN-OF-CUSTODY, SAMPLE LOG-IN, SAMPLE CUSTODY, AND SAMPLE DISPOSAL PROCEDURES

6.1 Chain-of-Custody Procedures

- 6.1.1 For enforcement or other purposes, it is necessary for field personnel to collect samples under the chain-of-custody protocol. MassDEP policy requires that samples be collected under chain of custody if the: 1) Samples are taken as part of an enforcement action; 2) Samples have a potential for litigation; and/or 3) Samples are part of hazardous waste cleanup activities. However, DELS-WES policy requires that ALL samples submitted for analysis to DELS-WES be collected under chain of custody with proper sample transfer sign-off documented on the *WES Sample Tracking/Chain-of-Custody Record* (see Form 1 and Form 2).
- 6.1.2 MassDEP follows the U.S. EPA's National Enforcement Investigations Center (NEIC) definition of chain of custody. The chain-of-custody documentation procedure begins in the field at the time of collection. A sample is considered under chain of custody if it meets the following criteria: 1) It is in your possession; 2) It is continuously in your view, after being in your possession; 3) It was in your possession and then you locked it up to prevent tampering or it is in a designated secure area; and 4) A chain-of-custody form accompanies the sample from the field to the laboratory.
- 6.1.3 Each COC is assigned a unique identifier (WinLIMS Login #) where the first 4 digits represent the year the batch record was created. The collection of samples on a given COC are collectively referred to as a Login Batch.

6.2 Sample Log-in Procedures

This section addresses the laboratory's sample receipt, log-in, and custody procedures. Samples collected by field staff are brought to the DELS/WES sample receiving areas for inspection and LIMS log-in. Samples are also delivered by commercial overnight courier services. All incoming samples are evaluated against the following criteria:

- 6.2.1 Proper sample container
- 6.2.2 Proper sample volume
- 6.2.3 Proper sample preservation – i.e., chemical and/or thermal ($4 \pm 2^{\circ}\text{C}$ for chemistry samples and 1 to $< 10^{\circ}\text{C}$ for microbiology samples) preservation. (See Login Preservation Checklist)
- 6.2.4 Correct date and time of sampling
- 6.2.5 Properly completed sample identification
- 6.2.6 Properly documented chain-of-custody form
- 6.2.7 Recording of internal temperature of each sample cooler in the MassDEP Sample Tracking/Chain-of-Custody Form.
- 6.2.8 Compliance with sample holding times as per EPA methods



- 6.2.9 If any of the above information is questionable, the DELS-WES staff member logging the samples will contact the respective laboratory supervisor as to whether or not to accept the samples. The supervisor will then immediately notify the DELS-WES Director, Laboratory Quality Assurance (QA) & Data Manager, and the client's project manager and/or point of contact to inform them of any sampling protocol deviations. If the project manager and/or point of contact still wants the samples to be analyzed, they are informed that the data produced will be qualified regarding the sampling deviation in the final analytical report.

Once a sample is in-house (i.e., it has been logged in), if a quality assurance issue is identified regarding that sample, including the potential for a holding time violation, the laboratory supervisor must immediately notify the DELS-WES Director and Laboratory QA & Data Manager. The laboratory supervisor must then telephone the project manager and/or point of contact to inform them of the quality assurance issue. The laboratory supervisor will then follow the telephone call with an email to the project manager and/or point of contact, with read-receipt requested (or equivalent confirmatory documentation), describing the quality assurance issue. The laboratory supervisor must copy the DELS-WES Director and Laboratory QA & Data Manager, and any other appropriate persons on the email and save the email with read-receipt tracking/documentation in the DELS-WES login folder for the sample(s). The laboratory supervisor must add comments describing the issue(s) in the login record in WinLIMS. Sample level comments should be added to the sample record for issues that only apply to a subset of samples. Issues related to the entire login batch should be documented in the login level comment field.

If a sample is rejected for QC issues prior to analysis, and needs to be resampled, the replacement sample is assigned the same sample ID as the original. A copy of the COC is annotated that the sample was recollected, and the COC is marked up with changes such as a new collection date/time, or collector. This information is updated in WinLIMS. When the new sample is received, the receipt for the recollected sample is documented on a new relinquisher/receiver line on the COC. The previous sample should be disposed of immediately.

For samples from the Watershed Planning Program (WPP) of the Division of Watershed Management (DWM), the laboratory supervisor will send emails regarding any quality assurance issues with read-receipt requested to the WPP QA Officer and copy the DELS-WES Director and Laboratory QA & Data Manager, the Director of the MassDEP Office of Research and Standards, BPE Assistant Commissioner, DWM Director, and WPP Director. The emails will describe the nature of the QA issue and be saved with read-receipt tracking/documentation in the DELS-WES Login folder for the sample(s).

SAMPLE CONDITIONS THAT CAN RESULT IN SAMPLE REJECTION OR DATA QUALIFICATION			
WES Laboratory	Applicable Analytical Method	Conditions where sample rejection applies	Conditions where data qualification applies
Microbiology Laboratory	All	Improper sample container (not sterile) or leaking/broken container	Holding time exceeded Insufficient sample volume or not



SAMPLE CONDITIONS THAT CAN RESULT IN SAMPLE REJECTION OR DATA QUALIFICATION			
WES Laboratory	Applicable Analytical Method	Conditions where sample rejection applies	Conditions where data qualification applies
			enough head space
	All drinking water methods	Failure to properly dechlorinate chlorinated finished drinking water samples	
	All non-potable water methods	Failure to dechlorinate chlorinated wastewater effluent samples	
	All source water and non-potable water methods		Failure to properly cool the samples to 1 - <10°C during shipment.
Inorganic Chemistry Laboratory	All	Improper preservation (e.g., wrong acid, acid when there should not be, cyanide samples not preserved with hydroxide, etc.); insufficient sample quantity.	Holding time exceeded; insufficient sample quantity; containers and/or caps broken or leaking; caps loose; sample collected in improper container.
Organic Chemistry Laboratory GC & HPLC Section	All	Samples collected in plastic containers, except for the collection of tissue samples where HTPE and PP containers free of target are used.	Holding time exceeded
		Container caps are broken or loose	
		Insufficient volume or sample quantity	
Organic Chemistry Laboratory MS Section	Volatiles (VOCs): EPA 524.3, EPA 8260D	Vials not tightly capped	Holding times exceeded.
		Samples not collected in VOA borosilicate glass vials; for EPA 524.3, not collected in amber VOA vials with preservative	
		Air bubble in vial larger than a pea size bubble (6mm in diameter)	
	THM analysis: EPA 524.3	Sample not preserved with dechlorinating agent (ascorbic acid)	
	Soils/sediments EPA 8260D	Sample not preserved in the field with methanol or frozen	



SAMPLE CONDITIONS THAT CAN RESULT IN SAMPLE REJECTION OR DATA QUALIFICATION			
WES Laboratory	Applicable Analytical Method	Conditions where sample rejection applies	Conditions where data qualification applies
		at time of collection until delivered to lab	
	Semivolatiles (SVOCs): EPA 525.2, EPA 8270E	Samples received in non-amber containers	Holding times exceeded
		Samples received in plastic containers except for the collection of tissue samples where HTPE and PP containers free of target analytes are used.	
	1,4-Dioxane: EPA 522	Samples not preserved with dechlorinating agent (sodium sulfite) and to pH < 4 with sodium bisulfate; samples received in non-amber containers.	
	EPA 537	Sample collected in a container other than polypropylene.	Not collecting FRB from each site. Sample collected without preservative. Insufficient volume to conduct LFM and/or DUP or LFMDup.
	EPA 537.1 and 533	Sample collected in a container other than polypropylene.	Not collecting FRB from each site. Sample collected without preservative. Insufficient volume to conduct LFM and/or DUP or LFMDup.

- 6.2.10 After the samples have been evaluated for the correct information, the samples are logged into the MassDEP/WES LIMS. Sample login is not assigned to one person; rather, any available trained laboratory staff member can log in samples. Usually, however, laboratory personnel check the physical conditions of the samples and the administrative program coordinator enters the data into the LIMS. A unique sample identification number (Sample ID) is assigned to each sample by the LIMS. The Login # and the Sample ID is entered on the MassDEP Sample Tracking/Chain-of-Custody Form. The first two digits of the Sample ID represent the year the sample record was created. The sample is then placed in the sample custody refrigerator and eventually withdrawn for analysis by laboratory staff.



6.3 Sample Custody Protocol

Access to the WES building is strictly limited to authorized personnel. Non-DEP visitors must sign in at the WES front office and be escorted by a WES employee during the entire visit. All samples must be properly identified with a sample label and with the Sample Tracking/Chain-of-Custody Form containing all of the required information regarding the sample. To establish tracking control and documentation of samples in the laboratory, the following procedures have been established:

- 6.3.1 Incoming samples are received by laboratory personnel who indicate receipt by signing and dating the Sample Tracking/Chain-of-Custody Form. Laboratory personnel receiving the samples are responsible for noting the condition of the samples, including temperature at receipt and any other preservation used and then completing the SCRF. From information on the chain-of-custody form, laboratory personnel mark those samples to be disposed 30 days after the analysis report has been sent out and those to be held until further notice depending on the client's requirements. The 30-day pre-approval notice meets the written permission requirement described in Section 6.3.4 below.
- 6.3.2 After the samples have been received, the samples are either taken directly to the laboratory that will perform the analysis or immediately placed in refrigerators or freezers (for fish tissue samples) in the DELS-WES Sample Storage Laboratory. The Sample Tracking/Chain-of-Custody Form and the SCRF are given to the administrative program coordinator for entry into WinLIMS. All refrigerators and freezers used to store environmental field samples are located in laboratory areas that have controlled card access and only selected laboratory employees have access to these areas; the WES security system electronically records the following information each time a WES employee enters a card accessed laboratory/room: Employee ID, date, and time.
- 6.3.3 Laboratory personnel are responsible for the care and custody of samples handed to them or that they remove from a sample custody refrigerator. The samples shall be handled by a minimum number of laboratory staff members. Within each laboratory, chain-of-custody samples must be stored in a refrigerator within an accessed controlled room except when being tested. All samples are stored at all times under conditions specified in their respective analytical methods, and are isolated from other samples, reagents, and standards that could cross-contaminate them.
- 6.3.4 Once the analyses have been completed, and sample data verified and reported, the unused portion of the chain-of-custody sample is kept in an accessed controlled refrigerator or freezer in the laboratory that analyzed the sample or in the DELS-WES Sample Storage Laboratory until written permission for disposal is obtained from the MassDEP region or program that submitted the sample(s). At that time, if the sample is hazardous, it will be transferred to the WES Hazardous Waste Storage Room which is kept locked at all times (note: the DELS-WES Director, Laboratory QA & Data Manager, and laboratory supervisors and analysts have card key access to this room). Chain-of-custody samples shall remain locked in this room until they are removed for disposal by a hazardous waste management contractor.

6.4 Laboratory Sample Control and Tracking Procedures

The documentation of a laboratory's sample control and tracking procedure is important in order to:

- Trace a test sample from the field to the final results.
- Describe the sampling and analytical procedures used by the laboratory.



- Support the laboratory's level of detection.
- Support the laboratory's quality assurance practices.

- 6.4.1 When the samples are delivered to the respective DELS-WES laboratory, laboratory personnel will check the samples for: requested analyses, correct sample volume and collection, proper preservation procedures, proper sample container, sample source, collector, and properly documented sample label. If the samples are deficient in any of the required information, the laboratory supervisor has the final discretion in accepting the samples for analysis.
- 6.4.2 When the analytical work on the samples has begun, instrument printouts, and/or sample analysis bench sheets become the documentary linkage between analysis and final data reports. All hand entered information in these documents are made using black ink and dated. The analyst initials the top of the first page of each document or report or document/report subsection where applicable. When analyses are completed, any non-instrument reported final analytical data are transferred to the sample bench sheet. Information from the sample bench sheet or from the instrument report are then entered into the LIMS for the generation of the final analytical report directly from the LIMS.
- 6.4.3 After the analytical results have been reported, the laboratory report becomes part of the WES record system and is stored for 10 years.

6.5 Protocol for Disposal of Hazardous Waste Samples

It is the policy of DELS-WES that all hazardous waste samples be disposed of properly. The laboratory uses the following protocol for the disposal of hazardous waste materials and chain-of-custody hazardous waste samples.

- 6.5.1 A licensed hazardous waste management contractor is used for the safe, legal, and proper disposal of hazardous materials generated by the laboratory. DELS-WES maintains a hazardous waste facility for the storage of hazardous waste materials. The facility is locked at all times and is accessible only to authorized personnel via card access. The facility has a continuously operating ventilation system that exhausts any vapors to the outside. The types of materials stored in the room include waste oils, caustic and corrosive liquids, waste solvents, PCBs, metals, and laboratory reference standards.
- 6.5.2 Materials placed in the hazardous waste facility are documented in the Sample and Hazardous Waste Inventory found at W:\WES All\EMS-Sample & Waste Mgt\Sample & Haz-Inf Waste Inventory & Disposal\Disposed\ HW Room Inventory 2020.xlsx.
- Types of information that must be included on the manifest each time samples are deposited in the facility are: the date, container number, size of the container, the sample matrix, contents of the container and its markings, and name of the person depositing the materials.
- 6.5.3 Hazardous waste samples with high concentrations of toxicants (e.g., PCBs in concentrations greater than 50 ppm) must be placed in metal cans, packed with vermiculite, and sealed. The outside of the container is then marked with the identified substance and its concentration.
- 6.5.4 Waste organic solvents are placed in a drum supplied by the hazardous waste management contractor. Waste reference standards are placed in specially marked



containers dedicated for analytical standards. Inorganic wastes are placed into a separate 55-gallon drum supplied by the hazardous waste management contractor. The first person to add waste to a drum must write the date on the label to indicate the date when accumulation began. The drums are labeled with the types of waste chemicals contained and placed in the hazardous waste storage room. Great care is taken to avoid mixing reference standards and waste solvents due to current disposal regulations.

- 6.5.5 Bacteriological plates or broths that contain active cultures are autoclaved for 30 minutes prior to their disposal.

6.6 Transferring Samples to Outside Laboratories

Occasionally, DELS-WES needs to transfer received samples to an outside laboratory for analysis. This can occur when samples are sent to DELS-WES in error; when an instrument breaks-down or has other QC issues which cannot be corrected within sample holding time; or when trained analysts are not available to perform the analysis within holding time.

In these cases, DELS-WES staff follow the Transfer to Outside Laboratory SOP, which provides for maintaining the Chain-of-Custody record for the samples and transparently documenting the transfer to the outside laboratory within WinLIMS.

7.0 INSTRUMENT CALIBRATION PROCEDURES

7.1 Instruments

Numerous laboratory instruments are available in the DELS-WES laboratories to perform complex analytical tests required by the MassDEP regions and programs and to maintain USEPA certification as a state principal laboratory under the Safe Drinking Water Act. The laboratory instruments available at DELS-WES are listed in Tables 2 through 5.

7.2 Specialized Glassware

DELS-WES uses specialized glassware for designated analytical tests. DELS-WES uses only "Class A" volumetric flasks, pipettes, and burettes for preparing and delivering standards and reagents as well as for making dilutions in all inorganic and organic chemical analyses. "Class A" glassware (marked "A" or with other equivalent identification) meets National Institute of Standards and Technology specifications. Volumetric syringes are used in preparing dilutions and standards for chromatographic analyses. In order to maintain its calibration, "Class A" volumetric glassware is never placed in a drying oven. If volumetric glassware containing standards is stored in a refrigerator, it is first brought to room temperature for at least 30 minutes prior to being used in preparing calibration standards. All steps in the analyses of organic pollutants are performed using only borosilicate glassware in order to eliminate potential contamination from plastics. Labware used for some steps in inorganic and metals analyses may be of borosilicate glass, or Nalgene® or PMP (Polymethylpentene) or other plastic as long as the material is compatible with the analysis. However, most plastic labware is not "Class A" and must therefore only be used where appropriate.

- 7.2.1 Glassware Cleaning Procedures. Clean labware is important to laboratory operations as well as an integral part of a quality assurance program. Each DELS-WES laboratory has specific glassware and plastic-ware cleaning procedures for its analytical determinations.

7.3 Calibration Procedures

- 7.3.1 The laboratory staff calibrates instruments or equipment using certified reference standards traceable to NIST standard reference materials (SRMs) or calibration is performed externally by agencies on service contracts. Calibration procedures are



specific for the matrix, analytical method, detection limits, and instrument. Generally, the calibration procedures are specified in the respective EPA, *Standard Methods*, or ASTM methodology.

In all cases, method-specific calibration requirements are followed (see method SOPs). If a method does not specify calibration requirements, and if the analytical instrument used is capable of running three calibration points, a daily initial calibration curve is run with at least a calibration blank and three standards. The lowest initial calibration standard used is always less than the MCL when analyzing drinking water and is always set at the minimum reporting level or lower. Sample data associated with unacceptable initial calibrations are never reported. Once initial calibration has been completed, adjustment of the calibration curve zero point (i.e., re-zeroing or auto-zeroing) is prohibited.

Initial instrument calibrations are verified using second source standards or using method-specific calibration acceptance criteria. Continuing calibration verifications (CCVs) are used to confirm the validity of initial calibrations according to method-specific criteria. Method-specific initial and continuing calibration criteria are achieved, or method-specific corrective action is taken promptly and documented.

For each analysis, a CCV is analyzed immediately after the initial calibration (or calibration check), at the end of each analytical batch, and periodically throughout the batch (e.g., after every 10 samples).

For GC/MS methods, the CCV is run at the beginning of each day and prior to any overnight runs. Whenever a CCV fails to meet the method-specific criteria, all analyses are stopped, and an initial multipoint method-specific calibration is performed. If the same analyte fails the CCV during GC/MS analysis, the data for that analyte are qualified in the final analysis report.

- 7.3.2 As part of the calibration protocol for laboratory instrumentation, the method detection limit (MDL) is experimentally determined for each method and sample matrix for which it is required (note: determination of the MDL is no longer required for many new EPA analytical methods). The MDL is referenced in Section 40, Code of Federal Regulations, Part 136, Appendix B. MDLs for laboratory analytical procedures are determined based on the frequency required by the specific analytical methods. If an analytical method does not specify a frequency for determining MDLs, a new MDL is only determined if environmental field samples are received or will be received for testing and the current MDL is more than 1 year old. It should be noted, however, that an MDL-check spiked sample is generally analyzed with PT samples for each drinking water analytical method. If unacceptable results are obtained, the laboratory must stop the analytical process to identify, correct, and document the deficiencies.
- 7.3.3 DELS-WES utilizes both physical and chemical calibration standards as part of its analytical procedures. Physical standards are used for calibrating analytical balances with ASTM Class 1 weights, and calibrating laboratory ovens and refrigerators with National Institute of Standards and Technology certified thermometers. Chemical calibration standards are used in the preparation of stock, intermediate, and working standards. Chemicals or reagents used in the preparation of calibration standards or analyses are analytical reagent (AR) grade or better in quality. All standard containers are labeled with expiration date. The laboratory uses ultra-high purity grade and lab grade gases for its analytical instrumentation.



- 7.3.4 Calibration standards used in inorganic, volatile organic, and semi-volatile organic chemical quantitation are prepared and stored as specified in the respective *Standard Method* or EPA analytical method (see method SOPs). All calibration standards and reagent solutions are labeled with the name of the solution, preparation date, expiration date, and initials of preparer.
- 7.3.5 For all calibration standards and other analytical reagents for a specific analytical method, the following information, as appropriate, is recorded in a standard/reagent preparation form specific to that method (**note:** in order to trace a set of prepared calibration standards/analytical reagents to a specific analytical run for a given method, the LIMS WL batch number for that run is recorded on the standard/reagent preparation form and the form is then also scanned and saved with the electronic raw data file for that WL batch number):
- Name of the standard/reagent or names of analytes contained in a standard/reagent mixture
 - Date of standard/reagent preparation
 - Date of standard/reagent expiration
 - Standard/reagent lot numbers
 - Parent solution numbers
 - Weight or volume of standard/reagent
 - Concentration of parent solution
 - Aliquot volume of standard/reagent taken
 - Dilution volume of standard/reagent
 - Final concentration of standard/reagent
 - Name or initials of analyst preparing standard/reagent
- 7.3.6 Whenever a new set of calibration standards is prepared, a standard calibration curve must be performed. The purpose of preparing a calibration curve is to determine the accuracy and correctness of the concentrations to their assigned values. The procedure for preparing a calibration curve must be performed as follows:
- 7.3.6.1 Calibration curve is prepared using at least three different concentrations of standards. Some EPA procedures specify that five or more concentrations must be used for calibration. A method blank must also be prepared.
- 7.3.6.2 Calibration curve is determined within the instrument's working or linear range. Sample concentrations outside of the calibration curve must be diluted and reanalyzed. In some cases, a calibration standard at or near the concentration of the analyte(s) of interest is prepared and run to quantify these analyte(s). For metal analyses, sample results can be reported from projected parts of the curve beyond the highest calibration standard up to 90% of the upper limit of the Linear Dynamic Range (LDR).



