

# Utah Division Of Waste Management and Radiation Control



**WASTE MANAGEMENT  
& RADIATION CONTROL**

## **Quality Assurance Program Plan**

**Revision 3  
January 2017**



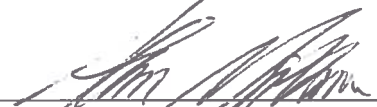
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**Quality Assurance Program Plan (QAPP)**  
**Utah Division of Waste Management and Radiation Control**  
**Utah Department of Environmental Quality**

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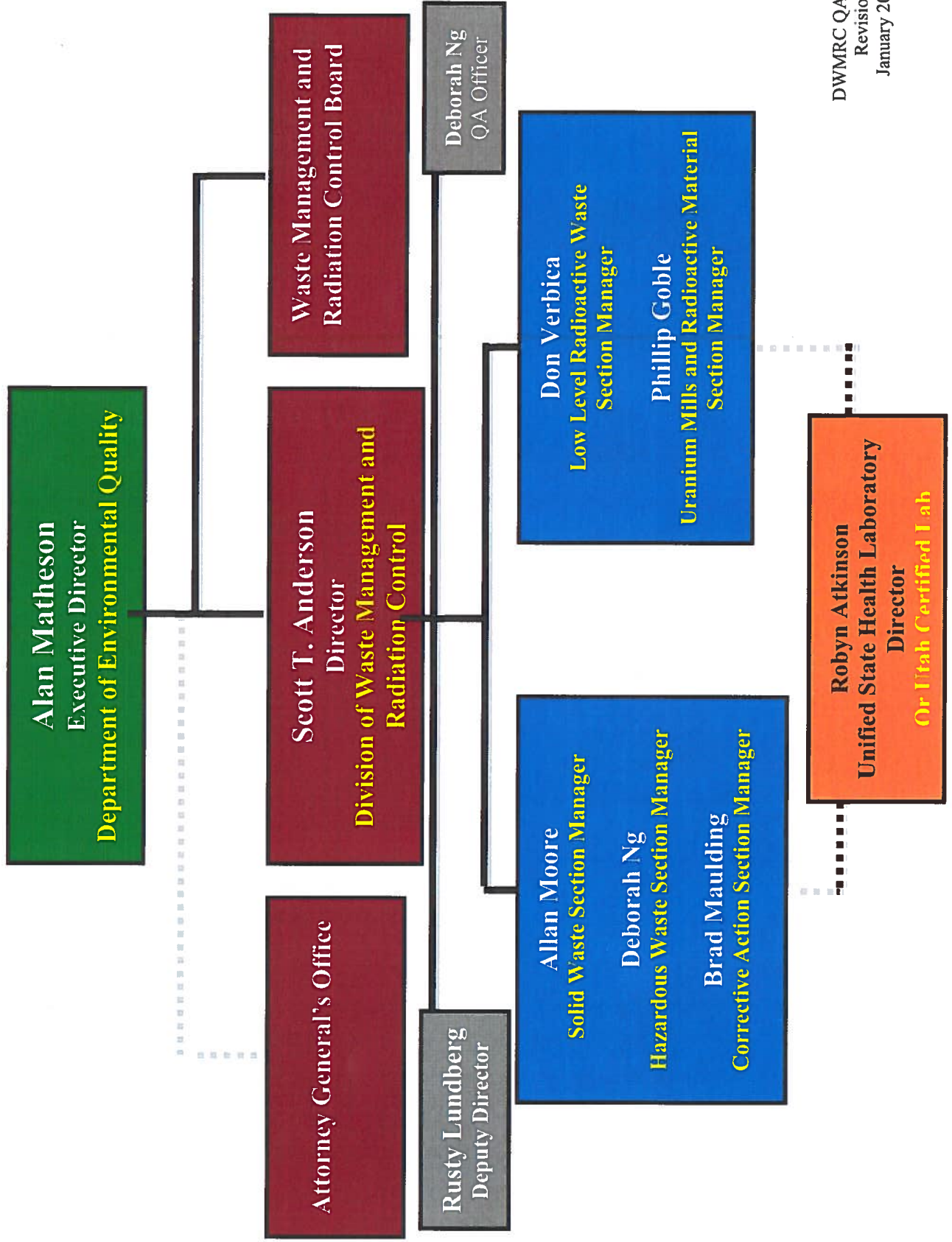
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## **1.0 Program Organization and Responsibility**

- 1.1 The Division of Waste Management and Radiation Control (the Division) administers solid and hazardous waste and radiation programs for the State of Utah. The Division Director is Scott T. Anderson. The Division is a part of the Utah Department of Environmental Quality (UDEQ), which is directed by Alan Matheson. (See Figure 1)
- 1.2 The EPA and Nuclear Regulatory Commission oversees the Division's programs, and monitors and advises the Division on Quality Assurance (QA) issues.
- 1.3 The Utah Attorney General's office provides advice on legal issues of the Division's programs, including but not limited to contractual, enforcement, and policy matters.
- 1.4 The Utah Waste Management and Radiation Control Board (Board) is the statutory authority through which the Division administers solid and hazardous waste and radiation programs in the State of Utah.
- 1.5 The Division's QA/QC Plan officer, Deborah Ng, is responsible for generating, maintaining, and distributing the QAPP. A secure current copy will be maintained in a dedicated file for staff reference.
- 1.6 The Unified State Health Laboratory or a Utah-certified laboratory (UAC R444, Rules for Certification) performs sample analyses. Quality requirements for physical and chemical analyses performed by the Unified State Health Laboratory are delineated in the Utah Public Health Laboratory Quality Assurance Plan (Appendix 2) or Project specific sample and analysis (SAP) requirements.
- 1.7 Test procedures and methods performed by laboratories are described in:
  1. Test Methods for Evaluating Solid Waste (SW-846), current edition.
  2. Standard Methods for the Examination of Water and Wastewater, current edition.
  3. Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act.
  4. Guidelines Establishing Test Procedures for the Analysis of Contaminates under the Safe Drinking Water Act.
  5. Other methods approved by the Director in accordance with Utah Administrative Code (Rules).
- 1.8 The Division technical staff's main focus is to review sampling and analysis plans and quality assurance project plans provided by the regulated community to determine if they meet regulatory or risk requirements. The technical staff will verify the minimum requirements of this QAPP are met in site specific project plans provided for final approval by the Director. The Division does not write project specific plan that is the responsibility of the regulated entity. The minimum quality requirements for all laboratory analyses are specified in this document. The quality requirements for sampling are provided in Appendix 1, Sampling Protocol and Chain-of-Custody Procedures. Project leads and technical support members, including contractors, review and implement the Quality Assurance Project Plans (QAPjP).

The QA officer provides guidance to project leads for any issues arising during the plan development and throughout the project life time.

1.9 Individuals listed in Section 1.0 will be updated annually if applicable.

## 2.0 Background

2.1 The Division is authorized by EPA to administer solid and hazardous waste regulatory programs. The Division is also authorized by Nuclear Regulatory Commission to administer the Radiation Program.

2.2 The Resource Conservation and Recovery Act, commonly referred to as RCRA, is the law governing the disposal of solid and hazardous waste. Congress passed RCRA on October 21, 1976. RCRA, which amended the Solid Waste Disposal Act of 1965, set national goals for:

- Protecting human health and the environment from the potential hazards of waste disposal.
- Conserving energy and natural resources.
- Reducing the amount of waste generated.
- Ensuring that wastes are managed in an environmentally and sound manner.

2.2.1 To achieve these goals, RCRA established three distinct, yet interrelated, programs:

- The solid waste program is governed under RCRA Subtitle D, to develop comprehensive plans for managing nonhazardous industrial solid waste and municipal solid waste, sets criteria for municipal solid waste landfills and other solid waste disposal facilities, and to prohibit the open dumping of solid waste.
- The hazardous waste program, under RCRA Subtitle C, establishes a system for controlling hazardous waste from the time it is generated until its ultimate disposal; in effect, from "cradle to grave".
- The underground storage tank (UST) program is governed under RCRA Subtitle I to develop comprehensive plans for the management of underground storage tanks. This program is not regulated under the Division's responsibilities.

2.3 The first RCRA regulations, "Hazardous Waste and Consolidated Permit Regulations," published in the Federal Register on May 19, 1980 (45 FR 33066; May 19, 1980), established the basic "cradle to grave" approach to hazardous waste management that exists today.

2.4 Congress amended RCRA in November 1984 with the passing of the Federal Hazardous and Solid Waste Amendments (HSWA).

### **3.0 Program Objective**

- 3.1 The overall objective for the Quality Assurance Program Plan is to develop and implement procedures for field sampling, chain-of-custody; laboratory analysis, data validation and reporting that must be met for specific project by the regulated entity. The Division technical staff's main focus is to review sampling and analysis plans and quality assurance project plans provided by the regulated community to determine if they meet regulatory or risk requirements. The technical staff will verify the minimum requirements of this QAPP are met in site specific project plans provided for final approval by the Director. Minimum requirements for development of individual SAPs are outlined in this QAPP. Quality controls measures are required to prevent, identify and correct errors that may occur at any point in process. The generated data is intended to support monitoring, investigation, and enforcement activities associated with regulated activities. Both physical and chemical analyses are performed.
- 3.2 Specific details to be used for the above referenced activities are described in other sections of this QAPP. The quality requirements for sampling are provided in Appendix 1, *Sampling Chain of Custody Procedures*.
- 3.3 This plan incorporates parts of the Unified State Health Laboratory Quality Assurance Plan, Appendix 2, specific to solid and hazardous waste programs and groundwater monitoring. This plan provides guidance for 1) review of facilities' quality assurance project plans, and 2) sampling activities performed by Division personnel.
- 3.4 Specific sampling processes and data objectives will be detailed in the individual quality assurance project plans.

### **4.0 Data Usage**

- 4.1 Data collected, analyzed and validated is used to support the Division's waste management programs. The project lead reviews sampling and analytical data submitted to the Division to meet the project goals and objectives.

### **5.0 Sampling Responsibility and Type**

- 5.1 The Project Manager for each project will determine the nature and extent of sampling. Types of sampling include:
- a. Identification of waste streams to determine whether or not the waste is a listed or characteristic hazardous waste.
  - b. Closure Activities to determine whether or not facilities are properly closing interim status/permitted units.
  - c. Environmental Samples to determine whether or not the environment has been contaminated as a result of a spill or other activity.

- d. Groundwater monitoring to ensure that facilities are monitoring the aquifer properly to detect any impact on the environment by their regulated units.
- e. Other projects including but not limited to trial burns, Subpart X processes and site assessments.
- f. Leachate sampling to determine potential contamination and closure status.

## **6.0 Sampling Procedures**

- 6.1 Sampling should be conducted following the protocol established in *A Guide for Field Samplers* (EPA Region VIII, 2004 or current version), Standard Operating Procedures for Hazardous Waste Streams (EPA Document 600/80-018), Sampler's Guide: Contract Laboratory Program Guidance for Field Samplers, EPA 540-R-014-13, October 2014), Standard Methods for the Examination of Water and Wastewater, 22<sup>nd</sup> Edition December 16, 2013 or other applicable guidance. Additional information on acceptable procedures is contained in the Division's document titled *Sampling and Chain-of-Custody Procedures and Utah Guidance Document for Collecting Split samples from groundwater monitoring wells at EnergySolutions, Low-Level Radioactive Waste, Mixed Waste and 11e.(2) Waste Disposal Facilities, September 2016.*
- 6.2 Few analyses will take place at the sampling site (e.g. pH) most samples will be preserved if applicable and returned to the designated laboratory for analysis. If waste characterization is unknown or staff personnel are unfamiliar with processes that created the wastes to be sampled and/or determine there may be a safety problem by preserving samples, then no sample preservation will occur and a shorter holding time will be considered. The sample label will note any preservation including cold preservation or that the sample has not been preserved. Additional container, volume and preservation requirements are located in Annex A. Any problems which arise during sampling will be corrected on the spot by the project lead before sampling is completed.

## **7.0 Data Quality Objectives**

- 7.1 The objective of the QAPP is to develop and implement procedures for field sampling, chain-of-custody, laboratory analyses and reporting that are technically and legally defensible. Specific procedures to be used for sampling, chain-of-custody, calibration, laboratory analyses, reporting, internal quality control, audits, preventative maintenance, and corrective actions are described in other sections of the QAPP. The purpose of this section is to define goals for completeness, accuracy, precision, representativeness, and comparability. The use of EPA's User's Guide to the Contract Laboratory Program, (EPA 540-R-08-01, June 2008 and EPA 540-R-04-004, October 2004, EPA 540-R-10-011, January 2010)) Organic and Inorganic Validation Functional Guidelines. Documents may be used for determining data usability.
- 7.2 A detailed listing of parameters and method numbers, precision, accuracy and completeness are found in Appendix 1, Table 1. Test methods are determined by sample matrix, detection limit requirements and data usage.

## **8.0 Data Completeness**

- 8.1 Completeness is defined as the amount of valid data obtained from a measurement system compared to the amount that is expected to be obtained. A goal of at least 95% completeness should be obtained.

## 9.0 Data Accuracy

- 9.1 Accuracy is the degree of agreement between a measurement and an accepted reference or true value. The accuracy is determined from analyses of samples spiked with a known concentration. The number of spiked samples and the spiking levels will be taken from the respective methods.

The formula used to assess the accuracy of a laboratory control spike (LCS) is:

$$\%R = (Q_{LCS} / Q_{KC}) \times 100$$

Where: %R = Percent Recovery  
Q<sub>LCS</sub> = Quantity of Analyte Found in the Spike Sample  
Q<sub>KC</sub> = Known Concentration of the LCS

The formula used to assess the accuracy of the matrix spike/matrix spike duplicates (MS/MSD) samples is:

$$\%R = ((Q_{SS} - Q_{US}) / Q_S) \times 100$$

Where: %R = Percent Recovery  
Q<sub>SS</sub> = Quantity of Analyte Found in the Spike Sample  
Q<sub>US</sub> = Quantity of Analyte Found in the Unspiked Sample  
Q<sub>S</sub> = Quantity of Added Spike

- 9.2 Calculation of the accuracy for each analysis will be based on different criteria as discussed in the Quality Assurance Project Plan and the analytical methods. The default values for water and soil are 75-125% and 60-140%, respectively. Project specific requirements may vary from the default values due to other considerations. Project manager will review if project goals and data quality have been met, if not, the project manager may discuss with the QA officer the impact to the data and if data is useable.

## 10.0 Data Precision and Bias

- 10.1 Precision is defined as the degree of mutual agreement among individual measurements made under prescribed conditions. Precision will use two different measurements depending on the number of data points being considered. Two data points will have the relative percent difference (RPD) calculated. Three or more data points will use the relative standard deviation (RSD) as a measure of the precision. External precision audits may be conducted by submitting blind duplicates to the laboratory and comparing the results with the acceptance criteria. The number of blind duplicates required will usually be 20 percent of all samples taken. Precision will be calculated for laboratory or field samples using the following equations:



$$\%RPD = \{(X_1 - X_2) / [(X_1 + X_2)/2]\} \times 100$$

Where: RPD = Relative Percent Difference  
X<sub>1</sub> = Highest Analytical Result of Sample  
X<sub>2</sub> = Lowest Analytical Result of Sample

$$RSD = (\text{standard deviation/average value}) \times 100$$

10.2 Calculation of the precision for each analysis will be based on different criteria as discussed in the project plan and the analytical methods. The default values for water and soil are <20%, <40%, respectively. Project specific requirements may vary due to other considerations.

10.3 Bias is a measure of systematic error. When a sample of known concentration is tested repeatedly, the Bias is determined by how close the average test value is coming to the actual, known value.

### **11.0 Data Representativeness**

11.1 To assure representativeness, all samples should be taken following protocols as set forth in Standard Operating Procedures for field samplers, samplers and samples or other procedures approved by the Project Manager. Also, site descriptions, site photo documentation, and sampling conditions and techniques should be documented in bound field notebooks.

### **12.0 Data Comparability**

12.1 Comparability is a quantitative characteristic, which may be considered in planning sampling activities. The Project Manager should work closely with the Unified State Laboratory to ensure all data generated are consistent with and expressed in the same units as the data generated by other laboratories reporting similar analyses. This will allow comparison of data among organizations.

12.2 Similarly, the Project Manager should work closely with the field team to ensure that all data generated by field measurements are expressed in units that are consistent with standard practices. In addition to units, comparability should be assured in terms of sampling plans, analytical methodology, quality control and data reporting.

12.3 Proper preservatives, appropriate containers, and holding times for samples and analyses are given in Annex A.

12.4 Unless specifically outlined in the project plan, all soil/solids data will be reported on a dry weight basis.

### **13.0 Method Sensitivity**

13.1 Each project plan will specify the regulatory or site specific requirements (e.g. risk levels) and the method sensitivity for each specific sample set. The method specified must meet or exceed the specified requirements or a new method must be selected for evaluation.

## **14.0 Uncertainty**

- 14.1 Any data not meeting the required DQOs will be discussed with the laboratory and client and usability of the data will be determined for each project. Any qualified data will be discussed in the case narrative for project management.

## **15.0 Chain-of-Custody and Sample Tracking**

- 15.1 Samplers may use either a legal chain-of-custody or sample tracking form to enable tracking the possession and handling of a sample during transfer (from sample collection through laboratory analysis and final disposal) so that its physical possession is known at all steps in the process.
- 15.2 A sample is under legal chain-of-custody if:
1. It is in the person's possession, or
  2. It is in the person's view at all times, or
  3. It is locked in a secure location.
- 15.3 At the laboratory, samples are logged in and identified as either legal chain-of-custody or sample tracking samples. The laboratory will follow the sample handling procedure appropriate to the sample, e.g., chain-of-custody procedures.

## **16.0 Analytical Procedures**

- 16.1 Utah-certified laboratories will provide analytical data for compliance with R444 of the Rules. Analytical method selection for samples will be based on whether or not the method provides comparable, representative, complete, precise, sensitive and accurate data for the sample matrix and the range of expected values for the constituents for which the samples are being analyzed. EPA and ASTM analytical methods will be used for analyses when available. If EPA or ASTM does not have a method for analysis, then the Project Manager can request a copy of the standard operating procedure and validation package for that method for Division approval for a specific project.

## **17.0 Calibration Procedures and Frequency**

- 17.1 Laboratory equipment calibration procedures will be in accordance with the method and manufacturer specification. Any equipment used for field measurements will be calibrated according to manufacturer's specifications prior to use. Documentation of the calibration is required. The Project Manager will maintain documentation on all field equipment calibrations. The laboratory will maintain their calibrations and maintenance documents. Any problems associated with field equipment, will be identified to the project manager and s/he will implement a corrective action.

## **18.0 Data Analysis, Validation and Reporting**

18.1 The primary data analysis, validation and reporting is performed by the Unified State Laboratory. Data is stored on site per the Utah Division of Archives and Records Service Retention Schedule. Internal validation is performed by the Division or by the Division's contractor. Upon completion of the sample analyses, the Laboratory will submit the results to the QA officer who will forward them to the Project Manager for review. Laboratory reports will be filed in the Division's facility files or the Division's electronic database. Other Utah certified laboratories will retain the sample analysis records according to UAC R444-14.

## **18.2 Laboratory Analysis, Validation and Reporting**

18.2.1 Each laboratory analyst will ascertain if the analytical data are within prescribed control limits before the data is entered into the Laboratory Information Management System (LIMS). Data is then reviewed for quality assessment.

18.2.2 At least 25% of all final analytical data will be cross-checked before the results are forwarded by the laboratory to the Division. Certified analytical data will be reported on standard report forms in both hard and searchable electronic format. Data will be reviewed to verify it meets the project specific requirements, e.g., detection limits.

## **18.3 Laboratory Quality Control Procedures**

18.3.1 The Unified State Health Laboratory internal quality control procedures are in accordance with EPA guidelines. Internal quality control procedures include the use of duplicate analyses, spikes, calibration standards, internal standard, blanks, quality control charts, standard reference materials, reagent checks, and sample splits as described in the Unified State Laboratory Quality Assurance Plan. Laboratories other than the Utah Unified State Laboratory must be Utah-certified for all parameters being reported.

## **18.4 Data Measurements (Non-direct) and Management**

18.4.1 EPA approved models will be used for risk assessments, groundwater, etc. and outlined in project specific plans. Data summaries will be placed in facilities' file folders by the project managers.