- 7.3.6.3 Calibration curve is checked against a known certified reference standard for accuracy. The reference standard accuracy is method-dependent.
- 7.3.6.4 Calibration curve must have a linear regression correlation coefficient value, r , of 0.995 (or the method-prescribed value) or greater.
- 7.3.6.5 Calibration procedure is performed under the same testing, sampling, and instrumental conditions as the actual measurement process.
- 7.3.6.6 Instrumentation or calibration curves that fail the calibration procedure are removed from the analytical process. Instrumentation that fails calibration must be repaired or re-calibrated prior to being placed back online. Calibration curves that fall out of conformance to EPA known values must be prepared again and re-evaluated. Instruments and other laboratory equipment are calibrated according to instrument specifications or methodology. Factors governing frequency of calibration are the specific analytical methods, instrument and calibration stability, sample matrices, and analyst experience. Consult each respective laboratory standard operating procedure for specific calibration procedures.

7.4 Quality Control for Equipment and Supplies used in the Microbiology Laboratory – Including Equipment Maintenance Procedures

7.4.1 Incubators

- 7.4.1.1 Temperatures of air incubators are checked twice each day with readings taken at least four hours apart. The date, time, temperature, and initials of the analyst performing each check must be documented. Incubators used at 35°C must maintain temperature to within 0.5°C. The thermometers must be placed in liquid.
- 7.4.1.2 Temperatures of water baths are checked twice each day when in use with readings taken at least four hours apart. The date, time, temperature, and initials of the analyst performing each check must be recorded. Water baths used at 44.5°C must maintain temperature to within 0.2°C. The thermometer used in the water bath must be graduated in increments of 0.1°C or smaller.

7.4.2 Refrigerators

Temperatures of refrigerators are checked once each day. Refrigerators must maintain a temperature of 1 to 6°C. The date, temperature, and initials of the analyst performing each check must be documented. Thermometers used in the refrigerators must be graduated in increments of 1°C or smaller. Thermometers must be placed in liquid.

7.4.3 UV Lamp (254 nm) Used for Sanitation

- 7.4.3.1 Lamps used for sanitation of the filtration funnels must be disconnected monthly and cleaned with ethanol.
- 7.4.3.2 The effectiveness of the germicidal unit must be tested quarterly. The date and initials of the analyst performing each check must be documented. The effectiveness can be tested using the HPC spread plate method. The procedure is as follows:



1. Prepare 2 spread plates containing 200-300 colony-forming-units (CFU) of *E. coli* on plate count agar or a non-selective agar.
2. Expose one plate to the UV light for a minimum of 3 minutes and do not expose the second plate.
3. Incubate the plates at 35°C for 48 hours.
4. Count colonies on both plates and record results in the monthly QC Form.
5. If the exposed plate does not show a 99% reduction in colonies relative to the unexposed plate, replace the UV bulb and repeat the effectiveness test.

7.4.4 Autoclave

- 7.4.4.1 The temperature of each autoclave cycle must be recorded from a certified maximum-temperature registering thermometer or from a calibrated autoclave internal thermometer.
- 7.4.4.2 The date, total time, sterilization time, sterilization temperature, contents, and analyst initials must be recorded for each autoclave cycle.
- 7.4.4.3 Spore ampoules must be analyzed each week the autoclave is used to ensure proper operation of the autoclave. Refer to the standard operating procedure for the autoclave for the use of these ampoules.
- 7.4.4.4 The autoclave must complete a cycle within 45 minutes when a sterilization time of 15 minutes is used.
- 7.4.4.5 Sterilization times to be used are as follows:

Membrane Filter Assemblies	15 minutes
Individual Glassware	15 minutes
Buffered Rinse Water	45 minutes
Media	15 minutes

- 7.4.4.6 The autoclave timer must be checked quarterly against a stopwatch.
- 7.4.4.7 The most recent autoclave service report must be placed on file and available for inspection.

7.4.5 Thermometers

- 7.4.5.1 Thermometers used within the laboratory must be calibrated annually at the temperature used against a thermometer traceable to NIST. The NIST-



traceable thermometer must be graduated in increments equal to or smaller than the thermometer being checked. If a thermometer differs by more than 1°C from the reference thermometer, it must be replaced except as noted below. The maximum-temperature registering thermometer used in the autoclave must be measured against the NIST-traceable thermometer by placing both thermometers in a boiling water bath. The maximum-temperature registering thermometer is calibrated by an external vendor every 5 years.

The following exception will be made to the rule that all thermometers that have a correction factor that exceeds 1°C will be discarded/replaced:

1. Built-in digital thermometers on ultra-low temperature freezers (-80 to -100 degrees Celsius) used for daily readings that have a correction factor exceeding 1 degree Celsius will be deemed acceptable. However, the calibration against a NIST-traceable thermometer will now have to be performed on a quarterly basis instead of the traditional annual calibration.
2. Any thermometer used for readings of autoclaves (121 degrees Celsius) that has a correction factor exceeding 1 degree Celsius will be deemed acceptable. The calibration against a NIST-traceable thermometer will remain on a quarterly basis.

7.4.5.2 Each thermometer must have a tag which identifies the thermometer, the date the thermometer was last calibrated against a NIST-traceable thermometer, and the correction factor.

7.4.6 Balances

7.4.6.1 Balances must be kept clean and free of corrosion.

7.4.6.2 The balance must be calibrated monthly with ASTM Class 1 weights. The results of these checks must be recorded.

7.4.6.3 A weight deflection test must be performed on the balance monthly. The balance must have a sensitivity of at least 0.1 g for a load of 150 g, and 1 mg for a load of 10 g or less. The results of these checks must be recorded.

7.4.6.4 The balance must be serviced at least annually by an outside contractor and the most recent service date must be affixed to the balance.

7.4.7 Colony Counter & Microscopes

7.4.7.1 DELS-WES uses a Leica Quebec Colony Counter, model # 3325, for counting Heterotrophic Plate Count (HPC) plates. The maintenance procedures for this instrument are as follow:

1. The counting plate is cleaned prior to each use. To clean the counting plate, remove the screw on the left side of the instrument. Swing the magnification lens aside and open the black front section attached to the lower hinge. The counting plate is held in place with four screws attached to the back of the front panel. Loosen the screws and slip the plate out of the retainer. Clean the plate with a diluted mild detergent. Do not use an



abrasive cleaner. Dry the counting plate with a lint-free cloth. Place the counting plate back into the retainer and tighten the four screws.

2. The bulb is changed as needed, replaced with a standard 40W soft white incandescent bulb. To change the bulb, unplug the instrument, remove the screws on the face of the instrument, and swing the magnification lens aside. Open the black front section attached to the lower hinge. Unscrew the malfunctioning bulb and replace with a standard 40W soft white incandescent bulb.

7.4.7.2 DELS-WES uses a Spencer or the VWR dissecting binocular microscope for counting colonies on membrane filter plates. A fluorescent light is attached to the microscope and must be turned on when the microscope is in use. The fluorescent light on time is recorded in a log sheet. The microscope is cleaned prior to each use. The lenses are wiped with lens papers and the body of the microscope is wiped with a lint-free cloth.

7.4.8 Sample Containers

7.4.8.1 Each lot of sample containers received must be tested for sterility. The following procedure is used:

1. 25 mL of tryptic soy broth must be placed into one sample container.
2. The sample container is rotated to ensure the broth comes into contact with all surfaces.
3. The container is incubated for 48 hours at $35 \pm 0.5^{\circ}\text{C}$.
4. After incubation, the broth is checked for turbidity indicating growth at both 24 and 48 hours.
5. Batches of containers for which the sterility check indicates growth are to be returned to the supplier.

7.4.8.2 The calibration of the volume measurements on each lot of sample containers received must be verified by taring the sample container, filling it to the 100-mL mark, and ensuring the weight of water in the container is 100 ± 2.5 grams.

An alternative procedure to determine the accuracy of the volume measurements is to fill a 100-mL Class A volumetric flask (or a pre-calibrated 100-mL graduated cylinder) to the 100-mL mark. The water from this flask is then poured into the sample container. The sample container must measure the volume to be 100 ± 2.5 mL.

7.4.8.3 One bottle from each lot used for enzymatic tests (e.g., SM 9223), which generate a fluorescent response, is checked against a 365-366-nm ultraviolet light source for autofluorescence. Results are recorded in the Microbiology Laboratory QC Sample Bottle Sterility/Accuracy/autofluorescence Check Form. Do not use the bottles from the lot if they fluoresce.

7.4.9 Membrane Filters



- 7.4.9.1 The membrane filters used by the laboratory must be certified by the manufacturer to be suitable for microbiological analyses. Filters are purchased pre-sterilized.
- 7.4.9.2 Filters must be 47 mm in diameter and 0.45- μ m pore size.
- 7.4.9.3 Filters that display inhibition or promotion of growth along the grid marks must be returned to the manufacturer.
- 7.4.9.4 The lot numbers and date of receipt must be recorded for each batch of filters.
- 7.4.9.5 Each lot of filters received must be tested for sterility. The following procedure is used:
 - 1. One filter from the lot is placed in 25 mL of sterile tryptic soy broth in a sterile container.
 - 2. The container is shaken to ensure the broth comes into contact with the entire membrane surface.
 - 3. The container is incubated for 48 hours at $35 \pm 0.5^{\circ}\text{C}$.
 - 4. After incubation, the broth is checked for turbidity indicating growth at both 24 and 48 hours.
 - 5. Membrane filter lots for which the sterility check indicates growth are returned to the supplier.

7.4.10 Pipettes

The laboratory uses disposable plastic pipettes that are purchased pre-sterilized from the manufacturer. Open packages of pipettes must be resealed between use periods. Each lot of pipettes must be checked for volume accuracy and the result recorded in the QC Form. The lot is rejected if the difference is greater than 2.5%.

7.4.11 Filtration Funnels

- 7.4.11.1 The laboratory uses stainless steel filtration funnels for membrane filtration methods. The funnels must be autoclaved at 121°C for 15 minutes prior to initiating a filtration series. Funnels may be wrapped in Kraft paper prior to autoclaving if they are not to be used on the day they are sterilized.
- 7.4.11.2 A filtration series is considered to be ended if greater than 30 minutes elapses between samples. Filter assemblies must be re-autoclaved prior to initiating a new series.
- 7.4.11.3 Filter assemblies are exposed to UV light (254 nm) for a minimum of three minutes between sample filtrations in a series.
- 7.4.11.4 Funnels that become scratched or corroded must be discarded.

7.4.12 Media



- 7.4.12.1 Whenever possible, media are purchased in powdered form from suppliers.
- 7.4.12.2 Each bottle of media received must be marked with the date received and date opened. Record date received, date opened, and amount received in media QC Form.
- 7.4.12.3 Dehydrated media are to be stored in a cool dry location. The desiccator is to be used whenever possible for media storage.
- 7.4.12.4 Containers of media must be discarded within six months of opening when not stored in the desiccator. If a desiccator is used for storage, open containers of media may be stored for up to -the manufacturer's expiration date.
- 7.4.12.5 In no case is media to be used beyond the manufacturer's expiration date.
- 7.4.12.6 Media must be used in the order received. To minimize waste, media must be ordered in quantities that will be used prior to expiration.
- 7.4.12.7 Each lot of media received must be tested with positive and negative culture controls prior to use to ensure satisfactory performance. The results of the control checks must be recorded in the media preparation log. Recommended control organisms are:
- | | |
|-------------------------------|---|
| Total coliform positive: | <i>Escherichia coli</i>
<i>Enterobacter aerogenes</i>
<i>Klebsiella variicola</i> |
| Total coliform negative: | <i>Staphylococcus aureus</i>
<i>Pseudomonas</i> sp. |
| Fecal coliform positive: | <i>Escherichia coli</i>
<i>Klebsiella variicola</i> |
| Fecal coliform negative: | <i>Enterobacter aerogenes</i>
<i>Enterococcus faecalis</i> |
| <i>E. coli</i> positive: | <i>Escherichia coli</i> |
| <i>E. coli</i> negative: | <i>Pseudomonas</i> non-fluorescent sp. |
| Enterococci positive: | <i>Enterococcus faecalis</i> |
| Enterococci negative: | <i>Staphylococcus aureus</i>
<i>Escherichia coli</i> |
| <i>Enterobacter</i> positive: | <i>Enterobacter aerogenes</i> |
| <i>Enterobacter</i> negative: | <i>Escherichia coli</i> |
- 7.4.12.8 Media preparation logs must include the media type, lot number of the media, date prepared, details of preparation, total volume prepared, sterilization time and temperatures, final pH and the initials of the analyst preparing the media.



7.4.12.9 Prepared media must be stored in the refrigerator. Broth type media are stored in culture tubes with screw cap tops for three months or less. LTB and EC-MUG screw cap tubes should be refrigerated and placed in a dark area. HPC Agar should be kept in screw cap test tubes and be stored for up to six months while refrigerated. Plated media are stored in a plastic container for two weeks or less. The test tube racks or plastic containers must be clearly marked with the type of media along with the preparation and expiration dates of the media. Any plates or tubes that indicate growth prior to use are discarded. Tubes with gas present in the Durham tube prior to use are discarded.

7.4.13 Reagent-Grade Water

The quality of the reagent water must be tested, recorded, and determined to meet the following requirements:

Parameter	Limits	Frequency
Resistivity	> 10 megohm-cm at 25°C	Each day used (in-line meter)
Conductivity	< 2 μ S/cm at 25°C	Monthly
Pb, Cd, Cr, Cu, Ni, Zn	< 0.05 mg/L per metal and < 0.1 mg/L total metals	Annually (by DELS-WES Inorganic Chemistry Laboratory)
Total Chlorine Residual	< 0.1 mg/L	Monthly
HPC	< 500 CFU/mL	Monthly

7.4.14 Dilution/Rinse Water

Each batch of prepared rinse water used by the laboratory must be checked for sterility prior to initial use. The following procedure is used:

7.4.14.1. 50 mL of the water is poured into 50 mL of 2x tryptic soy broth.

7.4.14.2. The broth is incubated for 48 hours at 35°C.

7.4.14.3. During the incubation, the broth is checked at 24 & 48 hours for turbidity or growth. Prepared bottles from each batch must not be used unless satisfactory results (i.e., no turbidity/growth) are obtained from the tested bottle.

7.4.15 pH Meter

7.4.15.1 The pH meter must be standardized each day it is used with a minimum of two buffers. The date and the buffers used must be recorded in the logbook.

7.4.15.2 Aliquots of buffer solution must be used only once.



7.5.15.3 The electrodes must be kept clean and stored in Electrode Storage solution.

7.5 Equipment maintenance procedures for the Inorganic Chemistry Laboratory and Organic Chemistry Laboratory – MS Section

The procedures are described in the analytical method SOPs for these two laboratories.

7.6 Equipment Maintenance Procedures for the Organic Chemistry – GC/LC Section

7.6.1 Liquid Chromatography (LC) Systems (HPLC & UPLC)

7.6.1.1 Annual preventative maintenance under a service contract provides change of pump seals, syringe change, and if needed, UV lamp change. The annual service contract also provides software upgrades.

7.6.1.2 After all HPLC analyses, run 50% solvent and 50% water through system to clean out salts and buffers.

7.6.1.3 Change pre-column frits when high backpressure is observed.

7.6.2 Gas Chromatographs

7.6.2.1 Change liners and septa on a when-needed basis.

7.6.2.2 Biannual ECD wipe tests

7.6.2.3 Change carrier gas tank before empty

7.6.2.4 Call manufacturer if electrically related problem

7.7 Maintenance Procedures for Common Laboratory Equipment in All DELS-WES Laboratories

7.7.1 Analytical Balances

7.7.1.1 Record 1.0000-gram weight and 5.0000-gram weight each day the balance is used. (100, 10, and 0.1 g weights may also be used, as appropriate). The date and analyst's initials must be entered into a record book or log that is kept near the balance.

7.7.1.2 A qualified service contractor checks balance calibration twice a year; external calibration records are maintained in W:\DELS\DELS-QAP\QCDocumentation-General\Analytical Balance Calibration External-All DELS Labs.

7.7.1.3 ASTM Class 1 weights are used for routine calibration. ASTM Class 1 weight sets are checked twice a year, at the time of balance calibration, against the calibrated weights of the outside service contractor. If a DELS-WES Class 1 weight set does not agree with the contractor calibrated weight, if it is corroded or damaged in any way, or if has been 5 years since last certified, then it is sent to another outside contractor for cleaning and recalibration/recertification to Class 1 specifications.



7.7.2 Refrigerators and Freezers

7.7.2.1 Temperatures of all refrigerators and freezers are measured with NIST-traceable thermometers and recorded daily by laboratory staff. All thermometers are calibrated at least annually against a NIST-traceable thermometer and the calibration records are maintained in the shared electronic folder for documentation of general quality control (W:\DELS\DELS-QAP\QC Documentation-General).

7.7.2.2 If the temperature reading is outside of the acceptance limits specified on the refrigerator/freezer door, adjustments are immediately made to bring the temperature reading within the acceptance limits.

7.7.3 Fume Hoods and Biological Safety Cabinets

7.7.3.1 Annual certification is performed by a qualified service representative.

7.7.3.2 Hoods and cabinets are maintained free of "clutter" at all times.

7.7.3.3 If used, mat material is kept clean and promptly replaced when soiled.

7.7.4 Reagent-Grade Water

The quality of the reagent water must be tested, recorded, and determined to meet one of the following requirements as monitored by and read from each specific reagent water system:

Parameter	Limits	Frequency
Resistivity	> 18 megohm-cm at 25°C	Each day used (in-line meter)
Conductivity	< 0.055 μ S/cm at 25°C	Each day of use

7.8 Equipment maintenance records, including minor maintenance procedures conducted by laboratory personnel as well as preventative maintenance and major repairs conducted by service contractors, are kept up to date and in chronological order. These records are stored in the laboratory in which the equipment is housed/used.

8.0 **SAMPLE PREPARATION, ANALYTICAL PROCEDURES, AND METHOD VALIDATION**

8.1 DELS-WES utilizes analytical procedures that were developed/approved by the U.S. EPA, American Public Health Association, USGS, MassDEP, AOAC International, and various manufacturers. DELS-WES analytical laboratory SOPs follow the format specified for technical SOPs in the U.S. EPA Guidance for Preparing SOPs (42) [note: previously referenced as the Environmental Monitoring Management Council (EMMC) Methods Format]. If a sample is analyzed using a procedure outside of the stated approved analytical method SOP, the respective laboratory supervisor and Laboratory QA & Data Manager are notified of the deviation. The change in sample methodology is noted and approved by the laboratory supervisor in the raw laboratory data, QA



Level 1 and 2 review forms, and final analysis report. The analytical methods used by DELS-WES laboratories are listed in Tables 8 through 12.

8.2 Method Validation. Method validation is a critical part of any quality assurance program. DELS-WES uses analytical methods that have been validated for environmental analysis by the U.S. EPA and/or other professional scientific organizations. The laboratory performs further method validation by using the following as appropriate for the method:

- Analysis of spiked matrix samples to determine matrix effects
- Analysis of certified reference materials of known concentration to verify calibration and system accuracy
- Participation in proficiency tests for water supply analyses to evaluate the overall quality control system
- Monitoring the overall analytical system with a series of quality control checks
- Assessment of precision via the analysis of duplicate samples

9.0 DATA REDUCTION, VERIFICATION, AND REPORTING

This section describes the procedures for data reduction, data verification, and data reporting used by DELS-WES as part of its quality control program.

9.1 Data Reduction

Data reduction refers to the conversion of raw analytical data to the final analyte concentration in the sample reported in appropriate units after the analysis has been completed. Most chemistry data reduction at DELS-WES is performed directly by the computer/software that controls the analytical instrument. However, data reduction for some wet chemistry and microbiological methods is performed manually. For these methods, the analyst performing the final sample analysis is responsible for converting the raw data to final sample concentration in units specified by the method (e.g., mg/L, μ g/L, CFU/100 mL, etc.), documenting the calculation, and recording the final result. Analytical results for blanks, duplicates, spikes, and other quality control samples are also reported along with the sample result.

9.1.1 The data reduction protocol includes the sample handling process for the laboratory. This process includes sample receipt, sample preparation, sample analysis, data acquisition and reduction, raw data analysis, and analytical quality control review.

9.1.2 The laboratory sample file includes the laboratory identification number; dates of collection, receipt, and analysis; analytical tests performed; name and affiliation of sample collector; analytical method; sample concentrations; and quality control data. The laboratory sample file is generated from the data entered in the respective laboratory logbook or bench worksheet, or found on an instrument computer printout that are then entered into the DELS-WES LIMS to generate the official electronic laboratory report. The analyst completing the sample analysis enters the final concentration and quality control results on the official laboratory report forms in the LIMS. The laboratory supervisor or their delegate is responsible for generating and communicating the final verified LIMS report to the client.

9.1.3 Where data reduction occurs electronically, either partially or in its entirety, the U.S. EPA Good Automated Laboratory Practices (GALP), 1995 edition, guidelines shall be followed



as described below. For this purpose, electronically shall refer to algorithms, formulas, text, scanned copies of hardcopy, etc., kept by or on a tamper-resistant electronic media such as write-once compact disks (CD-R) or a limited access password protected software system or data base.

- 9.1.3.1 A summary description of each piece of software and/or firmware involved in the calculation(s) and its requirements for proper functioning shall be recorded and kept either electronically or by hardcopy.
- 9.1.3.2 For each test/analyte, all algorithms, formulas, and applicable sample matrices shall be recorded and kept either electronically or by hardcopy.
- 9.1.3.3 The accuracy of each set of calculations shall be determined in the following manner:
 - 1. The first use of each software/firmware version + calculation(s) combination shall be manually checked for accuracy by a method that does not employ the software/firmware being checked. Alternatively, a vendor's certification of accuracy may be used.
 - 2. At a minimum, one of each type of Quality Control sample calculation shall be checked – e.g., percent recovery of standard, surrogate, etc.; proper calculation of Acceptance Criteria Range such as Instrument Performance Check or Quality Control Sample pass-fail; Relative Percent Difference (RPD); Matrix Spike; etc.
 - 3. At a minimum, the calculations from seven to ten randomly chosen samples are checked.
 - 4. All calculations must agree within the limits of rounding error.
 - 5. A preliminary check of accuracy shall be performed by the analyst/user, but a person other than the analyst/user must confirm accuracy.
 - 6. The dates, names, and signatures (initials) of the persons who perform this determination must be recorded.
 - 7. The first and last use of a particular test/analyte software/firmware calculation combination shall be recorded to facilitate cross-referencing with the data and to determine the date this information may be disposed of.
 - 8. This information shall be recorded and kept either electronically or by hardcopy.
- 9.1.3.4 The above shall be kept, at a minimum, with the equipment used to generate the raw data. In the case it is kept electronically in a central location, it shall be readily available at the location of the equipment used to generate the raw data.
- 9.1.3.5 Any changes to the software/firmware, algorithms, formulas, etc. used in the data reduction require a new verification as described above. Changes to software/firmware that do not affect calculations, e.g. new auto-sampler interface, do not require accuracy verification.



- 9.1.3.6 The above information shall be kept for 10 years after the last use of that particular combination.

9.2 Data Verification

Data verification refers to the process used to evaluate the completeness, accuracy, precision, and overall conformance of analytical data produced by DELS-WES Laboratories against method, procedural, and quality assurance/control requirements (44). DELS-WES performs data verification on its analytical data using the following criteria:

- 9.2.1 Was the sample analyzed within the prescribed holding time? If not, the result is qualified as estimated data in the report ("H" Flag – Holding time violated). At the discretion of the project coordinator or point of contact, a new sample may be submitted for analysis.
- 9.2.2 Was the instrumentation used in analyzing the sample calibrated according to the analytical method and documented in the respective logbook, bench worksheet, or analytical instrument computer printout? Was the correct analytical method used?
- 9.2.3 Are the correct units used for determining the final concentrations (e.g., solids in $\mu\text{g/g}$ dry or wet wt. and liquids in mg/L or $\mu\text{g/L}$)?
- 9.2.4 Are solids (other than fish/biota tissue) and sediments for semi-volatile organic compounds, metals, and other inorganic chemicals reported on a wet- or dry-weight basis with percent dry weight (solids concentration) where required?
- 9.2.5 Are solids and sediments for volatile organic compounds reported on a wet-weight basis with percent dry weight (solids concentration)?
- 9.2.6 Was a blank, spike, and/or duplicate analyzed with each sample batch? Was the blank concentration less than the MDL or minimum reporting level (MRL)? If not, were the data properly qualified in the final analysis report?
- 9.2.7 Was the correct number of significant figures used in the final result? It should be noted that the DELS-WES LIMS is configured for each analytical method with the correct number of significant figures for the test result.
- 9.2.8 Where reporting to the MDL is required, are reported concentrations less than the MRL but at or above the MDL, qualified as estimated data ("M" Qualifier), or just reported as < MRL? It should be noted that the DELS-WES LIMS is configured for each analytical method with the correct MDL and MRL to appear in the final analysis report if required.

If the final analyte concentration in the sample is less than the MDL or MRL, is the result correctly reported as < MDL or < MRL, respectively?

If the analytical method does not require reporting to an MDL, and the lowest concentration calibration standard used is at or below the MRL, are all concentrations detected below the MRL reported as < MRL or less than a fraction of the MRL for blanks (e.g., < $\frac{1}{2}$ MRL) where applicable?

- 9.2.9 Have the precision and accuracy of the respective analytical method been determined?
- 9.2.10 Have independent quality control reference standards been run to determine laboratory accuracy?



- 9.2.11 Does the final analysis report list all the correct sample ID information as per the *Sample Tracking/Chain-of-Custody Form* – i.e., Client Sample ID, Client Sample Description, date and time of sample collection, receipt at WES, and analysis; sample matrix; sample collector name or initials; login batch point of contact; name of project with contact where applicable, or and analyses requested? Was the correct analytical method used for the sample matrix and analyses requested? Were the quality control data included in the final analysis report within acceptance limits or were the sample data properly qualified in the report if any QC data were outside acceptance limits? It should be noted that the DELS-WES LIMS is configured for each analytical method with the correct QC acceptance limits to appear in the final analysis report.
- 9.2.12 Have the data on the final analysis report been verified against the data entered in the respective laboratory logbook, bench worksheet, or analytical instrument computer printout? Are all raw data records written legibly in ink and are all changes neatly lined through, initialed, and dated?
- 9.2.13 Have the data undergone first-level (peer) and second-level (reporting) QA reviews? The 1st level review is performed by the laboratory supervisor or another analyst in the laboratory (i.e., an analyst that did not perform the analysis) while the 2nd level review is performed by the laboratory supervisor, or in the absence of the laboratory supervisor, by the backup laboratory supervisor. The Level 1 review involves a comprehensive review of all raw data to identify and correct any technical, analyte identification/quantitation, calculation, or transcription error. The Level 2 review is a review of the final analytical report. The Level 1 reviews are documented using Reports 3 through 8. The Level 2 review is documented using Report 9. The disposition of Level 1 review documentation is described in Section 18.2; Level 2 review, in Section 18.3.
- 9.2.14 On completion of the Level 2 review, supervisors or back-up supervisors must enter their password to electronically sign the approval to release of the results.

9.3 Data Reporting

The final laboratory reports generated by DELS-WES include: The Login #, Sample ID, Client Sample ID, Client Sample Description, date of collection, date of receipt, date of analysis, name of collector, analytical method used, sample concentration results, and supporting quality control data. (See Reports 1 and 2 for examples of DELS-WES Final Reports for chemistry results and microbiology results respectively.) The completed reports are then sent electronically to the client, MassDEP region, or MassDEP program that had submitted the sample(s) for analysis. MassDEP program staff who have been approved and trained in using the client view of WinLIMS have the ability to retrieve copies of reports and extracts of reported data on their own. The analytical sample report includes the following information:

- Project Name and location (where applicable)
- Client Sample ID, Client Sample Description, Sample ID, and the Login #.
- Dates of sample collection, receipt, preparation, and analysis
- Analytical method(s) used and detection limit(s)
- Final analyte(s) concentration(s) and units
- Sample matrix



- Data qualifiers, if any
- Blank results (i.e., method blanks, preparation blanks, trip blanks, and field reagent blanks)
- Spike results (i.e., matrix spikes, post-digestion spikes, method of standard addition spikes, surrogate spikes, and reagent water spikes)
- Duplicate results (i.e., sample duplicates or matrix spike duplicates)
- Quality control acceptance limits for each QC type for each method

The reports are scanned and electronically filed indefinitely. The original copies of the reports are kept on file at DELS-WES for 10 years and then destroyed. After the results have been reported, the actual samples are then discarded or retained as instructed by the MassDEP program/regional project coordinator or point of contact. Samples are kept until official written notification is received from the sample project coordinator allowing for their legal and proper disposal. Occasionally, per request of the sample collector/project coordinator or due to an urgent situation, preliminary analytical results are reported with the acknowledgement that the results are not official until they are validated and approved.

10.0 INTERNAL QUALITY CONTROL CHECKS

10.1 Introduction

This section describes the internal quality control checks that are used by DELS-WES as part of its laboratory quality control activities. The quality control procedures stated below are a function of the quality assurance objectives stated in Section 4.0. The analytical requirements for the quality control procedures are specified in method SOPs, while the specific tests are described in Section 10.0. Single-blind quality assurance check samples (QCS) from a PT provider meeting the criteria set by the National Environmental Laboratory Accreditation Program (NELAP) and implemented by the Proficiency Testing oversight Body/Proficiency Testing Provider Accreditor (PTOB/PTPA) or its successor body for accredited PT providers are used to evaluate laboratory accuracy. Additional quality control elements used include:

- Positive controls and blanks for all bacteriological analyses, and laboratory duplicates for all enumerative bacteriological tests.
- A bacterial colony count comparison between analysts must be performed and recorded for each quantification method performed each month. Quantification assays not performed during the routine client testing of a calendar month are exempt from this requirement, e.g., if there were no requests for EPA 1600 analysis during December, a colony count comparison for this methodology would not have to be performed for this month. The colony counts must be within 10% and documented in the Monthly QC Form.
- All method-specific QC requirements and acceptance limits for IPCs, LFBs, LFM, etc., are followed.
- A quality control sample (QCS) prepared from a separate source is analyzed at least quarterly for all methods.
- A laboratory reagent blank (LRB) is prepared and analyzed with each batch of samples. If the LRB concentration is greater than the MDL or MRL, corrective action is taken.



- A laboratory-fortified blank (LFB), at 10x the MDL or at the mid-level standard as required by the method, is run with each batch of samples for all methods. Control charts are generated using the most recent 20 to 30 data points.
- A laboratory-fortified matrix sample (LFM) is run at a frequency of 10 or 20% as required by the analytical method being performed for all methods, except for Method 524.3.
- For the analyses for which they are required, MDLs are determined according to method-specific instructions.
- Minimum Reporting Levels (MRLs) for all regulated drinking water analytes are lower than or equal to their respective MCLs.
- For regulated drinking water synthetic organic chemicals (SOCs), required MDLs are achieved for most compounds. Analytical data (i.e., analyte concentrations) are reported only when bracketed by initial calibration standards. If the sample analyte concentration exceeds the highest calibration standard, it is reported qualified I or the sample is diluted and rerun. For metal analyses, sample results can be reported from projected parts of the curve beyond the highest calibration standard up to 90% of the upper limit of the Linear Dynamic Range (LDR). If the sample analyte concentration falls below the lowest calibration standard (i.e., below the MRL) but is above the MDL, it is reported as an estimated concentration with an "J" qualifier. If the sample analyte concentration is below the MDL, it is reported as < MDL.
- For GC methods, second-column confirmation is performed when recommended by the method.
- When samples are diluted, MRLs and MDLs are raised accordingly in the LIMS and included in the final analysis report.

The overall objective of the Wall Experiment Station quality control program is to demonstrate that the analytical data generated by this laboratory are scientifically valid and defensible. The laboratory's quality control program is based on the following practices:

- Utilization of *Standard Methods for the Examination of Water and Wastewater*, AOAC, USGS, MassDEP, and United States Environmental Protection Agency approved prescriptive and performance-based analytical methods.
- Utilization of approved laboratory calibration and operation of instrumentation
- Compliance with standard procedures for sample collection, sample management (e.g., meeting EPA holding times), and sample analysis.
- Compliance with sample chain-of-custody procedures
- Continuous monitoring for acceptable laboratory accuracy and precision by the use of certified quality control check samples, method blanks, duplicates, surrogate spikes, matrix spikes, trip blanks, and participation in proficiency testing for water supply and other samples.
- Triennial audits by the USEPA-New England Laboratory Certification Team.
- Participation in laboratory round-robin analyses and programs with the USEPA
- Continuing training of laboratory staff in all aspects of environmental laboratory sciences



10.2 Quality Control Samples and Their Definitions

The integral elements of a sound quality control program include training and use of qualified personnel, dependable and well-maintained instrumentation, proper number of calibration standards and check samples, review and surveillance of the program by the Lab Supervisor and Laboratory QA & Data Manager.

The primary means of assessing laboratory precision and accuracy are with the use of quality control samples. The number and type of quality control samples required by the USEPA are described in the respective analytical methods. All DELS-WES laboratories use quality control samples as part of their routine quality control programs.

DELS-WES utilizes the following laboratory quality control samples as part of its analytical program.

- 10.2.1 Proficiency Test Sample. Obtained from a source independent of the laboratory, these samples are spiked with the analytes of interest. The laboratory may receive single-blind samples, meaning the laboratory can identify it as a PT sample but it does not know its true value, or double blind, meaning the laboratory cannot identify the PT sample in a batch of environmental samples. PT samples must be in the same relative matrix as the environmental samples. These samples are to verify that the laboratory is capable of producing accurate data. All PTs for DELS-WES Laboratories are run in a manner identical to field samples. Since in an analytical batch one field sample is run as a laboratory duplicate, DELS-WES Laboratories may choose to run a PT sample in duplicate. As is the DELS-WES practice for field samples, assuming the method laboratory duplicate QC criterion is met, the analytical result for the "sample" will be reported to the PT provider rather than the result for the "duplicate" or the mean of the duplicate results. Consistent with the DELS-WES practice for field samples, if the method laboratory duplicate QC criterion is not met, the DELS-WES laboratory may choose to rerun the analysis of the PT sample. Also consistent with the DELS-WES practice for field samples, the analysis of a PT sample may be rerun if there is the need to dilute the sample because the initial result was higher than the highest calibration standard used in the calibration curve
- 10.2.2 Laboratory Check Standard (Quality Control Standard). Obtained from a source independent of the laboratory, this standard contains known concentrations of target analytes. These standards are used to check the bias in laboratory measurements. Laboratory check standards are used after calibration, after blank analysis and before and after sample analysis.
- 10.2.3 Calibration Standards. These samples contain known concentrations of the target analytes. Analytical methods dictate the number of calibration standards that must be analyzed and plotted on the calibration curve. In all cases, the lowest standard must be at or below the target quantitation limit (i.e., MRL) and the highest standard must fall within the calibration range of the instrument. These standards are used to produce a calibration curve from which to calculate contaminant concentrations in environmental samples. The minimum frequency is specified in the method.
- 10.2.4 Calibration Check Standard. This sample contains a known concentration of the target analyte(s). It should be run at or over the calibration range specified by the method. Where not otherwise specified, the calibration check standard concentration should be in the midrange of the calibration curve. It is used to verify that the instrument is still calibrated to the calibration curve. A calibration check sample is analyzed one per sample batch. The acceptance criteria of the calibration check standard is



analyte/method specific. The instrument must be re-calibrated whenever data from the calibration check standard falls outside of the acceptance limits.

- 10.2.5 Method Blank (Laboratory Reagent Blank). A sample of analyte-free reagent water, for aqueous samples, or analyte-free soil, for soil samples, it is prepared and analyzed by the analytical methods being used for the environmental samples. Method blanks are used to check on the cleanliness of the reagents, instrument systems, and laboratory environment. Method blanks are analyzed one per twelve-hour analysis day, one per twenty samples or one per sample batch, whichever requires the greatest number of blank analyses.
- 10.2.6 Laboratory Duplicates. Sometimes called laboratory replicates, these samples are two aliquots of a single field sample that are analyzed independently. Duplicates are used to check on precision in laboratory results. Laboratory duplicates are analyzed at the rate which requires the greatest number of duplicate analyses: one per twenty environmental samples; one per sample batch; or as specified by the method.
- 10.2.7 Matrix Spike (Laboratory Fortified Matrix). An aliquot of an environmental sample that has been spiked with known concentrations of target contaminants prior to extraction/digestion and analysis. After analysis, the percent recovery is calculated. Matrix spikes are used to check on bias and matrix interferences in laboratory measurements for an environmental sample matrix of interest. Matrix spikes are analyzed at the rate which requires the greatest number of spike analyses: one per twenty samples, one per sample batch, or as specified by the method.
- 10.2.8 Matrix Spike Duplicate. A second aliquot of the environmental sample that was used for the matrix spike is spiked with the same concentration of target contaminants, prior to extraction and analysis. After analysis, the relative percent difference between the matrix spike and its duplicate is calculated. The matrix spike duplicate is used to check on precision in laboratory measurements for an actual environmental sample matrix of interest. A matrix spike duplicate is analyzed at the rate which requires the greatest number of matrix spike duplicate analyses: one per 20 samples, one per sample batch or as specified by the method.
- 10.2.9 Surrogate Spike. Surrogate spikes are used to assess analytical accuracy (% recoveries) in samples tested. Blanks, standards, field samples, quality control samples, and blank and matrix spike samples are spiked with a known concentration of the surrogate, which is an analyte that is similar to method target analytes in chemical composition, extraction efficiency, chromatographic separation, etc., but which is not normally found in environmental samples.
- 10.2.10 Environmental Sample. Sometimes called a field sample – it is a sample of any matrix taken from an environmental site. An environmental sample is used to characterize the composition or contamination at that sampling point. The size of the sample is dictated by the methods used on analysis and the quality control that will be performed on it. The number of samples collected is dependent on the objectives of the sampling program.
- 10.2.11 Trip Blank. Duplicate vials of analyte-free water produced in the laboratory, transported to the field, and shipped back to the laboratory with the volatile organics samples. The purpose of the trip blank is to check for sample contamination originating from sample transport. One trip blank consisting of duplicate vials is collected per cooler of samples shipped for volatile organics analysis.



- 10.2.12 Field Reagent Blank (FRB). An aliquot of reagent water or other blank matrix that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to the sample site conditions, storage, preservation, and all analytical procedures. The purpose of the FRB is to determine if method analytes or other interferences are present in the field environment.
- 10.2.13 Equipment Blank. Sometimes called a field or rinsate blank, these samples are produced in the field by rinsing decontaminated sampling equipment with analyte-free water and collecting the rinsate for analysis. Equipment blanks are used to check on sample cross contamination resulting from inadequate decontamination of sampling equipment. DELS-WES has largely eliminated the need for most equipment decontamination by implementing the use of dedicated disposable sampling equipment. Equipment blanks should be analyzed for the same parameters as the environmental samples. Equipment blanks should be collected at least once at the beginning and once at the end of each sampling day.
- 10.2.14 Field Duplicate. A second environmental sample drawn from the same sampling location immediately after the original environmental sample was drawn. The two samples must be collected independently. Field duplicates are used to check on consistency in sampling technique. Field duplicates should be collected one per twenty environmental samples.
- 10.2.15 Split Samples. Two samples produced from the same sample collection event and analyzed by two different analytical laboratories. Non-VOC samples must be homogenized prior to sample collection. VOC samples may not be homogenized prior to sample collection. Instead, collect two aliquots from the same bailer of water or from the same region of a split spoon auger. Split samples are used to check precision between analytical laboratories. The number of split samples collected is dependent on the objectives of the sampling program, but usually one per ten environmental samples.
- 10.2.16 Quality Control Sample – Standard Reference Material (QCS_{SRM}). A sample of a matrix similar to the sample being analyzed which contains analytes of a known or accepted concentration. The QCS_{SRM} is obtained from a source external to the laboratory and contains the analytes of interest at certified concentrations for the method of interest. This QCS_{SRM} is processed in the same manner as the sample and is used to check method performance.

11.0 PERFORMANCE AND SYSTEMS AUDITS

11.1 Internal Systems Audit

An internal systems audit involves a thorough review, inspection, and evaluation of all components of a laboratory's quality assurance system, including standard operating procedures, personnel qualifications, and facilities. The DELS-WES Quality Assurance Program conducts internal systems audits of the DELS-WES laboratories annually (note: DELS-WES laboratories are also audited every three years by the U.S. EPA-New England Laboratory Certification Team). A systems audit includes the following components:

- 11.1.1 Review of sample handling and chain-of-custody procedures
- 11.1.2 Laboratory Methodology – Analytical methods used by the laboratory must be listed in the DELS-WES Laboratory QA Plan. They must be the correct methods based on analyte and sample matrix.