## **19.0 Special Training/Certifications**

19.1 Field personnel are required to obtain OSHA hazardous waste training per 29 CFR 1910. 120. The Division provides the initial 40 hour training and subsequent 8 hour refresher courses annually. Division managers assure training and certifications are complete and up-to-date. Documentation of training is maintained by the individual and copies are provided to DEQ Human Resource Department.

## **20.0 Internal Division Quality Control Procedures**

20.1 Field quality control samples will be submitted to the laboratory as appropriate and as often as practical during field investigations. Such quality control check samples may consist of:

1. One or more “blind” duplicate samples;
2. One or more field blanks;
3. One or more duplicate samples, or
4. Spiked” samples prepared with known amounts of constituents or standard reference samples.

20.2 Division Project Managers will determine sampling source(s), parameters to be audited and the appropriate field quality control samples. Field quality control samples will be collected or prepared in accordance with EPA approved procedures or approved Division procedures (e.g. chemical agent procedures)

20.3 Quality control samples, as identified above, may be collected or prepared for each sample event. The Division Project Manager will determine the number and type of quality control samples to be collected prior to going to the field. The quality control samples will be handled in the same manner as all other samples being analyzed for the same parameter. Sample identification labeling will be consistent with the identification of actual samples. Project records concerning quality control check samples and results of their analyses will be maintained by the Division in either electronic format or paper copy per the retention schedule specified at <http://www.archives.state.ut.us/>

## **21.0 Performance and System Audits of Regulated Entities**

### **21.1 Division Performance and System Audits**

21.1.1 The Division periodically monitors and audits the regulated facilities’ QA procedures to ensure that all project activities are performed in accordance with approved quality assurance procedures. Laboratory and system audits will be conducted, including systems performance audits. System audits will be conducted prior to the start of sampling episodes to determine if the system spelled out in the site-specific quality assurance project plan and sampling plan is adequate to produce quality data.

### **21.2 Laboratory Performance and System Audits**

21.2.1 The U.S. EPA subjects the Unified State Health Laboratory to audits. External performance audits, internal performance audits, and system audits are employed by the Unified State Laboratory to ensure the reliability and quality of data.

## **22.0 Preventive Maintenance**

- 22.1 The Project Manager will assess field equipment for proper operation and maintenance prior to use. Records of preventive maintenance performed will be maintained in a logbook with the equipment.
- 22.2 Any instrument consumables, including spare parts, will be approved for purchased through the Division Director. These items will be stored in the DWMRC Secured Storage location. Any required sample containers will be obtained from the Unified State Health Laboratory. The laboratory will maintain cleanliness records of sample containers.
- 22.3 All contractors working for the Division will be responsible for preventative maintenance of their equipment.
- 22.4 Preventive maintenance procedures for laboratory equipment are the responsibility of the laboratory.

## **23.0 Data Assessment Procedures**

- 23.1 Data quality will be evaluated using the precision, accuracy, representativeness and completeness criteria specific to each project plan or use the default criteria found in this plan. The Project Manager will evaluate field quality control sample results and analytical results submitted by the Unified State Health Laboratory or other Utah-certified laboratories in accordance with R444 to determine if project goals were achieved. All reports will be assessed to verify project objective were met.
- 23.2 If the quality control samples meet the project's criteria, the reported data will be accepted. If not, the laboratory will be consulted to determine what laboratory quality control/quality assurance samples were included with the sample batch. These samples will be included with the field set and reevaluated. If the combined set meets the acceptance criteria, the reported data may be accepted. If not, the data from analyzing the sample set may be used as a basis for a data corrective action referral.

## **24.0 Corrective Action Procedures**

- 24.1 If a quality control audit results in detection of unacceptable conditions or data, as defined by the criteria presented above, the Project Manager will be responsible for developing and initiating corrective action. If the unacceptable conditions indicate a program difficulty or if corrective action is likely to require expertise not immediately available to the project team, the Project Manager will be notified. Corrective action may include:
  - 1. Re-analysis of the sample batch.
  - 2. Re-sampling and analysis.
  - 3. Evaluation and amendment of sampling and analytical procedures.
  - 4. Acceptance of data, with an acknowledgement of the level of uncertainty surrounding the analytical results.

**25.0 Quality Control Reports**

- 25.1 A separate Division QC report is not required for the field sampling programs. Site-specific QA/QC information will be included in the Division facility files.

## References

Test Methods for Evaluating Solid Waste (SW-846, Second Edition and subsequent revisions.), EPA Federal Register, Most current publication

Rules for Certification of Environmental Laboratories, R444. Utah State Rules

Sampling Protocol and Chain-of-Custody Procedures for Hazardous Waste Management, DWMRC

A Guide for Field Samplers, current version, EPA Region VIII

Standard Operating Procedures for Field Samplers, EPA Region VIII

Samplers and Sampling Procedures for Hazardous Waste Streams, EPA 600/2-80-018

Annual Book of ASTM Standards, ASTM

Contract Laboratory Program Guidance for Field Samplers (EPA-540-R-09-03, January 2011)

USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, (EPA-540-R-08-01, June 2008)

USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, OSWER 9240.1-45, (EPA 540-R-04-004, October 2004)

USEPA Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review, (EPA-540-R-05-001), September 2005

Guide to Environmental Analytical Methods, 5<sup>th</sup> edition, Genium Publishing Corporation, March 2003.

QA/QC Data Validation for Organics, EPA

QA/QC Data Validation for Inorganic, EPA

Standard Methods for the Examination of Water and Wastewater, 22th Edition, 2013, American Public Health Association, American Water Works Association, Water Environment Federation Washington, D.C. p. 1-7

United States Environmental Protection Agency, et al.,1997. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1, EPA 402-R-97-016. Washington, D.C. August 2000 p. 4-34.

United States Environmental Protection Agency, 2002. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540-R-01-008. Washington, D.C. July 2002 (Final) p. 25.



## Acronyms

CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain of Custody
DWMRC	Division of Waste Management and Radiation Control
EPA	Environmental Protection Agency
HSWA	Hazardous and Solid Waste Amendments
LCS	Laboratory Control Spike
LIMS	Laboratory Information Management System
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NRC	Nuclear Regulatory Commission
OSHA	Occupational, Safety, Health Administration
QA	Quality Assurance
QC	Quality Control
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Program Plan
RCRA	Resource Conservation and Recovery Act
% R	Percent Recovery
% RPD	Relative Percent Difference
UAC	Utah Annotated Code
UDEQ	Utah Department of Environmental Quality
UST	Underground Storage Tank

## Appendix 1

### Sampling and Chain-Of-Custody Procedures For Division of Waste Management and Radiation Control

The following are the procedures and protocols for management of sample integrity for solid and hazardous waste samples and radiation samples.

#### Pre-Sampling Procedures

##### Safety Protection Protocols

The Project Manager will evaluate the personnel protection and safety equipment to be used.

The Project Manager will review existing information, including existing investigation files (permits, etc.), reports of previous studies (Federal, State, etc.), correspondence files and personal communication. Care should be taken to assure that files and one-of-a-kind reports are not misplaced or inadvertently destroyed. Removal of items from the office is highly discouraged. If material is to be taken into the field, copies should be made.

##### Proposed sampling locations

The Project Manager will prepare a list of the proposed samples to be taken, sampling locations, and sample analyses to be performed. In deciding the number of samples to be taken, scheduling coordination should be conducted with the Unified State Laboratory. This is to assure that the laboratory will be prepared to handle the incoming samples.

##### Containers and Forms

Once the number, types of samples and parameters to be analyzed are determined, the laboratory will be contacted and informed of the proposed sampling program. The laboratory will insure that capabilities are available to complete the required work within the appropriate holding times. If the laboratory can complete the proposed work, the Project Manager will inform the laboratory of the necessary supplies needed, including:

1. Types of sample containers with preservative (if necessary) and volumes of samples to be collected. Sample containers will be prepared in accordance with the method requirements.
2. Sample analysis request forms.
3. Sample tracking or chain-of-custody forms and seals, if applicable.
4. Sample seals and sample labels, if applicable.
5. Trip blanks, if applicable.
6. Ice chests and ice packs, if applicable.

It is recommended that extra containers and sample request forms be taken to the sampling site. This will ensure that the job will be accomplished if breakage occurs or conditions dictate that more samples need to be taken.

### Sampling Equipment Provision

The Project Manager will gather the sampling equipment. Examples of appropriate sampling equipment are contained in Appendix 1, Table 1. Appropriate support items, such as maps, GIS markers and stakes, will be collected as needed.

### Decontamination Supplies

The Project Manager will specify decontamination procedures and supplies or will use disposable equipment. Containers for the disposal of waste generated as a result of the sampling will also be supplied.

### Chain-of-Custody procedures

Each person involved in the collection and the handling of samples will know chain-of-custody procedures. Samples collected may be introduced as documentation or evidence into legal proceedings. Chain-of-custody sample integrity will need to be maintained and the possession of samples be traceable from the time samples are collected until results are obtained from the lab. Chain-of-custody starts when the sampling team accepts the sampling containers. Sampling containers should be kept in a secure manner or in the sampler's possession at all times. The Project Manager is responsible for coordinating the chain-of-custody.

### Sample Tracking Procedures

When chain-of-custody is not required, the Project Manager will follow the sample tracking procedure. At a minimum, this procedure will include:

1. Sample Identification (e.g., Division sample number)
2. Sample description (e.g., location and depth, if applicable)
3. Sample date and time
4. Sample matrix (e.g., air, water etc.)
5. Sampler and Division employee if not sampler
6. Analytes requested methods, and special instructions if needed.
7. Contact information.

## **Field Sampling Procedures**

### Field Sample Collection.

The following table lists procedures which may be used in the collection of field samples.

**Table 1**

<b>Sampling Point</b> →	Drum	Sack & bags	Open Bed Truck	Closed Bed Truck	Storage Tanks or bins	Waste Piles	Ponds, Lagoons, and pits	Conveyor Belt	Pipe
<b>Waste Type</b> ↓									
Free flowing liquids and slurries	Coliwasa	N/A	N/A	Coliwasa	Weighted bottle	N/A	Dipper	N/A	Dipper
Sludges	Trier (Spoon)	Trier (Spoon)	Trier (Spoon)	Trier	Trier	N/A		N/A	N/A
Moist Powders or Granules	Trier (Spoon)	Trier (Spoon)	Trier (Spoon)	Trier	Trier	Trier	Trier (Bucket*)	Shovel	
Dry Powders or Granules	Trier (Spoon)	Trier (Spoon)	Trier	Trier	Trier	Trier (spoon)	Trier (Bucket*)	Shovel	
Sand or packed powders and granules	Auger (Spoon)	Auger (Spoon)	Auger (Spoon)	Auger				N/A	
Large grained solids	Large Trier spoon	Large Trier spoon	Large Trier spoon	Large Trier	Large Trier	Large Trier	Large Trier	Large Trier	Large Trier

Note: Quality control samples will need to be collected as called for in the QAPjP. The Project Manager will ensure that the QAPjP is followed. Field preservation and filtering requirements should be met per the methods. A composite sample collected in the field will be mixed and placed in sample containers.