- 11.1.3 Initial Demonstration of Capability (IDC) – The laboratory must have documentation that an IDC is performed whenever a new instrument is put on-line, when a new analyst performs the method, when major changes have been made to a method or instrument. Records of these analyses must be maintained by the laboratory. The records should include analyst name, analytical method used, date of analysis, and all the raw data.
- 11.1.4 Routine Monitoring of Analytical Method Performance – Inorganic and organic chemical analytical methods specify the requirements for method performance. Microbiological methods require the use of duplicates, and positive and negative culture controls to assess method performance. Method performance is to be evaluated by the following:
- Instrumentation calibration, including preparation of analytical standards
 - Instrument performance
 - Method detection limits
 - Method validation procedures
 - Results of annual external single-blind proficiency testing (PT) as well as of double-blind PTs submitted by the MassDEP programs/regions.
- 11.1.5 Inventory of Laboratory Equipment, Condition and Maintenance, Physical Plant – The audit is conducted to determine if the laboratory has the proper and/or required instrumentation to perform the required analyses. The operating condition and age of each piece of major instrumentation will be noted. The laboratory's instrumentation maintenance log will be reviewed to determine if the scheduled maintenance has been performed and to note the date of any other repairs.
- 11.1.6 Laboratory Personnel – Personnel training documentation will be reviewed to ensure up-to-date training.
- 11.1.7 Data Handling and Documentation – A review will be performed on all procedures used to calculate final concentration values from raw data. The audit will verify representative calculations to show that appropriate procedures and final report units are being used. Documentation of peer reviews of analytical work will be reviewed during an audit.
- 11.1.8 General Laboratory Quality Control Procedures – During this phase of the audit, quality control procedures will be evaluated to verify that specific QC procedures are being performed and documented in lab records. It includes the following:
- Review of sample spikes, duplicates, matrix spikes, PT results, and sample blank results.
 - Review of lab balance certification and daily calibration checks.
 - Review of calibration standards purchase date and date of expiration.
 - Review of calibration standards logbook or standard preparation forms for date prepared, concentrations, prep analysts, expiration dates, and source lot numbers
 - Review of significant figures used.



- Review of QC limits.
 - Review for compliance with Lab QA Plan and SOPs.
- 11.1.9 Report of Systems Audit Findings to Management – Upon completion of the systems audit for a DELS-WES laboratory, the Laboratory QA & Data Manager documents the findings of the audit in a report submitted to the DEL/WES Director and laboratory supervisor. The report focuses on:
- Deviations from the Laboratory QA Plan and SOPs.
 - Areas for improvement in laboratory QC and analytical methods.
 - Data quality assessment.
 - Determination as to whether the laboratory QA objectives are being met.

11.2 Performance Audit

The objective of a performance audit is to review and evaluate the performance of the analyst and the other components of the analytical measurement system.

- 11.2.1 The WES/DELS laboratory analyzes laboratory quality assurance check samples that are obtained from an external source.
- 11.2.2 The WES/DELS laboratory participates in an annual Water Supply PT study. This study is a single-blind performance evaluation of the laboratory's accuracy in detecting/quantitating drinking water contaminants.
- 11.2.3 Laboratory supervisors and analysts perform Level 1 peer reviews of analytical data that includes the validation of the calibration curve and a review of the analytical run including quality control samples.
- 11.2.4 Laboratory supervisors and analysts perform Level 2 peer reviews of analytical data that checks sample handling, the reporting of analyses, and the frequency of analysis of and compliance with the acceptance criteria of quality control samples.
- 11.2.5 Laboratory supervisors review quality control data generated by the laboratory during the previous month. Data are reviewed for trends and for deviations from acceptable quality control criteria. Any necessary corrective action is taken and documented.
- 11.2.6 If staff availability allows, the Quality Assurance Program performs completeness reviews of analytical data packages to ensure that Level 1 and 2 reviews have been performed and any necessary corrective action has been taken and documented.

12.0 PREVENTIVE MAINTENANCE

- 12.1 DELS-WES laboratories perform preventive maintenance on analytical instruments such as MS source cleaning, detector cleaning, and lubrication according to the guidelines listed in the instrument manufacturer's manual. Analytical instruments, such as gas chromatographs, high-performance liquid chromatographs, inductively coupled plasma spectrometers, and gas chromatograph/mass spectrometers may be covered by manufacturer's service contracts and are regularly scheduled for routine maintenance and cleaning.



- 12.2 Each DELS-WES laboratory maintains an instrument maintenance logbook. Information recorded in the instrument logbook includes the date of instrument maintenance, nature of work performed on the instrument, replacement of columns, septa, injector liners, traps, lamps, gas purifier traps, reagent water ion-exchange cartridges, and electronic systems components. Maintenance is performed on the instrument when the analyst detects: poor sample peak resolution, high background noise, decreased instrument sensitivity, or failure to meet USEPA instrument quality control requirements.

13.0 DATA QUALITY INDICATORS

13.1 Introduction

The purpose of the DELS-WES Quality Assurance & Data Program is to ensure that the laboratory generates legally defensible and scientifically valid analytical data. The parameters that the laboratory uses to assess data quality are precision and accuracy.

13.2 Accuracy

Accuracy is defined as the closeness of agreement between the measured value and an accepted reference value. Accuracy in the laboratory is determined by the analysis of matrix spikes or standard reference material at a frequency of one per 20 samples (or one per 10 samples if required by the method used) or one per sample batch and determining the percent recovery of the spiked analyte.

- 13.2.1 For measurements where matrix spikes are used, the percent recovery is calculated as follows:

$$\% R = 100 \times \frac{S - U}{C_{sa}}$$

Where:

- % R = Percent Recovery
S = Measured concentration in spiked aliquot.
U = Measured concentration in unspiked aliquot.
C_{sa} = Actual concentration of spike added.

- 13.2.2 When a standard reference material (SRM) is used, the percent recovery is calculated as follows:

$$\% R = 100 \times \frac{C_m}{C_{srm}}$$

Where:

- % R = Percent Recovery



C_m = Measured concentration of SRM

C_{srn} = Actual concentration of SRM.

13.3 Precision

Precision is defined as the agreement among a set of replicate measurements without assumption of knowledge of the true value. Precision in the laboratory is determined by duplicate and replicate measurements at a frequency of at least one per twenty samples or one per sample batch.

13.3.1 If calculated from duplicate measurements (i.e., Sample Duplicate), the relative percent difference is the normal measure of precision.

$$RPD = \frac{(C1 - C2) \times 100}{(C1 + C2)/2}$$

Where:

RPD = Relative percent difference

C1 = Larger of the two observed values

C2 = Smaller of the two observed values

If calculated from three or more replicates, the relative standard deviation is used as the measure of precision.

$$RSD = \frac{S}{Y} \times 100$$

Where:

RSD = Relative standard deviation

S = Standard deviation

Y = Mean of replicate analyses

13.3.2 For microbiological analyses, laboratory precision is evaluated using the range of logs (ROL) of duplicate analyses.

Calculation of Precision QC Criterion – Determine the range of logs for the duplicate colony counts as follows (*Standard Methods for the Examination of Water and Wastewater*, 1998, Page 9-10):

ROL for a Duplicate Set = $\log_{10}(\text{Count 1}) - \log_{10}(\text{Count 2})$

If either result of a duplicate set is < 1, add 1 to both values before calculating the logarithms as follows:



$$\text{ROL for a Duplicate Set} = \log_{10} [(\text{Count } 1) + 1] - \log_{10} [(\text{Count } 2) + 1]$$

$$\text{Precision QC Criterion} = 3.27 \times (\text{Mean Range of Logs for 15 Most Recent Duplicate Sets})$$

13.4 Accuracy and Precision Control Limits

The accuracy and precision values for data acceptance are compared with the respective USEPA method quality control limits. If there is no published USEPA guidance for accuracy and precision, the laboratory will evaluate the data by method performance and method detection limit parameters. The Laboratory Supervisor reviews spike and duplicate results for compliance with method acceptance limits.

When an analyst enters quality control data into the DELS-WES LIMS, the LIMS generates precision and accuracy control charts that are specific for the analyzed parameter. Monthly quality control charts are generated after a set of 20 data points have been established. Two types of quality control limits are plotted on each respective chart: warning limits and control limits. The warning limits correspond to \pm two standard deviations from the mean. The control limits on the chart correspond to \pm three standard deviations from the mean. The control limits for bias are based on the USEPA-derived historical mean recovery \pm three standard deviations. The control limits for precision range from zero to the USEPA-derived historical mean relative percent difference plus or minus three standard deviation units. Data that fall outside of the control limits are not valid and the analysis must be repeated or the results qualified accordingly.

13.5 Method Detection Limit (MDL)

The MDL is the greater of the MDL_S or the MDL_B.

$$\text{MDL}_S = 3.14 \times S_S$$

Where:

MDL_S = the method detection limit based on spiked standards

3.14 = the Student's t-value for 7 replicates

S_S = standard deviation of the replicate spiked standards

$$\text{MDL}_B = \bar{X} + 3.14 \times S_B$$

Where:

MDL_B = the method detection limit based on method blank

3.14 = the Student's t-value for 7 replicates

S_B = standard deviation of the replicate method blanks

Standard deviation is defined as follows:

$$s = \sqrt{\sum_{i=1}^n \frac{(y_i - \bar{y})^2}{n - 1}}$$

Where:

S = Standard deviation



y_i = Measured value of the i^{th} replicate

\bar{y} = Mean of replicate measurements

n = number of replicates

14.0 CORRECTIVE ACTION

14.1 Introduction

DELS-WES continually monitors its analytical data for compliance with its quality control plan and established quality assurance guidelines. The laboratory initiates corrective action procedures when errors, deficiencies, deviations, or laboratory data fall outside of established acceptance criteria. Unacceptable quality assurance data will result in the respective sample batch being labeled as suspect data. The need for corrective action may be identified by system or performance audits, or by standard quality control procedures.

14.2 Corrective Action Procedure

The corrective action procedures that DELS-WES uses for suspect data are:

- 14.2.1 Qualify data that fall outside of the quality control limits
- 14.2.2 Investigate and identify the problem
- 14.2.3 Determine the appropriate corrective action to be taken. The DELS-WES Laboratory QA & Data Manager shall discuss the proposed remedial action with the Laboratory Supervisor, whose data failed to meet acceptance criteria.
- 14.2.4 Implement a corrective action plan and evaluate the results. The corrective action plan will consist of examining sample collection practices, methodology, reagents, solvents, sample preparation and analysis. Recommended quality control procedures would consist of the use of reference quality control samples, performing matrix or sample spikes, and solvent blanks.
- 14.2.5 Document that corrective action has eliminated the problem.
- 14.2.6 Release data that are in compliance with quality control limits.
- 14.2.7 All corrective action taken is documented in the DELS-WES Corrective Action Form (see Form 4).

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

- 15.1 If available manpower allows, the DELS-WES Laboratory QA & Data Manager prepares quality assurance reports to the DELS-WES Director. These reports may include any of the following quality assurance program activities:
 - 15.1.1 Revisions of the DELS-WES Laboratory Quality Assurance Plan and of general and analytical method Standard Operating Procedures
 - 15.1.2 Results of systems and performance audits



- 15.1.4 Recommended corrective actions and results of corrective actions taken.
- 15.1.5 Data quality assessment of accuracy, precision, and method detection limit results.
- 15.1.6 Determination of whether stated quality assurance objectives were attained.
- 15.1.7 Limitations on the use of generated analytical data.

16.0 TRAINING

- 16.1 The laboratory supervisors are responsible for the training of all employees under their direct supervision. Bench analysts develop and demonstrate proficiency in new analytical methods by performing initial demonstration of capability (IDC) and method detection limit (MDL) studies for each analytical method. IDC and MDL determinations are documented in Form 5. Bench training of laboratory staff is documented in Form 6. External training of laboratory staff is documented in Form 7, group-sign in sheets, training completion documentation, or email confirmations.

17.0 LABORATORY HEALTH AND SAFETY

17.1 Safety Equipment

WES provides its laboratory personnel with laboratory coats and eye protection as well as other laboratory safety equipment. Laboratory personnel must wear laboratory coats, gloves, and eye protection at all times when working in the laboratory. When special laboratory operations warrant, the analyst shall wear a face shield, heat-resistant gloves, and/or hearing protection. An appropriate cartridge respirator may be worn if the analyst has been properly trained, fitted, and approved to use.

The laboratory has the following equipment for maintaining a safe working environment:

- 17.1.1 A-B-C type fire extinguishers located throughout the building
- 17.1.2 Laboratory fume hoods and biological safety cabinets that are inspected and certified annually
- 17.1.3 Eye wash stations and emergency showers located in each laboratory
- 17.1.4 Automated External Defibrillator (AED) unit and staff members who are trained in its use
- 17.1.5 Spill clean-up kits for acids, alkalis, and organic solvents.
- 17.1.6 Dollies for transportation of compressed gas cylinders
- 17.1.7 First aid kits
- 17.1.8 N-95 Masks.
- 17.1.9 Emergency public address system from each phone in the building.
- 17.1.10 Central security and fire alarm (sensor and pull-box) system for the facility
- 17.1.11 Warning and Exit signs located throughout the building.
- 17.1.12 Safety Data Sheets (SDSs) for chemicals and standards used in the laboratory



- 17.1.13 Explosion-proof refrigerators for the storage of organic solvents
- 17.1.14 Flammable storage refrigerator for reagents, standards, and samples
- 17.1.15 Designated receptacles for the disposal of broken glass and other sharps.
- 17.1.16 HVAC system with exhaust hoods and snorkels (at the bench) and visible and audible alarms to indicate system imbalance.
- 17.1.17 Inert gas desiccators/storage cabinets.

17.2 WES Laboratory Safety Procedures

WES has adopted the following laboratory safety procedures to protect its staff:

- 17.2.1 Food and beverages are not allowed to be stored or consumed within any of the DELS-WES laboratories. Drinking water fountains are located outside of the laboratories.
- 17.2.2 Smoking is not permitted within the entire WES facility. Smokers outside the building must be at least 25 feet away from the building.
- 17.2.3 Laboratory coats, gloves, respirators and other laboratory apparel must not be worn outside of the laboratory in a public area or where food is consumed. DELS-WES uses ONLY ready-to-use disposable laboratory coats. When dirty/soiled, the laboratory coats are properly disposed of; lab coats that are especially soiled with hazardous materials are disposed of as hazardous waste. Laboratory coats must never be taken home.
- 17.2.4 Personal items such as coats, hats, umbrellas, and purses are to be stored outside of the laboratories. Staff are allowed to carry personal cell phones, but must follow decontamination procedures and exit the lab to initiate or answer personal calls. Personal or office/desk laptops must not be brought into laboratories.
- 17.2.5 Laboratory benches must be kept free of clutter and properly organized.
- 17.2.6 Working alone outside of normal work hours requires approval by the laboratory supervisor and the WES Director.
- 17.2.7 Mouth pipetting is prohibited; the use of pipette filling bulbs/devices is required for all pipette use.
- 17.2.8 Contact lenses may not be worn in the laboratory.
- 17.2.9 Protective impact-resistant lenses are required at all times in all laboratories.
- 17.2.10 Face shields are required when potential spill, splatter, or impact conditions may occur.
- 17.2.11 All chemical storage containers must be labeled. All unlabeled bottles are automatically discarded.
- 17.2.12 Separate recycle containers are provided in each laboratory for recycling of paper, non-contaminated disposable laboratory plasticware, and non-contaminated disposable laboratory glassware. Broken non-contaminated glassware is not recyclable and must be placed in specifically located cardboard boxes designed for safe disposal of broken glass. When full, these boxes are discarded in the regular trash.



- 17.2.13 Hazardous waste solvents and other hazardous waste chemicals are transferred to the WES Hazardous Waste/Chemical Storage facility for storage and to await removal by a licensed hazardous waste management contractor. Items contaminated with hazardous material are disposed of properly and not recycled or placed in the trash.
- 17.2.14 Used glassware must be emptied of solutions and solvents and rinsed with water before being released for regular cleaning. If special instructions for cleaning are necessary, clean-up personnel must be informed.
- 17.2.15 Chipped and cracked glassware must be placed in the glass-recycling container after being cleaned and decontaminated.
- 17.2.16 All laboratory analyses are to be reviewed for possible safety problems.
- 17.2.17 Safety shields are required around high-vacuum or high-pressure reactions.
- 17.2.18 Gas cylinders must be properly secured before removing protective caps.
- 17.2.19 Chemicals must be separated for storage based on chemical reactivity (e.g., oxidizers are stored together in a separate cabinet from other chemicals).
- 17.2.20 Movement of laboratory visitors within the facility shall be restricted. If visitors are allowed in the laboratory, they must be accompanied by a member of the staff and provided with eye protection, as necessary.
- 17.2.21 Hand washing is required after removing protective gloves and after returning to the laboratory from the restroom or from other outside areas.
- 17.2.22 Before use of any new, repaired, or moved equipment, the equipment shall be tested and inspected.
- 17.2.23 No storage of any type is allowed in the hallways, especially chemical or gas cylinder storage.
- 17.2.24 All operations that could result in the release of vapors or airborne particles, including pathogens, shall be performed in a suitable fume hood, ventilated bench, or biological safety cabinet.
- 17.2.25 In order to control and avoid inhalation of powdered microbiological culture media, all such media shall always be weighed out under containment in a vented, negative-pressure biological safety cabinet or weighing hood, or under a negative-pressure snorkel.
- 17.2.26 All surfaces shall be cleaned immediately if a spill occurs and at the end of the workday.
- 17.2.27 Testing of samples or chemicals by taste is forbidden, and odors should only be checked with care.
- 17.2.28 Limit the quantity of solvents and other chemicals in the laboratories; keep large chemical quantities in the WES Hazardous Waste/Chemical Storage facility.
- 17.2.29 See WES Health and Safety Plan for further details.



18.0 RECORDS MANAGEMENT, RETENTION, AND SECURITY

18.1 All analytical data reports, including sample identification information and QC data, generated by DELS-WES laboratories since February 1998 are stored electronically in the DELS-WES LIMS and in MassDEP secure drives that are backed up every business day. For all samples received through the end of calendar year 2007, the final analytical reports are also printed and the hard copy filed with the original Sample Tracking/COC Form in the WES Main Office for approximately one year. After one year, these reports are stored in the DELS-WES Records Storage Room for an additional 9 years and then destroyed after permission for destruction is granted by the State Records Retention Board. Starting with samples received at the beginning of calendar year 2008, the final analytical reports are no longer printed.

18.2 Starting with samples received at the beginning of calendar year 2008, all raw analytical data for a specific analytical method run (including raw PT data), including associated standard/reagent preparation form(s) and Level 1 QA Review Form are scanned and saved electronically under the specific Sample Master LIMS QC batch number, or WinLIMS Worklist (WL) batch number in a MassDEP secure drive.

The Sample Master Level 1 QA Review Form lists the Sample Master LIMS sample login number(s) associated with a specific QC batch number. The hard copy of the scanned data file is filed by the specific LIMS QC batch number in the laboratory that produced the data; this hard copy file is kept in the laboratory for approximately two years and is then transferred to the WES Records Storage Room for an additional 8 years and then destroyed after permission for destruction is granted by the State Records Retention Board.

18.3 Starting with samples received at the beginning of calendar year 2008, the final analysis report, Sample Tracking/COC Form, Sample Conditions Review Form, are saved electronically under the specific LIMS sample login number in a MassDEP secure drive. Prior to the introduction of WinLIMS, Level 2 Review Forms were saved with the Login Batch. Starting in 2017, for analyses managed in WinLIMS, the Level 2 Review Report is saved with the specific WL Batch. The hard copy of this file (i.e., Sample Tracking/COC Form, Sample Conditions Review Form, and Level 2 QA Review Form where applicable) is filed by the specific LIMS sample login number in the WES Main Office for approximately one year and is then transferred to the WES Records Storage Room for an additional 9 years and then destroyed after permission for destruction is granted by the State Records Retention Board. It should be noted that for analyses managed in Sample Master, the Level 2 QA Review Form(s) list the LIMS QC batch number(s) associated with all requested analyses for the samples in a given sample login number. Therefore, by combining the data under the specific sample login number and those under the associated QC batch number(s), we can easily generate a complete electronic or printed data package for all the samples submitted by a client in a given Sample Tracking/COC Form.

18.4 All raw IDC/MDL data for all staff are filed for approximately two years in the laboratory that produced the data and then are transferred to the WES Records Storage Room for an additional 8 years and then destroyed after permission for destruction is granted by the State Records Retention Board. Starting at the beginning of calendar year 2008, these data are also scanned and saved electronically under the specific laboratory in a MassDEP secure drive.

18.5 Records of purchased analytical standards, including analytes and concentrations, name of vendors, dates of receipt, and expiration dates are filed for approximately two years in the pertinent laboratory and then are transferred to the WES Records Storage Room for an additional 8 years and then destroyed after permission for destruction is granted by the State Records Retention Board. Starting at the beginning of calendar year 2008, these data are also scanned and saved electronically under the specific laboratory in a MassDEP secure drive.