Sample Seals

The following procedures apply to sample seals if chain-of-custody is required:

1. The sample seals are to be completed for each sample or the entire ice chest and include the Sample Number, date and collector’s signature.
2. A sample seal will be placed over the top or around the “neck” of each sample container used. The seal should be around or over the lid of the container. The seal ensures the integrity of the sample. The laboratory analyst will break the seal before analyzing the material collected.
3. The sample seals do not have to be used on each sample container if the samples remain in the custody of the sampler and are delivered directly to the laboratory by the sampler.

One seal can be used to seal the ice chest for the trip to the laboratory. The seal should not be broken until the laboratory representative, qualified to accept chain-of-custody samples, arrives.

### Sample Tracking Forms

When samples are collected, the appropriate sample tracking forms will need to be completed. The sample tracking forms may be obtained from the Laboratory. Samplers will need to notify the Division liaison prior to sampling.

### Sample Identification

Sample tracking is performed for every sample collected. There are two main purposes for collecting samples: 1) confirmation/environmental samples and 2) chain-of-custody samples as physical evidence from a facility or from the environment for enforcement investigations. To accomplish this, the following sample identification and chain-of-custody procedures have been established.

The method of identification of a sample depends on the type of measurement or analysis performed. When on-site measurements are made, the data are recorded directly in field logbooks, with identifying information. Samples are identified with a unique sample label. Field analysis, such as pH, are document in a field logbook. The information on the sample label includes, as applicable:

1. Field identifier
2. Date
3. Time
4. Sample location
5. Sampler
6. Type of sample
7. Preservatives
8. Methods

### Cleaning of Equipment

At each specific sampling point, the team should:

1. Use new or cleaned equipment.
2. Clean the sample equipment either in the field or laboratory, prior to use or re-use. This may be verified by the use of "rinsate blanks." These will be collected at a minimum rate of one blank per 20 samples. The sampling team should check with the Project Manager before leaving to determine an acceptable method of "field cleaning" for the equipment to be used. Single use disposable equipment does not need to be cleaned prior to use.

### Transporting Samples

The samples shall be transported either by sample personnel or by a commercial carrier with tracking ability, e.g., UPS, FEDEX.

### Completion of the Sampling Event

The following are items to consider prior to leaving the sampling location:

1. Verify the number of samples taken.
2. Match the physical samples with the paper work. The team should check for proper samples in the correct containers and that the field sample numbers on the samples correspond with the numbers on the sample request form.
3. Verify the samples are properly preserved.
4. Clean and package all non-disposable equipment.
5. Verify time/date on sample tag, request forms.
6. Bag all disposable items that need to be discarded.
7. Ensure that all sample containers are free of any debris or residue on the outside of the container.
8. As necessary, leave a spilt sample with the facility and a receipt for samples collected.

### Unified State Laboratory Check-In

During normal business hours, the following procedures apply:

1. Notify the Laboratory that the sampling team is delivering samples.
2. Check in with Sample Receiving, located on the first floor, front entrance.
3. Verify samples are received by a chain-of-custody technician if applicable.
4. Present all sample request forms to the laboratory receiving personnel.
5. Verify samples and provide laboratory sample numbers on the forms.
6. Document personnel/location where laboratory results are sent..
7. Provide copy of the chain-of custody/sample request forms to the sampling team leader after all pertinent information is completed and signed by the laboratory personnel.
8. After-hour check-in is unavailable unless prior arrangements with laboratory personnel.

9. If laboratory personnel are not available, then the sample team lead will keep custody of samples and place them in the Division sample refrigerator overnight located in MASOB Sample Storage Room located on the first floor. An ice chest seal will be placed on the chest and place into the refrigerator. Samples will be delivered the next business day. Sampling should be scheduled to minimize storage at the Division.

#### Completion of Laboratory Analysis

Upon completion of the sample analyses, the Laboratory will submit the results to the Project Manager for review. All laboratory reports will be filed in the Division facility file.

The laboratory will retain the sample records according to UAC R444.

After sample results are accepted, the remaining sample(s) will either be disposed by the laboratory or given back to the sample team for final disposition.

# **Annex A**

## **Sample Container Types/Volumes, Preservation and Holding Time Requirements**





## **Appendix 2**

### **Unified Health Laboratory Quality Assurance Plan**

## Quality Assurance Program Plan

Utah Public Health Laboratory  
Division of Disease Control and Prevention  
Chemical and Environmental Laboratory

Address: 4431 S. 2700 W.  
Taylorsville, Utah 84119

Responsible Official: Robyn M Atkinson, Ph.D.  
Director, Utah Public Health Lab  
Phone Number (801) 965-2424  
Email: rmatkinson@utah.gov

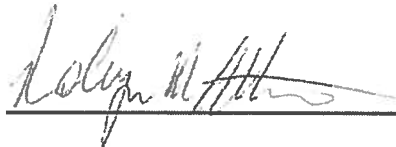
QA Manager: Alia Rauf, M.Sc.  
Phone Number (801) 965-2511  
Email: arauf@utah.gov

Plan Coverage: This is a document describing the State of Utah's Public Health Laboratory Quality Assurance Program Plan. The plan covers all environmental chemistry and microbiology data generated from sampling done in the State of Utah and submitted to the Laboratory for analysis. The coverage in this plan will be as resources and priorities allow.

Approval for Agency:

Name: Robyn M Atkinson, Ph.D.  
Title: Laboratory Director

Signature:



Date: d.ja/1&



# Quality Assurance Program Plan

Utah Public Health Laboratory  
Division of Disease Control and Prevention  
Chemical and Environmental Laboratory

1 Address: ..... 4431 S. 2700 W.

Taylorsville, Utah 84119

Responsible Official:

Robyn M Atkinson, Ph.D.  
Director, Utah Public Health Lab  
Phone Number (801) 965-2424  
Email: rmatkinson@utah.gov

QA Manager:

Alia Rauf, M.Sc.  
Phone Number (801) 965-2511  
Email: arauf@utah.gov

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**Approval for Agency:**

**Name:** Robyn M Atkinson, Ph.D.  
**Title:** Laboratory Director

**Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

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### **3.1 Program Organization and Responsibility**

**3.2 Laboratory Staff.** Laboratory director, chemical and environmental laboratory, QA manager, section managers, analysts, and sample receiving staff are responsible for the quality of work produced. The QA team is comprised of the Laboratory director, chemical and environmental laboratory, QA manager, section managers, analysts, and the sample-receiving technicians who have specific roles in assuring implementation of the Quality System.

Laboratory Organization has been provided in chart in Appendix G

### **3.3 Laboratory Director**

**3.3.1** QA/QC responsibilities for the laboratory:

**3.3.1.1** Gives final approval to the laboratory's Quality Assurance program plan.

**3.3.1.2** May suspend testing when documented quality for a method is in question.

### **3.4 Laboratory Supervisor (Section Manager)**

**3.4.1** QA/QC responsibilities of section managers:

**3.4.1.1** Responsible for training of staff in the section.

**3.4.1.2** Ensures compliance with laboratory's QA manual, approved methodology and SOP.

**3.4.1.3** Reviews or assures that the data is verified and validated before reporting.

**3.4.1.4** Initiates corrective action forms as necessary. Reports persistent or recurring out-of-control situations to the laboratory director and QA manager.

**3.4.1.5** Notifies clients of any problems with their samples discovered during the analysis and/or during data verification.

**3.4.1.6** Oversees the disposal of samples.

**3.4.1.7** Oversees the section's instrument repair and maintenance.

**3.4.1.8** Approves standard operating procedures (SOPs).

**3.4.1.9** Responds to performance audit report.

**3.4.1.10** Participates and assist QA Manager in the improvement of the QA/QC program plan.

### **3.5 Analyst**

**3.5.1** QA/QC responsibilities of analysts:

**3.5.1.1** Participates in the improvement of the QA/QC program plan.

**3.5.1.2** Responsible for quality control implementation for methods assigned.

**3.5.1.3** Performs analytical procedures and data recording in accordance with SOPs that have been approved by the section manager.

**3.5.1.4** Performs data processing and data verification.

**3.5.1.5** Initiates appropriate corrective action for out-of-control situations, such as instrument malfunction, calibration failure, contamination or other non-conformance as appropriate. Reports persistent or recurring out-of-control situations to the section manager. All communications and information, including data collected during a Corrective Action Investigation, must be archived. The analyst and/or the QA manager will accomplish this by storing images of hardcopy and records of e-mail files.

**3.5.1.6** Writes and updates SOPs.

- 3.5.1.7 Assists with sample disposal as assigned.
- 3.5.1.8 Assists in training new staff and in cross training staff.
- 3.5.1.9 Reports errors and problems to section manager.
- 3.5.1.10 Performs routine maintenance of instruments, performs scheduled instrument maintenance, maintains instrument logbook.
- 3.5.1.11 Assists section manager in solving problems.

### **3.6 Environmental QA Manager**

- 3.6.1 Responsible for the implementation of the Quality System.
- 3.6.2 Responsible for the oversight and review of QA data.
- 3.6.3 Reviews and analyzes Method QC data archives to ensure that the current Laboratory Quality Control Objectives and method QC requirements are being met.
- 3.6.4 Provides training on method development, reporting requirements, and legal defensibility. Provides the staff with periodic updates on regulations.
- 3.6.5 Performs and assign in-depth internal audits of methods and operations per SOP.
- 3.6.6 Submits, in writing, monthly QA report to Laboratory Director. The monthly report consists of internal audit reports, QA activities for the month plus corrective actions taken for any out-of-control problems.
- 3.6.7 Coordinates the distribution of proficiency testing samples. Provides response to certification authorities (EPA) with respect to any identified problem areas.
- 3.6.8 Maintains a log of all performance on proficiency test (PT) samples.
- 3.6.9 Initiates corrective action for a failed PT study.
- 3.6.10 Suggests modifications to the QA program which could improve the efficiency and quality of test results.
- 3.6.11 Provides training on QA requirements and specific topics as requested by the analyst and/or section manager. This may include providing guidelines for QA orientation to a newly hired analyst and providing QA review training as needed.
- 3.6.12 Maintains current list of SOPs.
- 3.6.13 Investigates persistent or recurring out-of-control problems, writes report of findings, *and* submits to section manager, chemical and environmental laboratory and laboratory director.
- 3.6.14 Calls attention to newly developed method requirements and monitors their implementation into the existing laboratory procedures.
- 3.6.15 Responds to external performance audit report.
- 3.6.16 Conducts internal performance audits.

### **3.7 Sample Receiving**

- 3.7.1 Promptly logs samples into computer. Maintains a review system to ensure correct entry. Contacts the appropriate section manager or designee for assistance as needed, such as for non-routine samples, rush samples, and samples from special projects.
- 3.7.2 Notifies the section manager or designee of rush or high priority samples upon arrival in the lab.
- 3.7.3 Delivers to the lab or analyst the samples and a copy of the request forms as soon as possible after sample receipt.



**3.7.4** For chain of custody samples, a copy of the chain of custody form must be given to the analyst or section manager.

**3.7.5** Must keep the chain of custody refrigerator organized so that samples may be easily retrieved.

**3.7.6** Samples with very short holding times, 48 hours or less, must be logged in as soon as possible and delivered to the labs within two hours of receiving them.

Turbidity, pH, Temperature, TDS, TSS, and TVS, Heterotrophic plate count (HPC) and Total & Fecal Coliforms by membrane filtration, and Total Coliform and E.coli by Colilert samples fall in this group. HPC samples (drinking and surface water) and SWTR source water compliance samples have the shortest holding time. HPC samples must be delivered immediately to analyst or refrigerated in the sample receiving area, with a message to analyst that samples have been received and are ready for analysis.

**3.7.7** BOD sample bottles must be delivered immediately to the analyst, if analyst is not in the building, sample should be refrigerated in the sample receiving area with a message to analyst that the sample has been received, and is ready for analysis.

**3.7.8** One member serves on the QA team.

### **3.8 LIMS - Staff Roles and Responsibilities**

**3.8.1** Whenever a change is made in a LIMS system, the programmer will document the change made in the program code. The Section Manager will notify all LIMS users of the effects of the change by email.

**3.8.2** All LIMS program changes, requested by the users, must be pre-approved by the laboratory director or his/her designee.

**3.8.3** The computer programmer will assist in training new analysts. He/She will also assist in training analysts when changes are made in the LIMS programs.

**3.8.4** The computer programmer will assist analysts and section managers in solving computer program problems.

## **4.1 Lab Quality Assurance Systems and Definitions**

**4.2 Authorities and Agencies:** The Chemical and Environmental Laboratory (CEL) is a part of the Utah Public Health Laboratory Division of Disease Control and Prevention (DCP) which is the analytical component of the Utah Department of Health (UDOH). The Utah Department of Environmental Quality (UDEQ) is composed of several Divisions which are the Utah State agencies which implement and enforce the State and Federal statutes prescribed under the US Environmental Protection Agency (US EPA) rules and regulations. The analytical services that UPHL provides to Utah DEQ are therefore subject to the US EPA Rules, Regulations and Policies.

**4.3 Quality Assurance Plan (QAP)** CEL has prepared a Quality Assurance Plan covering all operations and services that generate environmental data for State and Federal regulatory compliance. The QAP undergoes a comprehensive review and update once a year to ensure compliance with the current Quality Assurance Objectives of our clients, see Section 5.0 and 6.0.

- 4.4** The CEL QAP will be confined to the quality assurance protocols for sample handling, sample analysis, data analysis and documentation of all actions performed from the time samples are submitted for analysis. **Safety and Waste Disposal Requirements are not included in this QAP. The Standard Operating Procedures covering these operations are found in the respective division manuals.**
- 4.5 Analytical Method** A testing procedure recognized and authorized by a published government regulation as acceptable for generating data for the detection and monitoring of a specific contaminate for compliance with a specific regulation.
- 4.6 Method Calibration Definitions** Calibration covers the procedures used to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or instrument. The levels of the applied calibration should bracket the range of the planned or expected sample measurement.
- 4.6.1 Standard Traceability** - The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.
- 4.6.2 Standard Reference Material (SRM)** – A second source standard of a known concentration other than the source which was used to prepare the Working Standard Solutions. Whenever available, a second source standard that is traceable to a national standard should be purchased and used to verify initial calibration curves. The "certified solutions" some suppliers are selling can come from a common lot source sold by another supplier. Verify and request lot numbers and the source when purchasing materials.
- 4.6.3 Neat Standard Material** - A pure form of a single analyte. May be purchased from any supplier but must be at least 96% pure. An example would be Ultra high purity grade chemicals. Verify or request lot numbers of neat sources when purchasing materials.
- 4.6.4 Standard Preparation Logbook** - Analysts must verify all standard and spike solutions before use in the laboratory and document the verification with a routine determination of analyte content and the source of the determination (date/file/analyst). New solutions must be traceable to a verified standard. The verifications should *also* be documented in the Standard Preparation Logbook.
- 4.6.5 Stock Standard Solution** - A concentrated material containing a verified standard that is a method analyte or a concentrated solution of a single analyte prepared in the laboratory from a Neat Standard Material. Examples: Barium at 1000 mg/l or Benzene at 1000 µg/l.
- 4.6.6 Primary Standard Solution** - A solution of several analytes prepared in the laboratory from the Stock Standard Solution or purchased from an outside source and diluted as needed to prepare Working Standard Solutions and other needed analyte solutions.
- 4.6.7 Working Standard Solutions** - Solutions prepared from the Primary Dilution Standard Solution or Stock Standard Solution at concentration levels applicable for the linear range of the instrumentation. The Working Standard Solutions are used to calibrate the instrument's response with respect to analyte concentration. The

Working Standard Solutions or Primary Standard Solutions are verified, when appropriate with a Reference Material before use.

- 4.6.8 Calibration Method** - A defined procedure for performing a calibration.
  - 4.6.9 Calibration Standard** - A substance or reference material used to calibrate an instrument. (NELAC, QAMS)
  - 4.6.10 Calibration Curve** - The graphical relationship between known values, such as concentrations, of a series of calibration standards and the instrument's corresponding response.
  - 4.6.11 Initial Instrument Calibration** - The calibration process directly used for quantitation. Initial instrument calibration is usually generated on the day of sample analysis. In some instances, initial instrument calibration may be performed prior to the day of sample analysis.
  - 4.6.12 Continuing Instrument Calibration Verification** - When an initial instrument calibration is not performed on the day of analysis, the validity of the initial instrument calibration must be verified before analyzing samples.
  - 4.6.13 Internal Standard (IS)** - When used, a known amount of standard is added to every calibration standard, field sample and QC Sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. These compounds also serve to monitor the integrity of the system.
  - 4.6.14 Surrogate Standards** - Compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate. The surrogate recoveries are used to monitor method extractions for each sample analyzed.
- 4.7 Method Accuracy Definitions:** The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations. The following QC indicators are used to measure accuracy in laboratory testing:
- 4.7.1 Laboratory Spiked Blank (LSB) or Laboratory Fortified Blank (LFB) or QC check sample or Laboratory Control Sample (LCS)** - An aliquot of a clean reference matrix (see 4.8.3) that has been spiked with a known quantity of the method target analyte(s). The LSB is analyzed exactly like a sample (including digestion, extraction, etc.). Its purpose is to determine the accuracy and precision for the test method. In addition, laboratory policy sets an acceptance range for each method for the Laboratory Fortified Blank. The LFB must pass in order for the analytical batch to be accepted.
  - 4.7.2 Laboratory Spiked Sample Matrix (LSM) or Laboratory Fortified Sample Matrix (LFM) or Matrix Spike (MS)** - An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LSM is analyzed exactly like a sample, and its purpose is to determine the effect of matrix on the measurement efficiency of the testing method. The background concentrations of the analytes in the sample matrix must be determined in a

separate sample aliquot and the measured values in the LSM corrected for background concentrations.

**4.8 Method Precision Definitions** Precision is the measure of the degree of repeatability of an analytical method under normal operation. As individual measurements becomes more scattered, the analytical measurement becomes less precise. Precision is usually expressed as standard deviation or relative standard deviation (standard deviation divided by the mean, expressed as a percent, or RSD).

**4.8.1 Laboratory Spiked Blank (LSB) or (LFB) and the Laboratory Spiked Blank Duplicate (LSBD) or (LFBD)** - Separate aliquots of reagent water to which known amounts of the method analytes are added in the laboratory. The LSB and LSBD (also known as LCS, LCSD) are spiked and analyzed exactly like a sample and their purpose is to give a measure of precision associated with laboratory procedures, not the sample collection, preservation, or storage procedures.

**4.8.2 Laboratory Spiked Sample Matrix Duplicate (LSMD) or Laboratory Fortified Sample Matrix Duplicate (LFMD) or Matrix Spike Duplicate (MSD)** - A second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

**4.9 Sample Contamination Definitions: Blank samples**, have not been exposed to the analyte of interest, are processed along with the field samples in order to detect any contamination that may have occurred during sampling, transport, storage or analysis of the field samples.

**4.9.1 A Field Blank** is prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken.

**4.9.2 An Instrument Blank (IB)** is a clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument problems such as contamination or "drift".

**4.9.3 A Laboratory Reagent Blank (LRB), also known as "Method Blank"(MB)** is a sample of a matrix similar to the batch of associated samples that is free from the analytes of interest. The LRB is carried through all method steps to determine any contamination or other effects that may be contributed by the reagents, glassware, equipment or laboratory environment involved in the test method.

**4.9.4 A Trip Blank or Travel Blank** is a sample container filled with laboratory reagent water and sealed. These go to the field and are stored and returned, unopened, along with the field samples. They are stored and analyzed with all other samples for the same requested tests.

#### **4.10 General QA/QC Definitions:**

**4.10.1 Batch** - Environmental samples that are prepared and/or analyzed at the same time, with the same process and personnel, using the same lot(s) of reagents.