- 18.6 Records of prepared analytical standards and reagents, including traceability to purchased stocks, analytes and concentrations, dates of preparation, initials of preparer, and expiration dates are filed for approximately two years in the pertinent laboratory and then are transferred to the WES Records Storage Room for an additional 8 years and then destroyed after permission for destruction is granted by the State Records Retention Board. Starting at the beginning of calendar year 2008, these data are also scanned and saved electronically under the specific QC batch number(s) in a MassDEP secure drive
- 18.7 Access to all WES electronic records is limited to authorized WES/MassDEP personnel via password protection. All DELS-WES electronic data are backed up daily.
- 18.8 Hard copy laboratory records filed within the individual DELS-WES laboratories, in the WES Main Office, and in the WES Records Storage facility are considered to be secure as access to the WES building is strictly limited to authorized personnel. Non-MassDEP visitors must sign in at the WES front office and be escorted by a WES employee during the entire visit.
- 18.9 SOPs and Other Control Documents. Only 3 DELS-WES employees have write-access to final/active control documents and access to the electronic signature files: i.e., the DELS-WES Director, Laboratory QA & Data Manager, and the Document Control Custodian (Program Coordinator). Only these 3 employees make changes and add the electronic signatures to the electronic control documents. All new control documents as well as changes and updates are given to the Document Control Custodian who then makes the changes using "Track Changes" The staff who are responsible to approve the document reviews and then notifies the Custodian that the document has been approved. The custodian then inserts the signature and date of approval.
- 18.10 DELS-WES laboratories record observations, data, and calculations at the time they are made. Handwritten records are made in ink, not pencil. Mistakes in records are crossed out with a single line such that the original entry is still legible and the correct value is entered. All alterations to records are signed and dated by the person making the correction and a brief explanation for the correction is provided when necessary. In the case of records stored electronically, equivalent measures are taken to avoid loss or change of original data.

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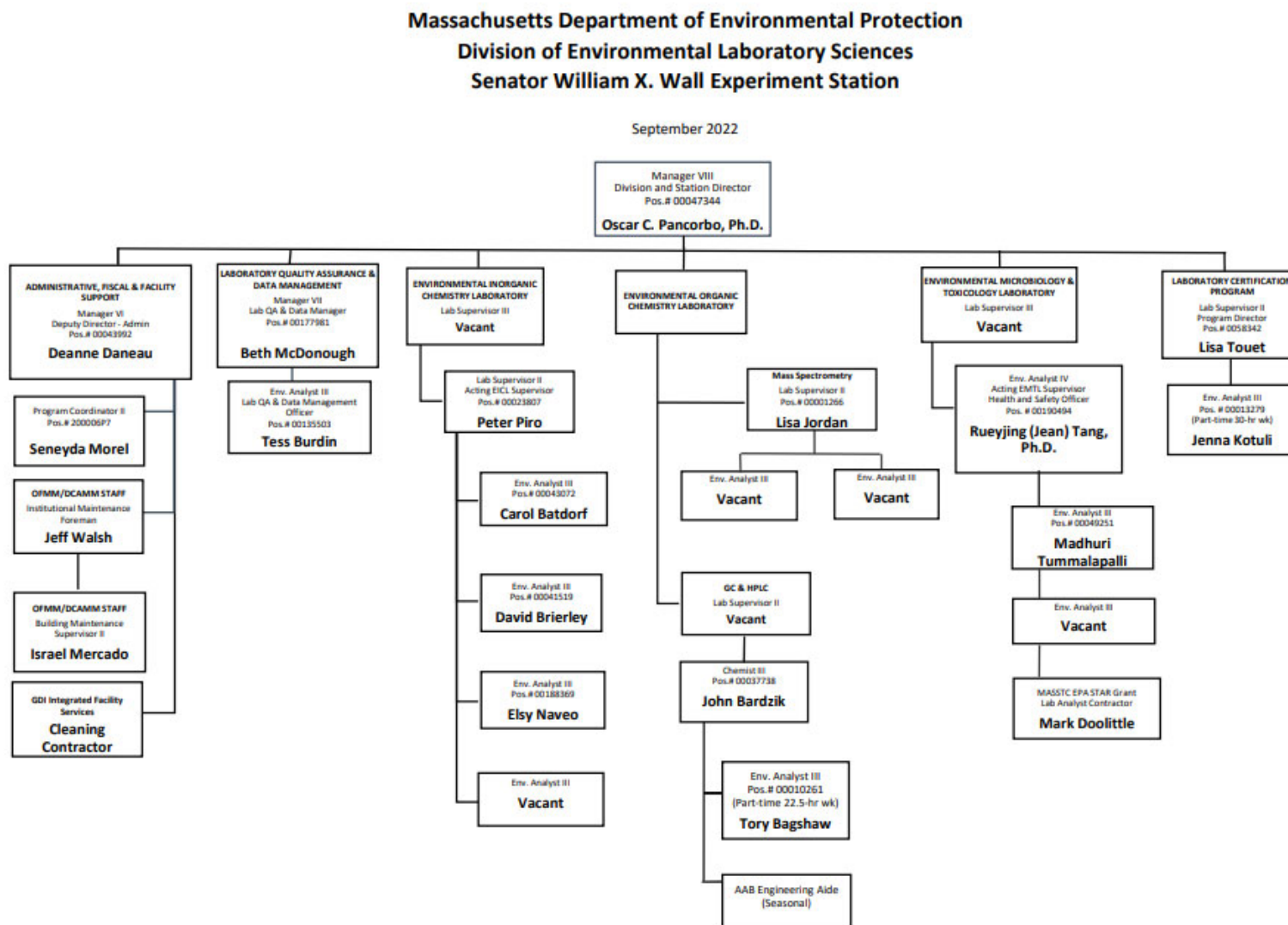
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20.0 FIGURES, TABLES, FORMS, AND REPORTS

FIGURE 1. ORGANIZATIONAL CHART

Organizational Chart for the MassDEP Division of Environmental Laboratory Sciences, Senator William X. Wall Experiment Station

FIGURE 1



TABLES

TABLE 1. DELS-WES TECHNICAL AND SUPPORT PERSONNEL

Position/Title	Name	Educational Degree(s) & Major(s)	Present Specialty	Primary Responsibility (Includes Analytical Methods)	Years of Experience in Field
Administration, Laboratory QA & Data Management, and Support Services					
Division & Station Director	Oscar Pancorbo	Ph.D. & M.S., Environmental Engineering Sciences B.S., Zoology	Environmental Microbiology & Toxicology	DELS-WES Administration	43
Laboratory QA & Data Manager	Beth McDonough	B.S., Chemical Engineering	Env Data Mgmt & Regulatory Processes Analysis	Laboratory QA & Data Management	37
Laboratory QA and Data Management Officer	Tess Burdin	B.S., Microbiology	Environmental Microbiology and QA & Data Management	Laboratory QA & Data Management	20
Administrative, Fiscal & Facility Deputy Director	Deanne Daneau	A.S., Biology, Registered Nurse	Accounting & Facility Management	DELS-WES Administration, Cost Center Accounting & Budget Management, and Facility Maintenance/Management	33
Program Coordinator II	Seneyda Morel	MS., Business Management	Fiscal and Administrative Specialist	WinLIMS Sample Login and Data Entry, WES Front Office Receptionist, Shipping-and-Receiving Clerk, DELS-WES Records Administration & Other Administrative Duties	14
Laboratory Certification Program					
Laboratory Certification Program Director & Lab Certification Officer – Chemistry (Inorganic & Organic) & Microbiology	Lisa Touet	B.S., Biochemistry	Environmental Chemistry & Microbiology	Management of the Laboratory Certification Program; Inspection of Chemistry (Inorganic & Organic) & Microbiology Laboratories; Lab Cert Fees, Database, Permit (SMS/Accela), and Records Administration	35

TABLE 1. DELS-WES TECHNICAL AND SUPPORT PERSONNEL

Position/Title	Name	Educational Degree(s) & Major(s)	Present Specialty	Primary Responsibility (Includes Analytical Methods)	Years of Experience in Field
Lab Certification Officer – Microbiology	Jenna Kotuli	B.A., Env. Science	Environmental Microbiology	Microbiology Lab Inspections & Other Lab Certification Duties and Lab Quality Assurance Duties	23
Environmental Microbiology and Toxicology Laboratory					
Acting Laboratory Supervisor; Health, Safety, & Emergency Preparedness Officer; and EMS Support	Jean Tang	Certified Microbiologist (NRCM), Certified Biological Safety Professional (ABSA), Ph.D., Env., Coastal, & Ocean Sciences M.S., Life Sciences B.S., Agricultural Chemistry	Environmental Microbiology & Molecular Microbiology; Biological and Environmental Safety	Direct Supervision of all Microbiology Laboratory Work; Lead Analyst for all PCR, RT-PCR, and rep-PCR Testing; Analytical Support for all Microbiology Laboratory Work; Management of WES Health, Safety, & Emergency Preparedness Programs; and EMS Support	33
Environmental Laboratory Scientist and Backup Supervisor in Absence of Supervisor	Madhuri Tummalapalli	M.S., Env. Science M.S., Plant & Soil Sciences B.S., Agricultural Sci.	Environmental Chemistry & Microbiology	Analytical Support for all Culturable Microbiology and Toxicology Laboratory Work and BOD ₅ assay.	27
Molecular Microbiology Laboratory Scientist	Mark Doolittle	M.S., Microbiology B.S., Biology	Environmental Microbiology & Molecular Microbiology	MASSTC EPA STAR Grant Contract Laboratory Analyst	33
Environmental Inorganic Chemistry Laboratory					
Acting Laboratory Supervisor	Peter Piro	B.A., Chemistry; Biology Minor	Analytical & Environmental Chemistry	Analytical Support for all Inorganic Chemistry Laboratory Work; and Lead Analyst for EPA 200.8, EPA 300.0, EPA 300.1, & EPA 6020.	33

TABLE 1. DELS-WES TECHNICAL AND SUPPORT PERSONNEL

Position/Title	Name	Educational Degree(s) & Major(s)	Present Specialty	Primary Responsibility (Includes Analytical Methods)	Years of Experience in Field
Environmental Laboratory Scientist	Carol Batdorf	M.S., Oceanic Sciences B.S., Aquatic Environments, Biology and Geology Minors	Environmental Chemistry	Lead Analyst for EPA 7473, and SM 2340 B; Analytical Support for all Inorganic Chemistry Laboratory Work.	40
Environmental Laboratory Scientist	David Brierley	M.S., Env. Studies B.S., Geology B.S., Chemistry	Environmental Chemistry	Analytical Support for all Inorganic Chemistry Laboratory Work; and Lead Analyst for Cyanide by SM 4500-CN C/E, nutrients and chloride in watershed samples.	28
Environmental Laboratory Scientist	Elsy Naveo	B.S., Chemistry	Environmental Chemistry	Analytical Support for all Inorganic Chemistry Laboratory Work; and Lead Analyst for EPA 200.7, EPA 6010D, and nutrient analyses using the discrete analyzer.	8
Environmental Organic Chemistry Laboratory					
Laboratory Supervisor, GC & LC	Vacant		Environmental Chemistry	Supervision of all GC & LC Laboratory Work	
Senior Environmental Chemist	John Bardzik	M.S., Plastics B.S., Chemistry	Environmental Chemistry	Analytical Support for all GC & LC Laboratory Work	38
Environmental Laboratory Scientist	Tory Bagshaw	M.S., Env. Studies B.A., Chemistry	Environmental Chemistry	Analytical Support for all GC & LC Laboratory Work	26
Laboratory Supervisor, Mass Spectrometry	Lisa Jordan	B.A., Chemistry	Environmental Chemistry	Supervision of all MS Laboratory Work; Lead Analyst for all LC/MS/MS Work – EPA 545 (Anatoxin-a & Cylindrospermopsin), EPA 537.1 and 533 (PFAS), and EPA 1694	13
Environmental Laboratory Scientist (2 Positions)	Vacant			Lead Analyst for EPA 524.3, 525.2, 8260D, 8270E, 522, Caffeine, and MA VPH	

TABLE 2. ENVIRONMENTAL MICROBIOLOGY AND TOXICOLOGY LABORATORY EQUIPMENT

TABLE 2. Environmental Microbiology and Toxicology Laboratory Equipment

Item	No. of Units	Method	Manufacturer	Model
Analytical Balance 0.1 mg readability Stable base ASTM Class 1 weights (Troemner) Service contracts	1		Mettler-Toledo	MS204S
Magnetic Stirrer Variable speed TFE coated stir bar	3		Thermolyne Thermolyne VWR	Cimarec 2 Nuova 97042-630
pH Meter Accuracy ± 0.01 units Line Usable with specific ion electrodes	2		Beckman Orion	390 Star A211
Vortex	3 6 1		VWR Scientific Industrial VWR	G562 SI-A236 Plate 89399-880
Hot Plate Temp Control Temp Control and Magnetic Stirrer	1 2		Corning Corning	PC351 PC620-D
Centrifuge Various speeds	8		Beckman Eppendorf Eppendorf Eppendorf Eppendorf Fisher	Avanti J-25 5810R 5804R 5424R 5424 (3 units) 141000143
Mini Centrifuge	3		VWR Fisher Argos Centrifuge	C1213 05-090-100 Flexifuge

TABLE 2. Environmental Microbiology and Toxicology Laboratory Equipment

Item	No. of Units	Method	Manufacturer	Model
Refrigerator/Freezer Standard laboratory Capable of maintaining nominal temperature of $4 \pm 2^{\circ}\text{C}$ Ultra-low temperature (-80 to -85°C) freezers (2) Walk-in cooler Standard freezers capable of maintaining $\leq 10^{\circ}\text{C}$	6 9		Hotpoint Revco Thermo Scientific Maytag VWR Fisher Scientific Harris Environmental Systems	CTX14catgrwh RCF252A14 TSX Series x (2)
Thermometer Alcohol filled and electronic Celsius 1°C or finer subdivision to 180°C NIST certified or traceable Max temperature mercury	Several 2			
Infrared Thermometer (1°C Resolution)	1		Control Company	4472
Glassware Borosilicate Volumetrics should be class A	Several			
Spectrophotometer Range 400 – 700 nm Band width - < 20 nm Use several size & shape cells Pathlength 1 – 5 cm	1		Genesys	Spectronic 20 Genesys
UV Viewing Cabinet	1		UVP Chromato-Vue	C-70G
UV Sterilizer	5		Millipore	XX6370000
Water Bath Electric or steam heat Control within 5°C to 100°C	4	Virology Fecal Coliforms & <i>E. coli</i>	NB Science Fisher Thermo/Precision VWR	Innova 3000 Isotemp 210 2862 1230

TABLE 2. Environmental Microbiology and Toxicology Laboratory Equipment

Item	No. of Units	Method	Manufacturer	Model
Dry Bath	2		Fisher Corning	110033 H1086785-SB
Glassware Filtration funnels	20		Kimble	
Desiccators	4		Bel-Art	
Quanti-Tray Sealer	2	Enterolert SM 9223-MPN	IDEXX	Model 2X PLUS
Incubator 35°C – Low Temp Incubator 41.0°C 36.5°C – CO ₂ Incubator 35.0°C 20°C – Low Temp Incubator	1 1 1 1 1	SM5210	VWR VWR VWR Thermo VWR	2020 1535 2500 Heratherm IGS 750 3733A
Reverse osmosis/ultra-filtration reagent water (ASTM Type I) system	1		Thermo Scientific- Barnstead	Barnstead- Genpure
Autoclave with RO (SRB 800)	2		Gettinge	LSS 275
Biological safety cabinets	7		NuAire	
Fume hood	1		Thermo-Fisher Scientific	Hamilton Safe Aire II
Microscopes Compound Scope Dissecting Scope Inverted Scope	1 3 2		Spencer American Optical Leica Quebec Olympus BH2 VWR Nikon	A1424 9925 LAB-0443 89404-476 TMS-F
Ice Maker	1		Scotsman	UF424A-1A

TABLE 2. Environmental Microbiology and Toxicology Laboratory Equipment

Item	No. of Units	Method	Manufacturer	Model
Dishwasher	1		Lancer	815LX
Glove Box	1		Germfree	Custom-built
Conductivity Meter	1	Method 2510B	Fisher Scientific	09-330/FB61273
PCR workstation	2		AirClean	300
Microplate reader	1	Toxicology	Awareness Technology	ChroMate 4300
Extraction & Purification system (Nucleic Acid)	1	Molecular Microbiology	Thermo Fisher	KingFisher Apex
Real Time PCR System	1	Molecular Microbiology	Applied Biosystems	7500 Fast
Homogenizer	1	Molecular Microbiology	MB Biomedical	FastPrep-24 5G
Gel Imaging System	1	Molecular microbiology	Bio-Rad	GelDoc Go
BioAnalyzer Instrument	1	Molecular Microbiology	Agilent	2100 Bioanalyzer
Liquid Sample Concentration System	1	Virology	Innova Prep	Innova Prep
Droplet Digital PCR System Including: Droplet Generator Deep-Well Thermal Cycler Droplet Reader	1	Molecular Microbiology	Bio-Rad	QX200
Digital PCR System	1	Molecular Microbiology	Qiagene	QIAcuity One, 5plex
Nano Drop 2000c	1	Molecular Microbiology	Thermo	2000c
Thermocycler	1	Molecular Microbiology	Eppendorf	Mastercycler gradient
Dissolved Oxygen Meter	1	SM5210	YSI	5000

TABLE 3. ENVIRONMENTAL INORGANIC CHEMISTRY LABORATORY EQUIPMENT

TABLE 3. Environmental Inorganic Chemistry Laboratory Equipment

Item	No. of Units	Method	Manufacturer	Model
Analytical Balance 0.1 mg readability Stable base ASTM type 1 (Troemner) Under service contracts	2 1		Mettler Toledo	XS 104 ME54TE/00
Top Loading Balance Under service contract	2		Mettler Mettler	PE 1600 ME4002E
Magnetic Stirrer Variable speed TFE coated stir bar	Several		Fisher Scientific	
Ph Meter Accuracy ± 0.1 Ph units Line Usable with specific ion electrodes	2 1	SM 4500 HB	Thermo Fisher Orion Beckman Thermo Fisher Orion	VSTAR80 510 Versa Star Pro
Conductivity Meter Readable in ohms or mhos Range of 2 ohms to 2 mhos Line or battery	2	SM 2510B	YSI	35 3200
Hot Plate -temp control	1		Thermolyne	2200
Color Standards To verify wavelength photometers Should cover 200-800 nm	Several			
Refrigerator Standard laboratory, explosion proof for organics Refrigerators capable of maintaining nominal temperature of 4°C	5 Large; 5Under bench		8 Fisher 1 Thermo Scientific 1 Marvel	

TABLE 3. Environmental Inorganic Chemistry Laboratory Equipment

Item	No. of Units	Method	Manufacturer	Model
Freezer Freezers capable of maintaining at least -10°C	6		3 Frigidaire 1 Maytag 1 Fisherbrand	
Refrigerator/Freezer	1		Frigidaire	
Drying Oven Gravity or convection Controlled from room temp to 180°C or higher ($\pm 2^\circ\text{C}$)	1	SM 2540 B, C, D, G	VWR	1370FM
Muffle furnace To 450°C for cleaning organic glassware	1	SM 2540 G	Thermolyne	FA1730
Thermometer Infra-Red 1°C resolution	1		Traceable	4472
Glassware Borosilicate, HDPE, PTFE, PMP Volumetrics and pipettes Class A	Several			
Spectrophotometer, UV-Visible Range 185 – 1200 nm Band width – 0.2, 0.5, 1.0, 2.0, 4.0 nm Standard cuvette path length 10 mm	1	SM 4500 CN E SM 3500 Cr D SM 4500-CI G SM 5220 D	Analytik Jena	SPECORD PLUS 210 Double-beam Spectrophotometer
Turbidimeter	1 1	SM 2130 B	HACH HACH	2100 AN TL2300
TCLP Extractor	2	EPA 1311	Millipore	
High pressure filter system	1	EPA 1311	Millipore	
Direct Mercury Analyzer DMA80	2	EPA 7473	Milestone	DMA80
Analytical Balance with DMA80	2	EPA 7473	Presisa	XB220A