**4.10.1.1 A Preparation Batch** is composed of 1 to 20 environmental samples with the same matrix (see definition for matrix (4.9.13) and matrix distinctions). The maximum time between the start of the processing of the first and last samples in the batch is 24 hours.

- 4.10.1.2** An **Analytical Batch** is composed of prepared environmental samples which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.
- 4.10.2 Blind QC Sample-** A sample for analysis with a composition known to the submitter. It is used to test the analyst's or laboratory's proficiency in the performance of the sample testing.
- 4.10.3 Chain of Custody-** An unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples. See Appendix C for chain of custody procedures.
- 4.10.4 Compromised Samples-** Samples which are improperly sampled, insufficiently documented, improperly preserved, collected in improper containers, or exceeding holding times when delivered to the laboratory. See paragraph 7.7 for a more complete description of what constitutes compromised samples and how to handle them.
- 4.10.5 Confirmation-** Verification of the identity of an analyte and/or environmental contaminant through the use of a method with a different scientific principle from the original test method.
- 4.10.6 Corrective Action-** The action taken to eliminate causes of a detected nonconformity, defect or other undesirable situation in order to prevent recurrence.
- 4.10.7 Demonstration of Capability-** A procedure to establish the ability of the analyst to generate acceptable accuracy.
- 4.10.8 Document Control-** The act of ensuring documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.
- 4.10.9 Duplicate Analyses-** The analyses of the analytes(s) of interest performed identically on two sub-samples of the same sample. The results from duplicate analyses are used to evaluate analytical precision of the test method.
- 4.10.10 Holding Times-** The maximum times that samples may be held prior to analysis and still be considered valid and not compromised. (40 CFR Part 136)
- 4.10.11 Interference** – The quantitative detection of the target analyte may be affected either positively or negatively by a non-target interfering material.
- 4.10.12 Laboratory Performance Checks (LPC)** - A solution of various analytes used to check the gas chromatographic column performance and/or instrument sensitivity.
- 4.10.13 Sample Matrix** - The component or substrate that contains the analyte of interest.  
For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:
- 4.10.13.1 Aqueous-** Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.
- 4.10.13.2 Drinking Water-** Any aqueous sample that has been designated a potable or potential potable water source.
- 4.10.13.3 Saline/Estuarine-** Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

- 4.10.13.4 Non-aqueous Liquid-** Any organic liquid with less than 15% settleable solids.
- 4.10.13.5 Biological Tissue-** Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin.
- 4.10.13.6 Solids-** Includes soils, sediments, sludges and other matrices with greater than 15% settleable solids.
- 4.10.14 Method Workstation Binder (MWB)-** Each Analytical Workstation will have a MWB that is specific to that workstation and the analytical Method being performed at that workstation. The MWB is covered in detail in Section 9.3.
- 4.10.15 Negative Control-** Measures taken to ensure that a test, its components, or the environment do not cause undesired negative effects, or produce incorrect test results. An LRB is an example of a negative control.
- 4.10.16 Positive Control-** Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. LFBs, LFM's and surrogates are positive controls.
- 4.10.17 Preservation-** Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

#### **4.11 Reporting Terminology**

- 4.11.1 Minimum Detectable Limit (MDL)** – The statistical estimation of the “best-case” sensitivity for a target analyte of the specified analytical method. The details for determining the MDL are found in 40 CFR Part 136 Appendix B.
- 4.11.2 Minimum Reportable Limit (MRL)** - The lowest concentration which will be indicated on a final analytical report for a particular method and matrix. All results found below the MRL shall be reported as less than the MRL. The MRL can be raised to account for matrix effects or dilutions if necessary. If the MRL is changed from the standard MRL for a particular analyte, an explanatory comment must be included in the final report. MRL is also referred to by some methods and/or programs as the Practical Quantitation Limit (PQL).
- 4.11.3 Combined Standard Uncertainty (CSU)** – As defined for radiological testing, the CSU is the sum of the standard uncertainties and the estimated co-variances of the inputs. The details for calculating the CSU are documented in the SOP for each radiological test.

#### **4.12 References:**

- 4.12.1** US EPA Quality Assurance Division
- 4.12.2** Uniform Federal Policy for QAPP, March 2005
- 4.12.3** Manual for the Certification of Laboratories Analyzing Drinking Water, 5<sup>th</sup> Ed
- 4.12.4** International Standards Organization Guides 2, 30, 8402
- 4.12.5** National Environmental Laboratory Accreditation Conference
- 4.12.6** Multi-Agency Radiological Laboratory Analytical Protocols Manual

### **3 14.0**

#### **5.1 Quality Assurance Objectives (QAOs) – Client QA Program Plans**

## **5.2 Data Quality Objectives (DQO)**

Utah Public Health Laboratories (UPHL) supports the Local, State, and Federal government agencies with analytical services for both regulatory and non-regulatory investigative purposes. UPHL therefore has established Standard Operating Protocols that implement the QA/QC requirements specified in local, State, and U.S. Federal Statutes.

## **5.3 Client Data Quality Objectives (DQO)**

Federal, Local, and State Statutes are the basic documents that define the minimum QA and QC requirements of the analytical services provided by UPHL. UPHL does not perform field-sampling services. Each data using organization is responsible for preparing the SOPs for the sampling procedures that will yield results that are representative of the system being measured. Specific details of the sampling criteria are addressed in their respective Quality Assurance Project Plans.

## **5.4 State of Utah Agencies**

UPHL's principal clients are the agencies within Utah Department of Environmental Quality (UDEQ) which perform regulatory and non-regulatory work. Individual environmental personnel within the UDEQ Divisions determine the monitoring program requirements.

- **Utah Division of Water Quality (DWQ)**

Analysis of environmental water samples for metals, inorganics, organic analytes, physical parameters and radiological analytes (Uranium, Gross Alpha + Beta, Radium-226, Radium-228 and Radon-222). Samples are obtained from lakes, streams, underground water and industrial effluents. Laboratory Methodology needs to be consistent with requirements of the Clean Water Act (CWA).

- **Utah Division of Drinking Water (DDW)**

Analysis of drinking water samples for content of metals, inorganics, organic analytes, physical parameters, and radiological analytes (Uranium, Gross Alpha + Beta, Radium-226, Radium-228 and Radon-222). Methodology needs to be consistent with the Safe Drinking Water Act (SDWA).

- **Utah Division of Solid and Hazardous Waste (DSHW)**

Support for hazardous waste site identification and characterization. Perform oversight monitoring for Treatment Storage and Disposal Facilities (TSDF) permits. Methodology involves SW-846 procedures for listed hazardous wastes and characteristics of hazardous waste for organics, metals and physical characteristics.

- **Utah Division of Air Quality (DAQ)**

Analysis of lead in air filters, PM-10s, and reactive acidic and basic gases.

- **Utah Division of Emergency Response and Remediation (DERR)**

Analysis of unknown materials samples in order to identify and characterize the presence of hazardous compounds (organic and inorganic). Detection of underground contamination from superfund sites and underground storage tanks.

- **Utah Division of Radiation Control (DRC)**

Analysis of environmental water and soil samples for Uranium, Gross Alpha & Beta, Radium-226, and Radium-228. Determination of gamma radiation from Uranium mine tailings, low-level radioactive disposal facilities and radioactive material spills.

- **Non-DEQ State Agencies**

The State Agencies outside the Utah DEQ normally request lab services as defined under the Utah DEQ or Federal regulations.

## **5.5 Private Sector Clients**

UPHL also provides analytical services to private sector clients, primarily to meet Local, State and Federal regulatory requirements. UPHL therefore implements the same QA/QC requirements as are implemented for local, State, and U.S. Federal agencies.

## **5.6 Non-Compliant Analytical Services Requests**

When a request is made for services that do not comply with the regulatory DQOs, the client is instructed that the results cannot be used for regulatory purposes. As detailed in Section 7, a CEL Manager must review these requests and only they can approve the acceptance of this type of sample. The request, the review, and the acceptance are documented in the permanent records for these samples.

## **6.1 Quality Assurance Objectives - Laboratory Analytical Services' Precision, Accuracy, Representativeness and Comparability**

### **6.2 Data Quality Objectives (DQO)**

Federal, Local, and State Statutes are the basic documents that define the minimum QA and QC requirements incorporated into the analytical services provided by UPHL.

### **6.3 DQO for Inter-laboratory Data Comparability**

All data generated by the Division of Laboratory Services will be expressed in units consistent with the data generated by other laboratories reporting similar analyses to allow comparability of data among data using organizations. For soil and other solid samples, the results will be flagged with a comment indicating the manner in which the sample weight was determined, e.g., air dried, oven dried, or as is.

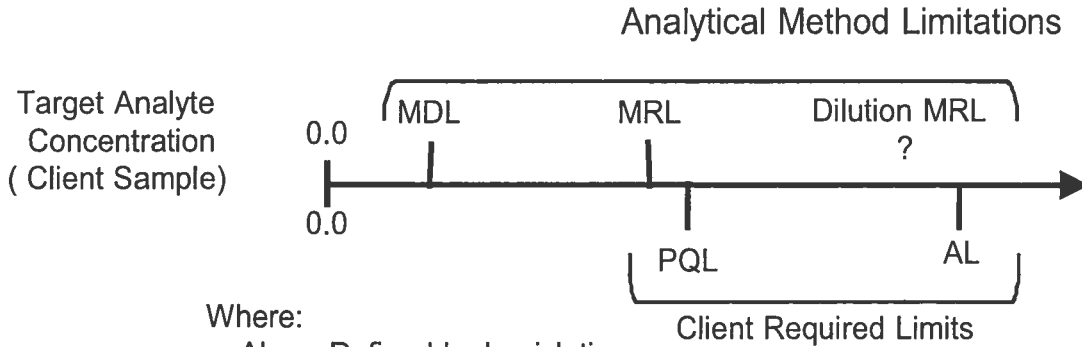
### **6.4 Analytical Method DQOs**

The specific objectives for each data quality element (calibration verification, LSM, LSB, etc.) are described in section 4. Appendix A is a comprehensive list of Analytical methods and Supporting QA Systems. Standard Operating Procedures are required for each of these operations. The Analytical Method SOPs list the overall precision and accuracy QC objectives for the analyses. Where applicable, these QA/QC objectives are based on the historical performance of data quality indicators (LFM and LFMD recoveries).