TABLE 3. Environmental Inorganic Chemistry Laboratory Equipment

Item	No. of Units	Method	Manufacturer	Model
Microwave Digestor	1	EPA 3015A EPA 3051A EPA 3052	Milestone	Ethos EZ
Hot Block 54 positions; 50ml digestion tubes	1	EPA 200.2	Environmental Express	SCI54
48 position; 50ml digestion tubes	1	EPA 3010A EPA 3050B	Perkin Elmer	SPB 50-48
COD Closed Reflux Reactor	1	SM 5220 D	Velp Scientifica	ECO 25 Thermoreactor
Mill Stainless Steel Screens 0.5-mm, 1-mm, 2-mm, & 5-mm mesh sizes	1		Thomas Scientific	Wiley Laboratory Mill, Model 4
Inductively Coupled Plasma – Mass Spectrometer Pulse-Analog Dual Detector Kinetic Energy Discrimination (KED) Dynamic Reaction Cell Computer Controlled, Syngistix V2.5 Background Correction RF Generator Autosampler Chiller Argon, Helium Gas Supply UPS	1	EPA 200.8 EPA 6020	Perkin Elmer Elemental Scientific PowerVar	NexION 1000 SC-4DX FAST ABCDEF800022

TABLE 3. Environmental Inorganic Chemistry Laboratory Equipment

Item	No. of Units	Method	Manufacturer	Model
Inductively Coupled Plasma Spectrometer Atomic Emission Spectrophotometer Simultaneous Dual-View Computer Controlled – Syngistix Background Correction RF Generator Autosampler Chiller Argon, Nitrogen, and Compressed Air Gas Supplies UPS	1	Metals EPA 200.7 Minerals EPA 6010D	Perkin-Elmer Elemental Scientific PowerVar	Optima 8300 DV SC-4DX prepFAST ABCDEF520022
Ion Chromatograph Inline Filtration Autodiluter & Intelligent Dilution Computer-controlled, Software	2	EPA 300.0 EPA 300.1 EPA 218.6	Metrohm	930 Compact Flex with 858 autosampler; 930 Compact Flex, 944 UV/Vis Detector, 919 autosampler
Automated Segmented Flow Analysis System Multi-channel pump Manifold, colorimeter Autosampler Standard Predilution Utility	2	Modified SM 4500 NH3-N (B,G) SM 4500 NO3 + NO2-N F SM 4500 Cl E SM 4500-P B(6) F Modified SM 4500-N C w/ SM4500 NO3 + NO2-N F	Skalar	San ++

TABLE 3. Environmental Inorganic Chemistry Laboratory Equipment

Item	No. of Units	Method	Manufacturer	Model
Discrete Analyzer Autosampler Autodiluter	1	SM4500NO3+NO 2-N F SM 4500 Cl E	Seal Analytical	AQ400
Moisture Analyzer	1	AOAC Int. 950.46B.(b)	Leco	TGM800
Freeze Dryer	1	DEP DELS SOP LabconcoPreeZo ne20150311	Labconco	FreeZone 2.5 Model 76705
Reagent Water (ASTM Type I) system	1 2		Millipore Thermo Fisher/Barnstead	Milli Q A10 Advantage GenPure (UV-TOC Model)
Fume Hoods Standard fume hoods Metal-free fume hood	10 1		Thermo Scientific Nuair	Hamilton Safe Aire II
Auto-Titrator	1	SM 2320B	Metrohm	-855 Robotic Titrator
Cyanide Distillation	1	SM 4500 CN C EPA 9010C	Environmental Express	SimpleDist
Desiccator	3 2		Bel-Art Bel-Art	Secador 120V, Model 4.0, Cat # F420741118 Inert Gas Purged Model 4.0, Cat #F420741009
Air Displacement Pipettes	Several	General Use	BrandTech	2-20 µL 5-50 µL 10-100 µL 10-1000 µL 20-2000 µL 500-5000 µL 1000-10,000 µL

TABLE 4. ENVIRONMENTAL ORGANIC CHEMISTRY LABORATORY – GC/LC SECTION EQUIPMENT

TABLE 4. Environmental Organic Chemistry Laboratory – GC/LC Equipment

Item	No. of Units	Method	Manufacturer	Model
Analytical Balance 0.1 mg readability Stable base ASTM type 1 weights (Troemner)	1		Mettler	AB 204
Refrigerator/Freezer Standard laboratory, explosion proof for organics Refrigerators capable of maintaining nominal temperature of 4°C. Freezer capable of maintaining a nominal temperature of -10°C.	7		2 Fisher Scientific refrigerators (samples)(extracts) Fisher Scientific refrigerator, explosion proof (standards) VWR refrigerator (air samples only) VWR, explosion proof refrigerator (air sample extracts only)	Frost clear 13-986-152 IsoTemp R406GABA R406XABA
Drying Oven Gravity or convection Controlled from room temp to 180°C or higher ($\pm 2^{\circ}\text{C}$)	1		Fisher	750G Isotemp
Flashpoint Tester	1	EPA 1010A	PetroTest	PMS-4
Thermometer Methanol filled Celsius submerged in ethylene glycol -5°C to 15°C (0.5°C or finer subdivision) NBS certified or traceable	5		Ertco	Refrigerator thermometers
Infrared Thermometer (1°C Resolution)	1		Control Company	4472

TABLE 4. Environmental Organic Chemistry Laboratory – GC/LC Equipment

Item	No. of Units	Method	Manufacturer	Model
Glassware Borosilicate Volumetrics, Class A Separatory funnels Kuderna Danish (K-D) concentrators	Several		Kontes, Pyrex, Fisher, & VWR	Various
Steam Bath/Concentrators Electric-generated steam heat with solvent recovery system Control within 0.1°C to 100°C Electric-generated steam heat with nitrogen blowdown.	1		Organomation	S-Evap-KD
	1	MA DEP 555 EPA 3510 EPA 3545A	Thermo-Fisher	Rocket Evaporator
Heat block with nitrogen blowdown	1	Lipid determination TPH	Lab-Line	Multi Block
Digital steel-shot heating bath	1	EPA 552.3	VWR	Digital Heat Block
Extraction Apparatus Accelerated Solvent Extractor	1	EPA 3545A	Dionex	ASE 350
Fume hoods	8		Thermo Scientific	Hamilton Safe Aire II (4-, 6- & 8-ft)
Gas Chromatograph Split/splitless injection Oven temp control $\pm 0.2^{\circ}\text{C}$ Oven temp programmer	1	EPA 552.3	Thermo Scientific	1310 GC-ECD
	1	Oil ID & MA EPH	Thermo Scientific	1310 GC-FID
Electron capture detector Linearized	2 on 1 GC	See above	Thermo Scientific	1310 GC-ECD
Flame ionization detector	1	See above	Thermo Scientific	1310 GC-FID

TABLE 4. Environmental Organic Chemistry Laboratory – GC/LC Equipment

Item	No. of Units	Method	Manufacturer	Model
High Performance Liquid Chromatograph Constant flow Capable of injecting 1 – 200µL Gradient System Post column reactor Fluorescence detector Isocratic System Photoarray/UV detector	1	EPA 531.2 MassDEP 555 Carbonyl compounds	Waters Waters	Alliance HPLC Acquity UPLC H-Class
TOC/DOC Analyzer	1	SM 5310 C	Teledyne Tekmar	Fusion

TABLE 5. ENVIRONMENTAL ORGANIC CHEMISTRY LABORATORY – MS EQUIPMENT

TABLE 5. Environmental Organic Chemistry Laboratory – MS Equipment

Item	No. of Units	Method	Manufacturer	Model
Analytical Balances 0.1 mg readability Stable base ASTM type 1 weights (Troemner)	2		Mettler	AB204 AL104
Fume hood	1		Thermo Scientific	Safe Aire II (4-ft)
Hot Plate -temp control	2		Equatherm Corning	
Refrigerator/Freezer Standard laboratory, explosion (5) or flammable (2) proof for organics Capable of maintaining nominal temperature of 4°C for refrigerators and -10°C for freezers	3 Refrig. 4 Freezer		Thermo Scientific (2) Fisher Scientific (1) VWR Scientific (1) Fisher Scientific (3)	
Gas Generator Hydrogen Generator	1		Packard	9200
Sample Concentrator	1 1	EPA 537.1 EPA 533	Thermo Scientific Organomation	Rocket Synergy Evaporation System N-Evap-111
Sample Extractor	1	EPA 537.1 EPA 533	Thermo Scientific	Dionex Auto Trace 280
Drying Oven Gravity or convection Controlled from room temp to 180°C or higher ($\pm 2^\circ\text{C}$)	2		Fisher Scientific VWR Scientific	Isotemp Oven 750 G 1330GZZ

TABLE 5. Environmental Organic Chemistry Laboratory – MS Equipment

Item	No. of Units	Method	Manufacturer	Model
Muffle furnace To 450°C for cleaning organic glassware and decontaminating sodium sulfate.	1		Thermolyne	
Thermometer -30°C to 10°C 1°C or finer subdivision NBS certified or traceable	Several			
Glassware Borosilicate Volumetrics should be class A Separatory funnels	Several			
Gas Chromatograph/ Mass Spectrometer/Data System (GC/MS/DS) Purge and Trap Concentrator and Auto Sampler (Refrigerated) Chiller	1 1 1	EPA 524.3 EPA 8260D	Thermo Scientific Teledyne Tekmar Thermo Scientific	Thermo Trace 1300 ISQ Quadrupole MS TraceFinder Software AtomX Haake A 28 F
Gas Chromatograph/ Mass Spectrometer/Data System (GC/MS/DS) Liquid Autosampler	1	EPA 525.2 EPA 522 Caffeine by modified EPA 525.2	Thermo Scientific	Thermo Trace 1300 ISQ Quadrupole MS TraceFinder Software AS1310
Gas Chromatograph/Tandem Triple-Quad Mass Spectrometer/Data System (GC/MS/MS) Autosampler	1	EPA 8270E	Thermo Scientific	Thermo Trace 1310 TSQ 9000 TraceFinder Software TriPlus RSH

TABLE 5. Environmental Organic Chemistry Laboratory – MS Equipment

Item	No. of Units	Method	Manufacturer	Model
Ultra Performance Liquid Chromatograph/Tandem Triple-Quad Mass Spectrometer (LC/MS/MS)	1	EPA 533 EPA 537.1 EPA 545	Waters	Acquity I-Class UPLC Xevo TQ-S micro Detector
	1	Modified EPA 533 EPA 537 EPA 1694	Waters	Acquity H-Class UPLC Xevo TQD Detector MassLynx

TABLE 6. EQUIPMENT CALIBRATION PROCEDURES

TABLE 6. Equipment Calibration Procedures

INSTRUMENT	FREQUENCY OF CALIBRATION	STANDARD REFERENCE MATERIALS USED	GENERAL PROCEDURES	CALIBRATION ACCEPTANCE LIMITS
Analytical Balances	Each day of use Semi-annually calibrated by qualified service representative	Check with 2 different Class S weights. Calibrated against certified ASTM Class I weights.	Manufacturer's instructions	By weight range, according to manufacturer's specifications
Analytical Balances (Microbiology)	Monthly Semi-annual	NIST-certified weights By vendor	Check accuracy Checked by a qualified service representative	± 0.001g
Top Loading balance	Each day of use	Same as for Analytical Balances	Manufacturer's instructions	By weight range, according to manufacturer's specifications
Auto Analyzer	When used	6 calibration standards + a blank + 2 QC samples	Manufacturer's instructions	± 2-3 standard deviations
Autoclaves	Daily or when in use	Pressure and temperature gauge NIST-certified stopwatch	Record date, contents, sterilization time and temperature for each cycle. Check cycle time	Reaches temperature of 121°C in 30 minutes. Maintains 121°C during sterilization cycle and completes the entire cycle within 45 minutes when a 12-15 minute sterilization period is used.
Conductivity meter	When used	1 standard + blank	Manufacturer's instructions	± 2% of span plus ± least 1 significant digit at 25°C.

TABLE 6. Equipment Calibration Procedures

INSTRUMENT	FREQUENCY OF CALIBRATION	STANDARD REFERENCE MATERIALS USED	GENERAL PROCEDURES	CALIBRATION ACCEPTANCE LIMITS
ThermoFisher/Barnstead ASTM Type I Reagent Water System – Microbiology Lab	In-line Annually	Check conductivity pH, heavy metals, and organic contaminants	Manufacturer's instructions & WES SOPs	ASTM Type I reagent water must have a resistivity of > 10 megohm-cm (conductivity of < 0.1 μ S/cm) at 25°C
Millipore and ThermoFisher/Barnstead ASTM Type I Reagent Water Systems – Inorganic Chemistry Lab	Daily	Check conductivity & TOC	Manufacturer's instructions	ASTM Type 1 reagent water must have a resistivity of >18 megohm-cm at 25°C. TOC < 10 ppb
Millipore ASTM Type I Reagent Water System – Organic MS Lab	Resistivity readings taken daily. Conductivity readings taken twice monthly.	Resistivity measurements taken directly from the RO Pod display. Conductivity measurements taken from a calibrated conductivity meter.		
Millipore ASTM Type I Reagent Water System – Organic GC/LC Lab	Resistivity readings taken daily. Conductivity readings taken twice monthly.	Resistivity measurements taken directly from the RO Pod display. Conductivity measurements taken from a calibrated conductivity meter.		
Gas Chromatographs (ECD, FID) High-Performance Liquid Chromatograph (HPLC)	When used	3 to 5 calibration standards + a blank depending on method used.	1. Run calibration curve of 3 to 5 standards and calculate r value 2. Compare resolution, sensitivity, and retention times with previous runs 3. Record values in instrument work book	Regression coefficient (r) > 0.99
Gas Chromatograph/Mass Spectrometers (GC/MS)	When used	5 to 7 concentrations depending on method used.	Calibrate as per analytical method	% RSD < 30% of the mean RF for SVOCs. For VOCs, low level standard must be \leq 150% recovery; medium and high levels must be \geq 50% recovery.
Hot Air Ovens	Daily or when in use	Thermometer	Check temperature	170° - 180°C for at least two hours \pm 10°C
DMA80-Mercury Analyzer	Check calibration when used; put in new curve when needed	8 calibration standards then check curves with 2 QC standards	Manufacturer's instructions	90 - 110%

TABLE 6. Equipment Calibration Procedures

INSTRUMENT	FREQUENCY OF CALIBRATION	STANDARD REFERENCE MATERIALS USED	GENERAL PROCEDURES	CALIBRATION ACCEPTANCE LIMITS
Incubators	Twice daily, with readings taken at least 4 hr. apart when in use	Thermometer	Check temperature	Maintain temperature to an accuracy of $\pm 0.5^{\circ}\text{C}$ or within a given range as called for in the analytical method.
Inductively Coupled Plasma Emission Spectrometer (ICP)	When used	Run instrument check standard and calibration blank every 10 samples	Manufacturer's instructions. Record values in instrument log book.	Method Specific
Laboratory Fume Hoods and Biological Safety Cabinets	Annually	Flow meter	Checked by a qualified service representative	100 LFPM face velocity.
pH Meters	Every 8 hours of operation	3 concentrations of buffers for older pH meters: 4, 7, and 10; for newer meters, perform a 2-point calibration with pH 4 and 7 buffers.	Bracket pH value expected as closely as possible with buffer	± 0.05 pH units
Refrigerators	Calibration Checked Daily	Thermometer	Thermometer bulb immersed in liquid	Temperature maintained at 1° to 6°C . Thermometer graduated in at least 1°C increments.
Freezers	Calibration Checked Daily	Thermometer		$\leq -10^{\circ}\text{C}$
Thermometers	Annually	Calibrated against NIST-traceable thermometer by qualified technician	Manufacturer's instructions	$\pm 1^{\circ}\text{C}$
Turbidimeter	Up to 3 months	4 calibration standards + a blank.	Manufacturer's instructions	10% turbidity units
Water baths for bacterial analyses	Twice each day when in use with readings taken at least 4 hrs. apart	Thermometer	Check temperature	Maintain temperature at $44.5^{\circ}\text{C} \pm 0.2^{\circ}\text{C}$
Inductively Coupled Plasma Mass Spectrometer (ICP-MS)	When used	Run instrument check standard and calibration blank every 10 samples, QCS after calibration. MRL(s) after calibration. Run tuning solution and daily solution before calibration	Manufacturer's Instructions and analysis method	Method Specific

TABLE 7. INSTRUMENT MAINTENANCE PROCEDURES

INSTRUMENT	PROCEDURE	FREQUENCY
MICROBIOLOGY LABORATORY		
Autoclave	Flush trap, check seals, clean chamber of any residue.	Each day of operation or as needed.
Water Baths	Drain and fill to level requirements, add sanitizing solution to curb growth.	As needed
Incubators	Check for proper temperature operation.	Daily or when used.
Type 1 Reagent Water System	Check resistivity daily	Change cartridges as needed
INORGANIC CHEMISTRY LABORATORY		
ICP-OES	Check nitrogen and argon flow rates, water circulation system, overflow tank, and change peristaltic pump lines.	Each time instrument is used or service contract guidelines
Auto Analyzer	Replace pump tubes and oil pump	Every 3 months
Discrete Analyzer	Check water baselines and compare current gain values to last gain values. If out of control, replace lamp. If running NO ₃ +NO ₂ -N test, perform cadmium coil checks, as needed. Change peristaltic pumps tubing. Periodic maintenance done by the analyst: Replace probe wash assembly, syringe assembly with O-ring, aspiration probe and sampling probe.	Each time instrument is used. Monthly. As needed.
pH Meter	Maintain electrolyte level in probe. Properly store and maintain storage solution	Inspect and replace as needed
Turbidity Meter	Clean filter with lens cleaner	Every 3 months
Conductivity Meter	Store cell in reagent water	Inspect and replace as needed
Autotitrator	Maintain electrolyte level in probe	Inspect and replace as needed
Moisture Analyzer	Self-calibrating	Each time instrument is used
Millipore Reagent Water System	Replace all filters and cartridges	Yearly
Ion Chromatograph	Check system pressure, baseline conductivity, pulse damper, guard column, pump lines, regenerant flow rate, replace Ultra Filtration Cell Membrane (UFC) and inline filters- where applicable, and detector.	Each time instrument is used UFC filter replaced after 100 injections or as needed.
DMA 80	Check for oxygen flow rate, oxygen pressure at tank, water build up in waste line and mercury residue in machine before starting a run. Periodic maintenance done by the analyst : Change out amalgamator, catalyst tube, silicon O-rings, silicon joints, grease boat	Each time instrument is used. As needed.

INSTRUMENT	PROCEDURE	FREQUENCY
	O-ring and exposed steel rods of the horizontal and vertical actuators. Should need to be done no sooner than 3000 burns. Condition the catalyst tube and run a stability test. New calibration curve must be done after changing parts or changing out an oxygen tank.	
ICP-MS	Check Argon/helium pressure. Check air filters and chiller. Check rough pump oil and replace peristaltic pump tubing daily. Replace fluids according to manufacturer's recommendations.	Each time instrument is used or according to manufacturer's specifications.
ORGANIC CHEMISTRY LABORATORY		
GC & HPLC SECTION		
Ni-63 Gas Chromatograph	Replace septa and check glass injector liner for contamination. Check column and detector operation. Perform solvent and column check. Perform 6-month wipe tests on ECDs	Each day of operation. Wipe tests performed every 6 months.
FID Gas Chromatograph	Replace septa and check column and detector operation. Perform solvent and column check for contamination.	Each day of operation or when instrument performance decreases.
HPLC & UPLC	Check connections for pressure leaks. Replace mobile phase carrier solutions. Perform solvent and column check for contamination.	Each day of operation or when instrument performance decreases.
Analytical Balance	Check for accuracy	Every 6 months by metrology service contract
Class 1 Weight Sets	Check for accuracy	Every year by metrology service contract
Laboratory Fume Hoods	Check for proper exhaust flow	Performed yearly by contract ventilation company
MS SECTION		
Gas Chromatograph/Mass Spectrometer	Clean source, check vacuum pressure, replace septum and liner	Each day instrument is used or per service contract.
Purge and Trap	Check and replace fittings and apparatus.	Each day instrument is used or per service contract.

TABLE 8. LABORATORY SOP AND QAP

Document #	Document Title	Latest Revision #	Date
Lab QA Plan	Laboratory Quality Assurance Plan	8.1	September 2022
Overnight Sample Delivery to WES	Operational Procedure for Overnight Sample Delivery to WES	1.0	August 2001
Fish Processing SOP	Processing Fish Samples Intended for Contaminant Analysis	1.0	August 2002
Thermometer Calibration	Standard Operating Procedures for Calibration of Laboratory Thermometers	1.6	January 2022
Lab-Ware Washing SOP	Standard Operating Procedure for Labware Washing in all DELS-WES Laboratories	0	April 2008
PE Samples SOP	Standard Operating Procedures for Performance Evaluation Samples	1.0	July 2022
Training Form SOP	SOP for Electronically Filling Out and Saving Training Forms	2.1	July 2022
WinLIMS QC Reports SOP	SOP for evaluating QC samples that are Outside QC Limits for proper data qualifications.	0	September 2022
COC SCRF WinLIMS SOP	Operational Procedure for Processing COC/SCRF in WinLIMS	0.0	March 2022
Manual Intg – OCL and IOCL	SOP for Conducting Reintegration of Data Generated by the Organic and Inorganic Chemistry Laboratories	1.0	February 2016
Environmental Microbiology and Toxicology Laboratory – Drinking Water Methods			
SM 9215B	SM9215B –Heterotrophic Plate Count - Pour Plate Procedure	1.9	February 2019
SM9222D	SM9222D - Standard Fecal Coliform Membrane Filtration Procedure	2.2	February 2019
SM 9222B	SM9222B – Standard Total Coliform Membrane Filtration Procedure	3.2	February 2019
SM 9222G	SM 9222G - Confirmation of <i>E. coli</i> from SM9222B Using Nutrient Agar with MUG	1.1	February 2019
SM 9223B	SM 9223 – Enzyme Substrate Coliform Test Presence-Absence Procedure for Analysis of Potable Water	2.4	February 2019
SM 9223B-MPN	SM 9223 – MPN Enzyme Substrate Coliform Test Most Probable Number Procedure for Analysis of Potable and Non-Potable Water Samples	1.2	December 2020
EPA 1604	EPA Method 1604 – Membrane Filtration Procedure for the Simultaneous Detection of Total Coliforms and <i>Escherichia coli</i> – MI Agar Method	1.6	February 2019
Autoclave SOP	SOP For Getinge LSS275 Gravity Steam Sterilizer	2.0	July 2022
Reagent-H2O-Microb	Reagent Water System - Reverse Osmosis/De-ionization System for the DELS-WES Environmental Microbiology & Toxicology Laboratory	3.0	October 2022
Enterolert	The Enterolert Test (SM 9230D) – Enzyme Substrate Enterococcus Test Most Probable Number Procedure for Analysis of Non-Potable Water Samples	2.1	February 2019
EPA 1600	USEPA Method 1600 – Standard Enterococci Membrane Filtration Procedure	1.8	February 2019
Environmental Microbiology & Toxicology Laboratory – Other Analytical Methods			
BacteroidetesG	Determination of <i>Bacteroidetes</i> Group Marker by PCR Assay Based on AEM 66:1587	0	March 2006

Document #	Document Title	Latest Revision #	Date
BacteroidetesHF	Determination of <i>Bacteroidetes</i> Human-Specific Marker - Modified Method of AEM 66:1587	0	March 2006
SM 9213D	SM 9213D - Standard <i>E. coli</i> Membrane Filtration Procedure	0	August 2000
SM 9222D	SM 9222D – Standard Fecal Coliform Membrane Filtration Procedure	2.1	February 2016
ENT-esp Marker	Determination of Enterococcal <i>esp</i> Gene (Sewage Marker) Based on ES&T 39:283	0	March 2006
Micro-ID	Identification of Enterobacteriaceae	0	November 2009
Microtox Acute 81.9%	Microtox Acute Toxicity Test (81.9% Test)	0	May 2005
Microtox Acute Solids	Microtox Acute Toxicity Test (Solid-Phase Test)	0	May 2005
Inhibitory Residue	Glassware Inhibitory Residue Test	0	May 2007
Rep-PCR Fingerprinting	Rep-PCR	0	April 2013
SM 5210B	SM5210 – Determination of Biochemical Oxygen Demand (BOD)	0	September 2000
Add Various Cyanotoxin Tests			
Environmental Inorganic Chemistry Laboratory – Drinking Water Methods			
EPA 200-2	USEPA Method 200.2 – Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements	1.4	October 2022
EPA 200-7	USEPA Method 200.7 – Determination of Metals & Trace Elements & Hardness in Water & Wastes by ICP-AES	7.0	October 2022
EPA 200-8	USEPA Method 200.8 – Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Mass Spectrometry	4.1	October 2021
EPA 300-0	USEPA Method 300.0 – Determination of Inorganic Ions	3.0	February 2019
EPA 300-1	USEPA Method 300.1 Part B. Inorganic Disinfection By Products – Determination of Inorganic Anions in Drinking Water by Ion Chromatography	3.0	February 2019
SM 2130B	SM 2130B - Determination of Turbidity, Nephelometric Method	2.1	March 2020
SM 2320B	SM 2320B - Determination of Alkalinity by the Titration Method	2.0	March 2022
SM 2510B	SM 2510B - Determination of Conductivity (Laboratory Method)	1.2	November 2006
SM 4500-Cl F	SM 4500-CLF – Determination of Chlorine Residual DPD Ferrous Titrimetric Method	1.0.	November 2003
SM 4500CN-C E	SM 4500CN-C E - Determination of Total Cyanide by the Distillation/Spectrophotometric Method	3.0	October 2022
SM 4500H-B	SM 4500-H+B - Determination of pH by the Electrometric Method	1.1	November 2003
Reagent-H2O-Chem	Milli-Q Water System for the Environmental Inorganic Chemistry Laboratory - Millipore A10 Advantage with Q-Pod Element	1.0	September 2010
Environmental Inorganic Chemistry Laboratory – Other Analytical Methods			
Auto Shredder Waste	Grinding, Sample Mixing and Subsampling of Auto Shredder Waste For Metals and PCBs Analysis	0	January 2012

Document #	Document Title	Latest Revision #	Date
AOAC Int. 950.46B.(b)	Moisture in Meat (Fish Tissue)	0	May 2020
SM 4500-CI-NO _x -NH ₃	Determination of Nitrate/Nitrite by SM 4500-NO ₃ F, Determination of Ammonia by SM 4500-NH ₃ G, Determination of Chloride by SM 4500-Cl ⁻ E	0	April 2022
SM 4500-TP-TN	Determination of Total Phosphorus by SM 4500-P B (5),F and Determination of Total Nitrogen by SM 4500-N C, SM 4500 NO ₃ -N F	0	January 2022
EPA 420-1	USEPA Method 420.1 – Determination of Phenol Phenolics, Total Recoverable	0	October 2000
EPA 1311	USEPA SW846 Method 1311 – Determination of TCLP Toxicity Characteristic Leaching Procedure	1.0	December 2010
EPA 3050B	USEPA Method 3050B – Acid Digestion of Sediments, Sludges, and Soils	0	March 2000
Mod EPA 3052	Modified USEPA Method 3052 – Microwave Assisted Acid Digestion of Organic Matrices	1.0	July 2020
EPA 6010C	Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry	0	December 2010
EPA 7196A	USEPA SW846 METHOD 7196A – Determination of Hexavalent Chromium	0	February 2000
EPA 7473	Mercury In Solids And Solutions By Thermal Decomposition, Amalgamation, And Atomic Absorption Spectrophotometry Using The Milestone DMA-80 Mercury Analyzer	2.0	July 2020
EPA 9010B	USEPA SW846 METHOD 9010B – Total and Amenable Cyanide by Distillation	0	August 2002
EPA 9040A	USEPA SW846 METHOD 9040A – Determination of pH in RCRA Samples	0	September 2000
EPA 9045A	USEPA SW846 Method 9045A – Determination of Soil pH	0	November 2000
SM 2340 B	SM 2340- Hardness by Calculation	2.0	July 2022
SM 2540B	SM2540B – Determination of Total Solids Dried at 103-105°C	0	October 2000
SM 2540C	SM2540C – Determination of Total Dissolved Solids Dried at 180°C	1.0	November 2006
SM 2540D	SM2540D – Determination of Total Suspended Solids Dried at 103-105°C	1.0	November 2006
SM 2540G	Determination of Total Fixed & Volatile Solids in Semi-Solid Samples	0	October 2000
SM 3500Cr-B	Determination of Hexavalent Chromium	0	March 2003
SM 4500-O-C	SM4500-OC – Determination of Dissolved Oxygen, Iodometric Method with Azide Modification	0	September 2000
SM 5220-D	Modified Chemical Oxygen Demand Closed Reflux, Colorimetric Method	1.00	November 2015
Environmental Organic Chemistry Laboratory – GC/LC– Drinking Water Methods			
EPA 531-2	USEPA Method 531.2– Measurement of N-Methylcarbamoyloximes and N-Methylcarbamates in Water by Direct Aqueous Injection HPLC with Post Column Derivatization	0	New Instrument – Projected 2023 (1 st Quarter)
EPA 552-3	USEPA Method 552.3 – Determination of Haloacetic Acids & Dalapon in Drinking Water by Micro Extraction, Derivatization and GC with ECD	0	New Instrument – Projected 2023 (1 st Quarter)

Document #	Document Title	Latest Revision #	Date
MassDEP 555	USEPA Method 555 – Determination of Chlorinated Acids in Water by High Performance Liquid Chromatography with a Photodiode Array Ultraviolet Detector	0	New Instrument – Projected 2023 (1 st Quarter)
Environmental Organic Chemistry Laboratory – GC/LC – Other Analytical Methods			
EPA 1010A	SW846 Method 1010A – Pensky Martens Closed Cup Method for Determining Ignitability	1.0	August 2010
EPA 1664 LIQ-LIQ	USEPA Method 1664 – Determination of N-Hexane Extractable Material (SGT-HEM) by Extraction and Gravimetry	1.0	February 2003
EPA 1664 SPE	USEPA Method 1664 – Determination of N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Total Petroleum Hydrocarbons) by Solid Phase Extraction (SPE) and Gravimetry	1.0	February 2003
EPA TO11A/CARB 1004	Compendium Method TO-11 and CARB 1004 – Determination of Carbonyl Compounds in Air by Extraction & UPLC Analysis	2.0	March 2020
EPA 9071B	N-Hexane Extractable Material in Soils and Sediments by Accelerated Solvent Extraction and Gravimetric Analysis	1.1	August 2013
MA EPH	MA EPH Method – Determination of Extractable Petroleum Hydrocarbons	0	February 2003
Oil ID	Modified EPA Method 3580A, 3510C, 3545 & 8015B – Oil Identification in Waste Oils, Wastewaters, Soils and Sediments	0	Projected 2021
Environmental Organic Chemistry Laboratory – MS – Drinking Water Methods			
EPA 524-3	USEPA Method 524.3 – Measurement of Purgeable Organic Compounds in Water by Capillary Column GC/MS	1.1	February 2016
EPA 525-2	USEPA Method 525.2 – Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column GC/MS	2.4	February 2016
EPA 537	USEPA Method 537– Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)	0	January 2021
EPA 533	EPA Method 533 – Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry		New Instrument – Projected Late Fall 2022
EPA 537.1	USEPA Method 537.1 – Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)		New Instrument – Projected Late Fall 2022
Environmental Organic Chemistry Laboratory – MS – Other Analytical Methods			
EPA 8260D	USEPA Method 8260D – Determination of Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry (GC/MS)	0	March 2003
EPA 8270E	USEPA Method 8270E – Determination of Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	0	New Instrument – Projected 2 nd Quarter 2023

Document #	Document Title	Latest Revision #	Date
Caffeine in water	Caffeine In Water by Solid-Phase Extraction and Capillary Column Gas Chromatography/Mass Spectrometry	0	October 2006
EPA 5035A	USEPA Method 5035A – Sampling Volatile Organic Compounds In Soils and Sediments	1.0	February 2007
MA VPH	MA VPH Method – Determination of Volatile Petroleum Hydrocarbons	0	February 2003
EPA 522	USEPA Method 522 – Determination of 1,4-Dioxane by Solid-Phase Extraction Gas Chromatography/Mass Spectrometry with Selected Ion Monitoring (SIM)	0	September 2014
EPA 1633	EPA Method 1633 – Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue samples by LC-MS/MS		New Instrument – Projected 2 nd Quarter 2023
Modified 1694	Modified EPA Method 1694 – Pharmaceuticals and Personal Care Products in Water, Soil, Sediment and Biosolids by HPLC/MS/MS		New instrument – Projected 2 nd Quarter 2023
Laboratory Certification Program (LCP) SOPs and Applications; and Administrative SOPs			
Document #	Document Title	Latest Revision #	Date
LCP Application	SOP for Reviewing Applications for Laboratory Certification	3.0	July 2022
LCP Database Program User Access	SOP for LabCert Database Users with LABCERT_PROGRAM_USER Access	2.8	July 2022
LCP Database Program View User Access	SOP for LabCert Database for Users with LABCERT_VIEW_USER Access	2.7	July 2022
LCP Onsite Inspections	SOP for Conducting Onsite Inspections of Laboratories	4.3	December 2021
LCP Records	SOP for the Management of Laboratory Certification Records	4.0	July 2022
LCP PT Revocations	SOP for PT Revocation Process for Chemistry and Radiochemistry Analytes/Methods	1.5	July 2022
LCP Validation Codes Screens	SOP for the Use of the LabCert Validation Codes Screens	1.4	July 2022
LES01instructions	LES 01 EA Instructions and Supporting Materials for Initial Certification of a Microbiology Laboratory	0	July 2022
LES02instructions	LES 02 EA Instructions and Supporting Materials for Initial Certification of a Chemistry Laboratory	0	July 2022
LES03instructions	LES 03 EA Instructions and Supporting Materials for Modification of Chemistry Certification	0	July 2022
LES04instructions	LES04 EA Instructions and Supporting Materials for Modification of Microbiology Certification	0	July 2022
Administrative Amendment instructions	LES EA Admin Amendment Instructions and Supporting Materials	0	July 2022
Renewal of Laboratory Certification	LES EA Renewal of Laboratory Certification Instructions	0	July 2022
WEB/Intranet			
WES WEB Procedure.doc	Procedure for Operation of the DELS-WES Web & Intranet Sites	D1.0	July 2001
LCP Policies and Regulations			
Document #	Document Title	Latest Revision #	Date
MA Env Lab Cert Regs 310 CMR 42	MA Regulations for the Certification and Operation of Environmental Analysis Laboratories (310 CMR 42.00)	--	June 2020

Document #	Document Title	Latest Revision #	Date
Chem PT Policy 20-001	Laboratory Certification and Quality Assurance Office Policy on Chemistry Proficiency Testing, Policy-- WES--20.001	WES-20.001	June 2020
Micro PT Policy 20-002	Laboratory Certification and Quality Assurance Office Policy on Microbiology Proficiency Testing Policy-- WES--20.002	WES-20.002	June 2020
EMS Documents			
Document #/Filename	Document Title	Latest Revision #	Date
ISO 14001 4.4.2 A1.0	DEP WES Anthrax Threat Plan	A1.0	October 2001
aspect_list_admin D1.0	Aspects Identification Macro Map – Administration	D1.0	April 2001
aspect_list_bldg_maint D1.0	Aspects Identification Macro Map – Building Maintenance	D1.0	April 2001
aspect_list_inorganic_lab D1.0	Aspects Identification Macro Map – Inorganic Laboratory	D1.0	April 2001
aspect_list_labcert D1	Aspects Identification Macro Map – Laboratory Certification	D1.0	April 2001
aspect_list_organic_lab D1.0	Aspects Identification Macro Map – Organic Laboratories	D1.0	April 2001
EMP Air Emissions D1.0	Air Emissions Environmental Management Program	D1.0	September 2001
EMP Elec-Gas D1.0	Electricity and Natural Gas Environmental Management Program	D1.0	September 2001
EMP_Gas_Vehicle D1.0	Gasoline Consumption Vehicle Emissions Environmental Management Program	D1.0	October 2001
EMP_HW_Chem Storage D1.0	Hazardous Waste Storage and Chemical Use Environmental Management Program	D1.0	September 2001
EMP Indoor Air Quality D1.0	Indoor Air Quality Environmental Management Program	D1.0	September 2001
EMP Noise D1.0	Noise Environmental Management Program	D1.0	October 2001
EMS Obj & Targets List D1.0	List of Objectives & Targets	D1.0	April 2001
EMS Policy D3.1	Environmental Policy for the Senator William X. Wall Experiment Station	D3.1	April 2001
EMS Signif Aspects D1.0	List of Significant Environmental Aspects	D1.0	April 2001
EMS Signif Criteria D1.0	List of Significance Criteria	D1.0	April 2001
EMP_Stormwater D1.0	Stormwater Management Environmental Management Program	D1.0	September 2001
EMP_SW Use & Reduction D1.0	Solid Waste/Paper Use and Reduction Environmental Management Program	D1.0	September 2001
EMP_Water WW D1.0	Usage of Water and Generation of Wastewater Environmental Management Program	D1.0	September 2001
SP Document Control D1.0	System Procedure for Document Control	D1.0	September 2001
SP Emerg Prepare D1.0	System Procedure for Emergency Preparedness and Response Plan	D1.0	September /2001
SP Ext-Int Communication D1.0	System Procedure For External/Internal Communication	D1.0	October 2001
SP Internal audits D1.0	System Procedure For Conducting EMS Internal Audits	D1.0	May 2002
SP Legal & Other Reg D1.0	System Procedure for Determining and Monitoring Legal and Other Requirements	D1.0	April 2001

Document #	Document Title	Latest Revision #	Date
SP Management Review D1.0	System Procedure For Conducting EMS Management Reviews	D1.0	May 2002
SP Measuring and MonitoringD1.0	System Procedure for Monitoring and Measuring Significant Environmental Aspects	D1.0	May 2002
SP Signif_Aspect s D1.0	System Procedure for Determining Significant Environmental Aspects	D1.0	April 2001
SP Struc & Resp D1.0	System Procedure for Structure & Responsibility of EMS	D1.0	September 2001
SP Training D1.0	System Procedure For Training, Awareness And Competence of The WES EMS	D1.0	October 2001
OP Air Emissions Reduction D1.0	Operational Procedure Air Emission Reduction	D1.0	October 2001
OP Analytical Request & Sample Handling D1.0	Operational Procedure Analytical Request & Sample Handling	D1.0	November 2001
OP_Haz Waste-Chem Storage D1.0	Operational Procedure for Hazardous Waste/Chemical Storage and Use	D1.0	December 2001
OP for Hearing Conservation D1.0	Operational Procedure for Hearing Conservation	D1.0	February 2002
OP_Vehicle Emissions Reduction D1.0	Operational Procedure for Vehicle Emissions Reduction	D1.0	February 2002
OP_Water UsageWW Generation D1.0	Operational Procedure for Usage of Water and Generation of Wastewater	D1.0	September 2001
OP_Stormwater Mgmt D1.0	Operational Procedure for Stormwater Management	D1.0	September 2001
OP_Solid waste D1.0	Operational Procedure for Solid Waste/Paper Use and Reduction D1.0	D1.0	December 2001
OP Indoor Air Quality D1.0	Operational Procedure for Indoor Air Quality Improvements D1.0	D1.0	October 2001
WES EMS INT-EXT Outreach		Pending	

TABLE 9. ENVIRONMENTAL MICROBIOLOGY & TOXICOLOGY LABORATORY - ANALYTICAL METHODS AND SAMPLE MANAGEMENT ELEMENTS

TABLE 9. Environmental Microbiology & Toxicology Laboratory – Analytical Methods and Sample Management Elements

Parameter	Method	Preservative ^a	Holding Time	Sample Volume	Container Type ^b
Potable Water Testing Methods					
Total Coliform	SM 9222B	0.1 mL (4 drops) 3% Sodium Thiosulfate in 120 mL of sample (EPA recommends < 10°C; use 1 - <10°C)	30 hours	100 mL	Sterile HDPE, G
	EPA 1604 (SM 9222)	0.1 mL (4 drops) 3% Sodium Thiosulfate in 120 mL of sample (EPA recommends < 10°C; use 1 - <10°C)	30 hours	100 mL	Sterile HDPE, G
	SM 9223B	0.1 mL (4 drops) 3% Sodium Thiosulfate in 120 mL of sample (EPA recommends < 10°C; use 1 - <10°C)	30 hours	100 mL	Sterile HDPE, G
<i>E. coli</i>	SM9222G	0.1 mL (4 drops) 3% Sodium Thiosulfate in 120 mL of sample (EPA recommends < 10°C; use 1 - <10°C)	30 hours	100 mL	Sterile HDPE, G
	EPA 1604 (SM 9222)	0.1 mL (4 drops) 3% Sodium Thiosulfate in 120 mL of sample (EPA recommends < 10°C; use 1 - <10°C)	30 hours	100 mL	Sterile HDPE, G
	SM 9223B	0.1 mL (4 drops) 3% Sodium Thiosulfate in 120 mL of sample (EPA recommends < 10°C; use 1 - <10°C)	30 hours	100 mL	Sterile HDPE, G
Potable Source Water & Non-Potable Water Testing Methods					
<i>E. coli</i> (MI Agar)	EPA 1604 (SM 9222)	1 - <10°C, 0.1 mL (4 drops) 10% Sodium Thiosulfate and 0.3 mL 15% EDTA solution pH 6.5 in 120 mL of sample	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	100 mL	Sterile HDPE, G
<i>E. coli</i> (Colilert)	SM 9223B	1 - <10°C, 0.1 mL (4 drops) 10% Sodium Thiosulfate and 0.3 mL 15% EDTA solution pH 6.5 in 120 mL of sample	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	100 mL	Sterile HDPE, G
Enterococci	EPA 1600	1 - <10°C, 0.1 mL (4 drops) 10% Sodium Thiosulfate and 0.3 mL 15% EDTA solution pH 6.5 in 120 mL of sample	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	100 mL	Sterile HDPE, G