## 6.5 DQO Review and Update

Government agencies and private sector clients often have programs and projects for which they want to impose different and/or additional QA/QC requirements. As indicated in the image below, the QA/QC limitations imposed on the analytical methods by



Where:

AL = Defined by Legislation

MDL = Defined by Method

MRL ~ (3 to 10) x MDL

Low Cal STD = MRL

PQL = MRL

PQL ~ (0.1 to 0.3) x AL

legislative acts may not accommodate the proposed QA/QC requirements (AL is the analytical limit often defined by legislation for a certain contaminant. The PQL is usually 0.1 to 0.3 times the AL). Therefore, UPHL CEL management must meet on a regular basis with representatives of the State Regulatory Agencies and agree upon analytical Data Quality Objectives (DQOs) which will meet both the minimum requirements of the law and the additional requirements of the clients. Thereafter, when a request is made for an analytical service that does not meet the DQOs, the client will be instructed that the results cannot be used for regulatory purposes and the request will be documented in the permanent records of the affected samples.

## 7.1 Client Samples – Containers, Documentation, and Acceptance

### 7.2 Sampling Responsibility

The DCP Chemical and Environmental Laboratory (CEL) do not perform sampling. Sampling is the responsibility of the Client organizations and should be addressed in their respective Quality Assurance Project Plans (QAPP). DCP personnel will assist clients in the preparation of sample containers with preservatives or by providing sample containers and the reagents necessary for the preservation of samples in the field. The CEL will make the division's Sample Acceptance Policy, CEL QAP Manual Section 7, available to all (Client) organizations.

### 7.3 Project specific QA/QC requirements

Project specific QA/QC requirements are part of the contractual agreement between the client and the CEL management. Client personnel may ask for and receive normal support services from the Sample Receiving personnel. However, if the client personnel have questions or complaints about project specific services being provided by the CEL, the Sample Receiving personnel must put the client personnel in contact with the CEL management in order that a Lab manager can resolve the situation under the client project contractual agreement. Every decision that deviates from the original Client project agreement must be documented and initialed by the CEL manager.

### 7.4 Project QA/QC Initialization

Project QA/QC begins with the creation of a sample and the associated documentation by the Client/Sampler. Thereafter, each person who handles and/or processes that sample and documentation package is responsible and accountable for the QA/QC requirements of the sample. Legally, the Sample/Document package (evidence) begins with the initial sampling and ends with the reporting of the final results.

### 7.5 Project Communications

All Sample and Project related conversations with Customers and Regulators must be documented and initialed.

### 7.6 Sampling Preservation and Container Requirements

When the CEL prepares containers for sample collection and/or accepts samples from Clients for Regulatory Testing (State or Federal), the following QA/QC requirements apply:

TEST: METHOD	CONTAINER TYPE	VOL.	PRESERVE	HOLDING TIME
Ammonia: Method EPA 350.3	Plastic <sup>1</sup>	500 ml	H <sub>2</sub> SO <sub>4</sub> pH < 2 store at 4-6°C	28 Days
Alkalinity(See Total Alkalinity SM2320B)	Plastic <sup>1</sup>	125 ml	Store at 4-6°C	14 Days

TEST: METHOD	CONTAINER TYPE	VOL.	PRESERVE	HOLDING TIME
BOD <sub>5</sub> and CBOD: Method EPA 5210 B	Plastic <sup>1</sup>	2 liter	No preservative, store at 4-6°C	48 Hours
BTEX: EPA 8260	Glass <sup>2</sup> Teflon lined silicon septa	2/40 ml	1:1 HCl to pH < 2 store at 4-6°C	14 Days
Carbamates: Method EPA 531.1	Amber Glass <sup>2</sup> with Teflon cap liner	40 ml	1.2 ml Monochloroacetic Acid Buffer, store at 4-6°C, Sodium Thiosulfate if residual chlorine present	28 Days
Chlorinated Pesticides (Soil): Method EPA 8151	Wide Mouth <sup>3</sup> Glass with Teflon Lined Lid	4 oz	Keep cool at 4- 6°C,	Extract within 14 Days, analyze within 40 Days
Chloride: Method EPA 325.2	Plastic <sup>1</sup>	2 Liter	Store at 4-6°C	28 Days
Chlorophyll a: Method SM10200H	Opaque Plastic <sup>1</sup>	Variable Filtration Volume	Keep Frozen	21 Days
Chromium VI: Method 218.7	Plastic <sup>1</sup>	250 ml	Store at 4-6°C 1:1 HNO <sub>3</sub> (.75ml)	24 Hours
C.O.D. (Chemical Oxygen Demand): Method EPA 410.4	Plastic <sup>1</sup>	500 ml	H <sub>2</sub> SO <sub>4</sub> to pH < 2 Store at 4-6°C	28 Days
Coliforms Total & E.coli Colilert – Drinking water & pools: Method SM9223B	Sterile plastic	100 ml	Sodium Thiosulfate, store at 4-6°C	30 Hours
Coliforms Total & Fecal SM 9223 B	Sterile plastic	100 ml	Sodium Thiosulfate, store at 4-6°C	8 Hours
Color: Method EPA 110.2	Plastic <sup>1</sup>	250 ml	No preservative, store at 4-6°C	48 Hours

TEST: METHOD	CONTAINER TYPE	VOL.	PRESERVE	HOLDING TIME
Conductivity EPA 120.1 (See Specific Conductivity)	Plastic <sup>1</sup>	125 ml	Store at 4-6°C	28 Days
Copper/Lead: Method EPA 200.8	Plastic <sup>1</sup>	1 liter	4 ml HNO <sub>3</sub> to pH <2 add on arrival at the lab	6 Months
Corrosivity (Characteristic of a Hazardous Waste): Method EPA 1110 **	Glass, Amber <sup>2</sup>	2 liter	None Required	7 Days
Cyanide (Total and amenable to chlorination): Method EPA 335.4	Plastic <sup>1</sup>	500 ml	NaOH to pH>12 Ascorbic acid in the presence of residual chlorine	14 Days
Dissolved Solids: Method SM2540C, EPA 160.1 (See Solids)	Plastic <sup>1</sup>	2 liter	Store at 4-6°C	7 Days
Fluoride: Method SM4500C	Plastic <sup>1</sup>	125 ml	None Required	28 Days
HAAs (Haloacetic Acids): SM6251B	Glass <sup>2</sup> with Teflon lined septum	4/40 ml	65 mg NH <sub>4</sub> Cl, store at 4-6°C	Extract within 14 Days, analyze 14 Days
Ion Chromatography Bromide, Chloride: Method EPA 300.0	Plastic <sup>1</sup>	125 ml	Store at 4-6°C	28 Days
Ion Chromatography Bromate: Method EPA 300.0	Plastic <sup>1</sup>	125 ml	Store at 4-6°C Ethylenediamine	14 Days
Ion Chromatography Chlorate, Chlorite: Method EPA 300.0	Plastic <sup>1</sup>	125 ml	Store at 4-6°C	28 Days
Lead/Copper: Method EPA 200.8	Plastic <sup>1</sup>	1 liter	4 ml HNO <sub>3</sub> to pH<2 add on arrival at the lab	6 Months

TEST: METHOD	CONTAINER TYPE	VOL.	PRESERVE	HOLDING TIME
Maximum THM Potential: Method EPA 510.	Glass <sup>2</sup> , Cap with Teflon lined septum	2/40 ml	No preservative, store at 4-6°C	Spike with Chlorine as soon as possible. Analyze within 14 Days after quenching
Metals: (See Total Metals)	Plastic <sup>1</sup>	250 ml	HNO <sub>3</sub> to pH<2	6 Months
Mercury: (See Total Metals)	Plastic <sup>1</sup>	250 ml	HNO <sub>3</sub> to pH<2	28 Days
Nitrate Plus Nitrite <sup>4</sup> : Method EPA 353.2	Plastic <sup>1</sup>	120 ml	H <sub>2</sub> SO <sub>4</sub> to pH<2 store at 4-6°C	28 Days
Nitrite: Method EPA 353.2	Plastic <sup>1</sup>	125 ml	No preservative, store at 4-6°C	48 Hours
Nutrients (Total phosphate: Method 365.1, Nitrate plus Nitrite Method EPA 353.2)	Plastic <sup>1</sup>	500 ml	H <sub>2</sub> SO <sub>4</sub> to pH<2 Store at 4-6°C	28 Days
Odor: Method EPA 140.1	Amber Glass <sup>2</sup>	250 ml	No preservative, store at 4-6°C	24 Hours
Organohalides and PCBs: Method EPA 8081,8082 Water	Amber Glass <sup>2</sup> With Teflon lined lid	1 Liter	If residual chlorine present, 3 mg sodium thiosulfate, store at 4-6°C (0.08 % sodium thiosulfate)	Extract within 7 Days, analyze extract within 40 Days
Organohalides and PCBs(Soil): Method EPA 8081, 8082	Wide Mouth Glass <sup>2</sup> with Teflon Lined Lid	4 oz	Keep cool at 4-6°C	Extract within 14 Days, analyze extract within 40 Days
Perchlorate: Method EPA 314.0	Plastic <sup>1</sup> or Glass <sup>2</sup>		None	28 Days

TEST: METHOD	CONTAINER TYPE	VOL.	PRESERVE	HOLDING TIME
PCB Screening: Method EPA 508A (sub-contracting ALS)	Glass <sup>2</sup> With Teflon lined lid	1 liter	Store at 4-6°C	Extract within 14 Days and analyze the extract within 30 Days
Pesticides, Herbicides, Chlorinated Acids: Method EPA 515.1	Amber Glass <sup>2</sup> with Teflon cap liner	1 liter	Store at 4-6°C, Sodium Thiosulfate if residual chlorine present	Extract within 14 Days and analyze the extract within 28 Days
pH: Method EPA 150.1	Plastic <sup>1</sup>	2 liter	No preservative	Analyze Immediately
Phosphate, total: Method EPA 365.1 (See Nutrients)	Plastic <sup>1</sup>	500 ml	H <sub>2</sub> SO <sub>4</sub> to pH<2 Store at 4-6°C	28 Days
Phenols: Method EPA 625	Amber Glass <sup>2</sup> with Teflon cap liner	2/1 liter	0.008% Sodium Thiosulfate, Store at 4-6°C	Extract within 7 Days, analyze extract within 40 Days
Semi Volatile Organic Compounds: Method EPA 525.2	Amber Glass <sup>2</sup>	1 liter	50 mg sodium thiosulfate, to pH<2 with HCl, store at 4-6°C	Extract within 14 Days analyze extract within 30 Days
Semi Volatiles Methods EPA 625	Amber Glass <sup>2</sup> with Teflon cap liner	2/1 liter	Store at 4-6°C, If residual chlorine add 8 mg/L sodium thiosulfate	Extract within 7 Days, analyze extract within 40 Days
Semi Volatile Organics (Soil): Method EPA 8270	Wide Mouth Glass <sup>2</sup> with Teflon Lined Lid	4 oz	Keep cool at 4- 6°C	Extract within 14 Days, analyze extract within 40 Days
Semi Volatile Organics(Water): Method EPA 8270	Glass, Amber with Teflon lined lid	1 liter	0.08 % sodium thiosulfate if residual chlorine, store at 4° C	Extract within 7 Days, analyze extract within 40 Days