TABLE 9. Environmental Microbiology & Toxicology Laboratory – Analytical Methods and Sample Management Elements

Parameter	Method	Preservative ^a	Holding Time	Sample Volume	Container Type ^b
Enterococci	Enterolert (SM 9230D)	1 - <10°C, 0.1 mL (4 drops) 10% Sodium Thiosulfate and 0.3 mL 15% EDTA solution pH 6.5 in 120 mL of sample	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	100 mL	Sterile HDPE, G
Fecal Coliforms (MFC)	SM 9222 D	1 - <10°C, 0.1 mL (4 drops) 10% Sodium Thiosulfate and 0.3 mL 15% EDTA solution pH 6.5 in 120 mL of sample	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	100 mL	Sterile HDPE, G
Heterotrophic Plate Count	SM 9215 B	1 - <10°C, 0.1 mL (4 drops) 3% Sodium Thiosulfate in 120 mL of sample	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	100 mL	Sterile HDPE, G
<i>E. coli</i> DNA Fingerprinting	Rep-PCR	1 - <10°C, 0.1 mL (4 drops) 10% Sodium Thiosulfate and 0.3 mL 15% EDTA solution pH 6.5 in 120 mL of sample	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	100 mL	Sterile HDPE, G
<i>Bacteroidetes</i> Group & Human DNA Markers	16S PCR	1 - <10°C, 1 mL (20 drops) 10% Sodium Thiosulfate and 0.3 mL 15% EDTA solution pH 6.5 in 120 mL of sample	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	1 L	Sterile AJ, G
Enterococci	ENF esp Marker	1 - <10°C, 0.1 mL (4 drops) 10% Sodium Thiosulfate or tablet	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	100 mL	Sterile HDPE, G
Enterococci	EPA 1611	1 - <10°C, 0.1 mL (4 drops) 10% Sodium Thiosulfate or tablet	8 hours (usually 6 hours in the field + 2 hours in the laboratory)	250 mL	Sterile, HDPE, G
Acute Toxicity	Microtox Acute Toxicity Test (SDI, Newark, DE)	1 - <10°C	36 hours	120 mL	AJ
BOD 5d	SM 5210 B ²	Cool 4°C	48 hours	1 Liter	HDPE, G
^a Non-chlorinated samples do not require the addition of sodium thiosulfate.					
^b HDPE = High Density Polyethylene; G = Glass, PP = Polypropylene, AJ = Amber Jar with Teflon-lined screw cap					

TABLE 10. ENVIRONMENTAL INORGANIC CHEMISTRY LABORATORY - ANALYTICAL METHODS AND SAMPLE MANAGEMENT ELEMENTS

TABLE 10. Environmental Inorganic Chemistry Laboratory – Analytical Methods and Sample Management Elements

Parameter	Method	Preservative	Holding Time	Sample Volume	Container Type
Potable Water Testing Methods					
Antimony	EPA 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Arsenic	EPA 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Barium	EPA 200.7 & 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Beryllium	EPA 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Bromate	EPA 300.1	50 mg/L EDA	28 days	100 mL	HDPE, G
Cadmium	EPA 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Calcium	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Chloride	EPA 300.0	None required	28 days	200 mL	HDPE, G
Chlorine, Total Residual	SM 4500-Cl F ²	None required	Analyze Immediately	100 mL	HDPE, G
Chlorite	EPA 300.1	Cool to 4°C, 50 mg/L EDA	14 days	100 mL	Amber HDPE or G
Chromium	EPA 200.7 & 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Conductance	SM 2510 B ²	Cool 4°C	28 days	100 mL	HDPE, G
Copper	EPA 200.7 & 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Cyanide, Amenable	SM 4500-CN ⁻ G, C, & E ²	Cool 4°C, NaOH to pH ≥ 12	14 days	500 mL	HDPE, G
Cyanide, Physiologically Available (PAC)	MassDEP PAC Method	Cool 4°C, NaOH to pH ≥ 12, dechlorinate with 0.6-g ascorbic acid/L	14 days	500 mL	HDPE, G
Cyanide, Total	SM 4500-CN ⁻ C & E ²	Cool 4°C, NaOH to pH ≥ 12, dechlorinate with 0.6-g ascorbic acid/L	14 days	500 mL	HDPE, G
Fluoride	EPA 300.0	None required	28 days	300 mL	HDPE, G
Hardness	SM 2340 B ²	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Lead	EPA 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Magnesium	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Mercury	EPA 245.1 ¹	Cool 4°C, HNO ₃ pH < 2	28 days	200 mL	HDPE, G
Nickel	EPA 200.7 & 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Nitrogen, Nitrate-N	EPA 300.0	Cool 4°C	48 hours	100 mL	HDPE, G
Nitrogen, Nitrite-N	EPA 300.0	Cool 4°C	48 hours	100 mL	HDPE, G

TABLE 10. Environmental Inorganic Chemistry Laboratory – Analytical Methods and Sample Management Elements

Parameter	Method	Preservative	Holding Time	Sample Volume	Container Type
pH	SM 4500-H ⁺ B ²	None required	Analyze Immediately	100 mL	HDPE, G
Selenium	EPA 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Silver	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Sodium	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Sulfate	EPA 300.0	Cool 4°C	28 days	50 mL	HDPE, G
Thallium	EPA 200.8 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Turbidity	SM 2130 B ²	Cool 4°C	48 hours	100 mL	HDPE, G
Non-Potable Water Testing Methods					
Alkalinity, Total	SM 2320 B ²	Cool 4°C	14 days	500 mL	HDPE, G
Aluminum	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Antimony	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Arsenic	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Barium	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Beryllium	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Boron	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Cadmium	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Calcium	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Chloride	SM 4500-Cl ⁻ E ² & EPA 300.0	None required	28 days	100 mL	HDPE, G
Chlorine, Total Residual	SM 4500-Cl F ²	None required	Analyze Immediately	100 mL	HDPE, G
Chromium	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Chromium, Hexavalent (VI)	SM 3500-Cr D ²	Cool 4°C	24 hours	200 mL	HDPE, G
COD	SM 5220 D ²	Cool 4°C, H ₂ SO ₄ pH < 2	28 days	50 mL	HDPE, G
Conductance	SM 2510 B ²	Cool 4°C	28 days	100 mL	HDPE, G
Copper	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Cyanide, Amenable	SM 4500-CN ⁻ G, C, & E ²	Cool 4°C, NaOH to pH ≥ 12	14 days	250 mL	HDPE, G

TABLE 10. Environmental Inorganic Chemistry Laboratory – Analytical Methods and Sample Management Elements

Parameter	Method	Preservative	Holding Time	Sample Volume	Container Type
Cyanide, Physiologically Available (PAC)	MassDEP PAC Method	Cool 4°C, NaOH to pH ≥ 12, dechlorinate with 0.6-g ascorbic acid/L	14 days	250 mL or 5 g	HDPE, G
Cyanide, Total	SM 4500-CN ⁻ C & E ²	Cool 4°C, NaOH to pH ≥ 12, dechlorinate with 0.6-g ascorbic acid/L	14 days	250 mL	HDPE, G
Hardness	SM 2340 B ²	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Iron	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Lead	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Magnesium	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Manganese	EPA 200.7 & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Mercury	EPA 7473	Cool 4°C, HNO ₃ pH < 2	28 days	200 mL	HDPE, G
Nickel	EPA 200.7 ¹ 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Nitrogen, Ammonia-N	SM 4500-NH ₃ -N (B, G)	Cool 4°C, H ₂ SO ₄ pH < 2	28 days	500 mL	HDPE, G
Nitrogen, Nitrate-N	EPA 300.0	Cool 4°C	48 hours	100 mL	HDPE, G
Nitrogen, Nitrite-N	EPA 300.0	Cool 4°C	48 hours	100 mL	HDPE, G
Nitrogen, Nitrate- + Nitrite-N	SM 4500-NO _x -N F	Cool 4°C, H ₂ SO ₄ pH < 2	28 days	100 mL	HDPE, G
Nitrogen, Total (TN)	SM 4500-N C,	Cool 4°C, H ₂ SO ₄ pH < 2	28 days	500 mL	HDPE, G
pH	SM 4500-H ⁺ B ²	None required	Analyze Immediately	100 mL	HDPE, G
Phosphorus, Ortho	EPA 300.0	Cool 4°C	48 hours	50 mL	HDPE, G
Phosphorus, Total	SM 4500-P B (5), F	Cool 4°C, H ₂ SO ₄ pH < 2	28 days	100 mL	HDPE, G
Potassium	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Sodium	EPA 200.7 ¹	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Solids, Fixed Volatile	SM 2540 E ²	Cool 4°C	7 days	200 mL	HDPE, G
Solids, Settleable	SM 2540 F ²	Cool 4°C	48 hours	1 Liter	HDPE, G
Solids, Total	SM 2540 B ²	Cool 4°C	7 days	200 mL	HDPE, G
Solids, Total Dissolved	SM 2540 C ²	Cool 4°C	7 days	200 mL	HDPE, G
Solids, Total Suspended	SM 2540 D ²	Cool 4°C	7 days	1000 mL	HDPE, G
Sulfate	EPA 300.0	Cool 4°C	28 days	50 mL	HDPE, G
Turbidity	SM 2130 B ²	Cool 4°C	48 hours	100 mL	HDPE, G

TABLE 10. Environmental Inorganic Chemistry Laboratory – Analytical Methods and Sample Management Elements

Parameter	Method	Preservative	Holding Time	Sample Volume	Container Type
Vanadium	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Zinc	EPA 200.7 ¹ & 200.8	Cool 4°C, HNO ₃ pH < 2	6 months	200 mL	HDPE, G
Biological Tissue Testing Methods					
Metals (Usually limited to As, Cd, Pb, and Se)	EPA 6010D & 6020	Cool 4°C prior to resection & then freeze fillet/edible portion at -10 to -20°C	24 hr. to resection & 6 months to analyze frozen fillet or edible portion	50 g	HDPE, G
Mercury	EPA 7473	Cool 4°C prior to resection & then freeze fillet/edible portion at -10 to -20°C	24 hr. to resection & 28 days to analyze frozen fillet or edible portion	50 g	HDPE, G
Moisture, Total (%) ⁶	AOAC Int. 950.46B (b)	Analyze subsample of tissue collected for mercury by EPA 7473 analysis.		10 g	HDPE, G
Soil, Sediment, and Solid and Liquid Waste Testing Methods					
TCLP	EPA 1311 ⁵	None required	7 days to extract & 40 days to analyze	300 g	G
Solids, Total	SM 2540 G ²	Cool 4°C	7 days	50 g	HDPE, G
pH	SM 4500-H ⁺ B ²	None required	Analyze Immediately	100 g	HDPE, G
Metals/Elements	EPA 6010D & 6020 ⁵	Cool 4°C	6 months	50 g	HDPE, G
Chromium, Hexavalent (VI)	EPA 7196 ⁵	Cool 4°C	24 hours	300 g	HDPE, G
Mercury	EPA 7473 ⁵	Cool 4°C	28 days	20 g	HDPE, G
¹ EPA 600/R4-94/111, May 1994, <i>Methods for the Determination of Metals in Environmental Samples</i> . ² <i>Standard Methods for the Examination of Water and Wastewater</i> , 21 st , and 23 rd editions. ³ EPA 600/R-93/100, August 1993, <i>Methods for the Determination of Inorganic Substances in Environmental Samples</i> , or EPA 600/R4-94/111, May 1994, <i>Methods for Chemical Analysis of Water and Wastes</i> . ⁴ EPA 600/4-81-055, March 1980, <i>Interim Methods for the Sampling and Analysis of Priority Pollutants in Sediments and Fish Tissue</i> . ⁵ EPA SW-846, Update VI, Revision 6, June 2018 ⁶ AOAC Official Methods of Analysis, 15 th ed., 1990 vol II.					

TABLE 11. ENVIRONMENTAL ORGANIC CHEMISTRY LABORATORY – GC/LC SE–TION - ANALYTICAL METHODS AND SAMPLE MANAGEMENT ELEMENTS

TABLE 11. Environmental Organic Chemistry Laboratory – GC/LC – Analytical Methods and Sample Management Elements

Parameter	Method	Preservative	Holding Time	Sample Volume	Container Type
Potable Water Testing Methods					
N-Methylcarbamoyl-oximes and N-Methylcarbamates in Drinking Water	EPA 531.2 ¹	Cool 4°C, adjust pH 3.8 with potassium dihydrogen citrate	28 days	40-60mL	Amber glass with TFE-fluorocarbon-lined screw cap
Haloacetic Acids and Dalapon in Drinking Water	EPA 552.3 ²	NH ₄ Cl, cool at 4°C	14 days to extract & 21 days to analyze	40 mL	Glass VOA vial with Teflon-lined septum
Herbicides in Drinking Water	MADEP 555	Sodium sulfite added first to dechlorinate, then HCl to pH < 2, cool 4°C	14 days	1 Liter	Amber glass with Teflon-lined screw cap
Non-Potable Water Testing Methods					
N-Hexane Extractable Oil & Grease, and TPH	EPA 1664	H ₂ SO ₄ pH < 2, cool 4°C	28 days to extract & 14 days to analyze	1 Liter	Amber glass with Teflon-lined screw cap
Extractable Petroleum Hydrocarbons (EPH) in Water Matrices	MA EPH	5-mL of 1:1 HCl, cool at 4°C	14 days to extract & 40 days to analyze	1 Liter	Amber glass with Teflon-lined screw cap
Soil, Sediment, and Solid and Liquid Waste Testing Methods					
Oil & Grease and Total Petroleum Hydrocarbons in Soil & Sediment	EPA 9071B	Cool 4°C	Samples must be analyzed within 28 days of collection.	50 g	Glass with Teflon-lined screw cap
Extractable Petroleum Hydrocarbons (EPH) in Soil, Sediment, and Solid Waste	MA EPH	Cool at 4°C	7 days to extract & 40 days to analyze	20 g	4-ounce wide-mouth amber glass jar with Teflon-lined screw cap
Ignitability	EPA 1010A	Cool at 4°C	7 days	200 mL	G
Air Sample Testing Methods					
Carbonyl Compounds in Air	EPA TO-11A/CARB 1004	Cool at 4°C	14 days	1 DNPH cartridge	DNPH cartridge
¹ EPA 815-B-01-002, September 2001 ² EPA 815-B-03-002, July 2003 ³					

TABLE 12. ENVIRONMENTAL ORGANIC CHEMISTRY LABORATORY – MS – ANALYTICAL METHODS AND SAMPLE MANAGEMENT ELEMENTS

Parameter	Method	Preservative	Holding Time	Sample Volume	Container Type
Potable Water Testing Methods					
Volatile Organics in Drinking Water	EPA 524.3 ¹	Dechlorinate using 25 mg of ascorbic acid per 40 mL of sample added to the sample bottle prior to collection; acidify to pH 2 with 200 mg of maleic acid added to the sample bottle prior to collection; cool to 10°C or lower	14 days at 6°C or lower, protect from light	40 mL	Amber glass vial with Teflon-lined septum
Semi-Volatile Organics in Drinking Water	EPA 525.2 ¹	Dechlorinate with 40-50 mg of sodium sulfite; adjust pH < 2 with 6 N HCl after dechlorination; cool at 4°C	14 days to extract & 30 days to analyze	1Liter	Amber-glass with Teflon-lined screw cap
1,4-Dioxane in Drinking Water	EPA 522	Reduce chlorine with 50 mg/L of sodium sulfite added to bottles prior to shipment, add 1 g/L of sodium bisulfate as microbial inhibitor after the sodium bisulfate has been dissolved. Cool to 10 °C or lower	28 days to extract & 28 days to analyze	599 mL	Amber-glass with Teflon-lined screw cap
Non-Potable Water Testing Methods					
Volatile Organics in Non-Potable Water	EPA 8260D ²	Cool at 4°C, adjust pH < 2 with HCl	14 days	40 mL	Glass with Teflon-lined septum
Semi-Volatile Organics in Non-Potable Water	EPA 8270E ²	Cool at 4°C	7 days to extract & 40 days to analyze	1Liter	Amber glass with Teflon-lined screw cap
Volatile Petroleum Hydrocarbons (VPH) in Water Matrices	MA VPH	Cool at 4°C, adjust pH < 2 with HCl	14 days	40 mL	Glass with Teflon-lined septum
Soil, Sediment, and Solid and Liquid Waste Testing Methods					
Volatile Organics in Soil, Sediment, and Solid Waste	EPA 8260D ²	Cool at 4°C, add 1-mL methanol per 1-g sample	14 days	10 g	Glass with Teflon-lined septum
Semi-Volatile Organics in Soil, Sediment, and Solid Waste	EPA 8270E ²	Cool at 4°C	14 days to extract & 40 days to analyze	10 g	Amber glass jar with Teflon-lined screw cap
Volatile Petroleum Hydrocarbons (VPH) in Soil, Sediment, and Solid Waste	MA VPH	Cool at 4°C, add 1-mL methanol per 1-g sample	14 da-s	15 - 25 g	Glass with Teflon-lined septum

Biological Tissue Testing Methods					
PCBs (Aroclors & 28 Congeners) and Organochlorine Pesticides in Biological Tissue	EPA 8270E ²	Cool 4°C prior to resection & freeze fillet/edible portion at -10 to -20°C	24 hr. to resection & 1 year to analyze frozen fillet or edible portion	20 g	Aluminum foil, dull side toward tissue, no plastic
¹ EPA 815-B-09-009, June 2009 ² SW-846 Update VI, Revision 6, June 2018					

FORMS AND REPORTS

FORM 1. SAMPLE TRACKING/CHAIN-OF-CUSTODY RECORD BLANK

See Form 1. [COC Rev. 1.4.2 Blank.pdf](#)

FORM 2. SAMPLE TRACKING/CHAIN-OF-CUSTODY RECORD-PRELOG

See Form 2. [COC Rev. 1.4.2 WinLIMS Pre-Logged.pdf](#)

FORM 3. SAMPLE CONDITIONS REVIEW FORM (SCRF)

See Form 3. [WinLIMS SCRF Rev. 1.4.pdf](#)

FORM 4. CORRECTIVE ACTION FORM

See Form 4. [Corrective Action Form Rev 1.4.pdf](#)

FORM 5. INITIAL DEMONSTRATION OF CAPABILITY (IDC) and/or MDL FORM

See Form 5. [IDC-MDL-Documentation Rev 1.5.pdf](#)

FORM 6. DOCUMENTATION OF LABORATORY BENCH TRAINING

See Form 6. [Training Form-Laboratory Bench Rev 1.5.pdf](#)

FORM 7. DOCUMENTATION OF TRAINING – OTHER

See Form 7. [Training Form-Other Rev 1.3.pdf](#)

FORM 8. LOGIN PRESERVATION CHECLIST

See Form 8. [Login Preservation Check Rev.0.pdf](#)

FORM 9 ANALYTICAL PRESERVATION BENCH SHEET

See Form 9. [Preservation Bench Sheet Batch \(v1.1\).pdf](#)

REPORT 1. DELS-WES CHEMISTRY FINAL REPORT EXAMPLE

See Report 1. [DELS-WES Chemistry FR Example.pdf](#)

REPORT 2. DEL-WES MICROBIOLOGY FINAL REPORT EXAMPLE

See Report 2. [DELS-WES Micro FR Example.pdf](#)

REPORT 3. QUALITY ASSURANCE (QA) REVIEW LEVEL 1 - INORGANIC CHEMISTRY LABORATORY

See Report 3. [QAL1 Inorg.pdf](#)

REPORT 4. QUALITY ASSURANCE (QA) REVIEW LEVEL 1 - CULTURABLE MICROBIOLOGY LABORATORY

See Report 4. [QAL1 Micro Cbl.pdf](#)

REPORT 5. QUALITY ASSURANCE (QA) REVIEW LEVEL 1 - MOLECULAR MICROBIOLOGY LABORATORY

See Report 5. [QAL1 Micro Molecular.pdf](#)

REPORT 6. QUALITY ASSURANCE (QA) REVIEW LEVEL 1 - MICROBIOLOGY TOXICOLOGY LABORATORY

See Report 6. [QAL1 Micro Toxicity ELISA.pdf](#)

REPORT 7. QUALITY ASSURANCE (QA) REVIEW LEVEL 1 - ORGANIC GC/LC LABORATORY

See Report 7. [QAL1 Org GCLC.pdf](#)

REPORT 8. QUALITY ASSURANCE (QA) REVIEW LEVEL 1 - ORGANIC MS LABORATORY

See Report 8. [QAL1 Org MS.pdf](#)

REPORT 9. QUALITY ASSURANCE (QA) REVIEW LEVEL 2

See Report 9. [QAL2.pdf](#)