TEST: METHOD	CONTAINER TYPE	VOL.	PRESERVE	HOLDING TIME
Silica: Method EPA 370.1	Plastic <sup>1</sup>	2 liter	Cool 4-6°C	28 Days
Solids: Total Suspended Method EPA 160.2	Plastic <sup>1</sup>	2 liter	Store at 4-6°C	7 Days
Solids: Total Dissolved Method SM2540 C, EPA 160.1	Plastic <sup>1</sup>	2 liter	Store at 4-6°C	7 Days
Solids: Total Volatile Method EPA 160.4	Plastic <sup>1</sup>	2 liter	Store at 4-6°C	7 Days
Solids: Settleable Method EPA 160.5	Plastic <sup>1</sup>	1000ml	Store at 4-6°C	48 Hours
Specific Conductivity: Method EPA 120.1	Plastic <sup>1</sup>	125 ml	Store at 4-6°C	28 Days
Sulfate: Method EPA 375.2,	Plastic <sup>1</sup>	125 ml	Store at 4-6°C	28 Days
Sulfide: Method EPA 376.2 Hach Method 8131 Revision 9 February 2009	Plastic <sup>1</sup>	125 ml	3 Drops Zinc Acetate & NaOH to pH>9	7 Days
Surfactants: Method SM 5540C	Amber Glass <sup>2</sup>	1 liter	No preservative, Store at 4-6°C	48 Hours
Suspended Solids: Method EPA 160.2 (See Solids)	Plastic <sup>1</sup>	2 liter	Store at 4-6°C	7 Days
TCLP(Toxic Characteristic Leaching Procedure)-Metals: Mercury Method EPA 1311	Wide Mouth Glass <sup>2</sup> or Plastic <sup>1</sup>	16 oz solid or 4 L of Liquid	Preserve with Nitric Acid to pH <2 after TCLP	Mercury: 7 Days to TCLP, 28 Days to analyze
TCLP(Toxic Characteristic Leaching Procedure)-Metals: Other Metals Method EPA 1311	Wide Mouth Glass <sup>2</sup> or Plastic <sup>1</sup>	16 oz solid or 4 L of Liquid	Preserve with Nitric Acid to pH <2 after TCLP	Other Metals: 7 Days to TCLP, 180 Days to analyze

TEST: METHOD	CONTAINER TYPE	VOL.	PRESERVE	HOLDING TIME
TCLP(Toxic Characteristic Leaching Procedure)-Organics: Semi-VOAs Method EPA 1311	Wide Mouth Glass <sup>2</sup> with Teflon Lined Lid	8 oz (240 ml) <sup>3</sup>	Keep cool at 4-6°C	Semi Volatiles: 7 Days to TCLP, 40 Days to Analyze
TCLP(Toxic Characteristic Leaching Procedure)-Organics: VOAs** EPA 1311 ZHE	Wide Mouth Glass <sup>1</sup> with Teflon Lined Lid	8 oz (240 ml) <sup>3</sup>	Keep cool at 4-6°C	Volatiles: 14 Days to TCLP ZHE 14 Days to Analyze
THM, Maximum Potential: Method 524.2	Glass <sup>2</sup> , Cap with Teflon lined septum	2/40 ml	No preservative, store at 4-6°C	Spike with chlorine as soon as possible. Analyze within 14 Days after quenching.
THM/TTHM: Method EPA 524.2	Glass <sup>2</sup> with Teflon lined septum	2/40 ml	4 mg sodium thiosulfate, Store at 4-6°C	14 Days
T.K.N.: Method EPA 351.4	Plastic <sup>1</sup>	500 ml	H <sub>2</sub> SO <sub>4</sub> to pH < 2 Store at 4-6°C	28 Days
TOC: Method SM5310B, SM5310C	Amber Glass <sup>2</sup>	4 to 6 oz	H <sub>2</sub> SO <sub>4</sub> to pH < 2 Store at 4-6°C	28 Days
Total Alkalinity: Method SM2320B	Plastic <sup>1</sup>	125 ml	Store at 4-6°C	14 Days
Total Chemistry (Various methods and analytes)	Plastic <sup>1</sup>	2 liters	Store at 4-6°C	Variable, depending on analyte
Total Metals (Drinking and Wastewater): Methods EPA 200.7, EPA 200.8, EPA 200.9, EPA 245.1 (Mercury)	Plastic <sup>1</sup>	250 ml	HNO <sub>3</sub> to pH<2	Mercury: 28 Days Other Metals 6 Months



TEST: METHOD	CONTAINER TYPE	VOL.	PRESERVE	HOLDING TIME
Total Metals (Soils/Sediments and Sludges): Methods EPA 6010, EPA 6020, and EPA 7471 (Mercury)	Wide Mouth Plastic <sup>1</sup> or Glass <sup>2</sup>	4 oz <sup>3</sup>	Store at 4-6°C	Mercury: 28 Days Other Metals 6 Months
TPH: Method EPA 8015 (Modified)	Glass <sup>2</sup> with Teflon lined septum	2/40 ml	No preservative store at 4-6°C	Extract within 14 Days, analyze extract within 40 Days
Turbidity: Method EPA 180.1	Plastic <sup>1</sup>	2 liters	Store at 4-6°C	48 Hours
UV-254: Method SM 5910B	Amber Glass <sup>2</sup>	4oz	No preservative store at 4-6°C	As soon as possible, not to exceed 48 Hours
Volatile Organic Compounds: Method EPA 524.2	Glass <sup>2</sup> with Teflon lined silicon septum	3/40 ml Includes Trip Blank	25 mg ascorbic acid, to pH<2 with HCL, store at 4-6°C	14 Days
Volatile Organic Compounds: Method EPA 624	Glass <sup>2</sup> with Teflon lined septum	2/40 ml	Store at 4-6°C 10mg/L of sodium thiosulfate if residual chlorine present, If testing for aromatics, use HCl to pH < 2	14 Days
Volatile Organic Compounds (Soil): Method EPA 8260	Wide Mouth Glass <sup>2,3</sup> with Teflon Lined Lid	4 oz	Keep cool at 4-6°C	Extract within 14 Days, analyze extract within 14 Days
Volatile Organic Compounds(Water): Method EPA 8260	Glass <sup>2</sup> with Teflon lined septum	2/40 ml	store at 4-6°C Add sodium thiosulfate, if residual chlorine present	14 Days

TEST: METHOD	CONTAINER TYPE	VOL.	PRESERVE	HOLDING TIME
Volatile Solids: Method EPA 160.4 (See Solids)	Plastic <sup>1</sup>	2 liter	Store at 4-6°C	7 Days

- <sup>1</sup> All plastic containers, as specified by the Method, will be new, with the proper preservative added for the type of sample to be collected.
- <sup>2</sup> All glass containers, as specified by the Method, will be washed with soap and water, rinsed with de-ionized water, rinsed with distilled water, and oven dried.
- <sup>3</sup> The above sample containers assume that the sample is 100% solids and uniform particle size. If the sample is less than 100% solid a larger sample volume is required.

\*\* No longer performed at State Health Laboratory, but sample may be received preserved as indicated and then analyzed by a subcontracting laboratory.

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**Procedure for pH out of range nitrate and nutrient bottles**

**Bottle Preservation: For Nitrate and Nutrient**

For the small nitrate bottles three drops of sulfuric acid will be added to the bottles. This will decrease the number of samples received out of pH range.

Samples received with pH out of range:  
 For compliance samples, if the sample is received within 48 hours of the time it was sampled, sulfuric acid will be added drop wise until the pH is <2. If the sample was received outside of 48 hours, sample receiving will call and ask the customer to recollect. If recollection is not possible the analyst will be notified and the sample will be analyzed and reported with a qualifier.  
 For total nutrient bottles outside of pH range received within 48 hours, add the same amount of acid as is used initially for bottle prep (2 mL of 1:7 sulfuric acid). Mark the bottle cap with the new pH. If they are received beyond 48 hours, do not add more preservative just do the pH and mark the bottle and the results will be flagged. Due to large amounts of dirt in some of the samples there will likely be samples that are still over pH 2 after acid addition, the final report will be flagged in these cases.

For dissolved nutrient bottles outside of pH range received within 48 hours, add the same amount of acid as is used initially for bottle prep (1 mL of 1:7 sulfuric acid). Mark the bottle with the new pH. If they are received beyond 48 hours, do

not add more preservative just pH and mark the bottle and the results will be flagged.

## **7.7 Sample Receiving & Documentation**

The Chemical and Environmental Laboratory Services, working with Chemical and Environmental Laboratory Operations (CELO) staff, has the primary QA/QC responsibility for the accessioning of all environmental samples for storage or testing. The following paragraphs [Section 7.7] describe the basic conditions and requirements under which the CEL will accept environmental samples for analysis for regulatory compliance under the laboratory environmental QA plan. Samples, which cannot meet these conditions, will not be accepted by the CEL without flagging the sample and any result produced from the testing of the sample.

## **7.8 Sample Acceptance Criteria**

CEL sample staff receiving the samples will ensure that sample acceptance criteria are met. The Sample receiving staff will document and notify a CEL supervisor/manager when sample acceptance criteria are not met. Sample receiving staff will assign a laboratory accession number to each sample received, followed by entry of sample information and test requests into the CEL LIMS. A second staff member will review data entry in the LIMS to minimize error during entry of sample information into the DCP LIMS. All samples will be stored in storage areas as designated by a CEL supervisor/manager or designee.

**7.8.1 The Sample Documentation** must be present in order for a sample to be accepted at DCP without flagging the sample and any result produced from the testing of the sample. At a minimum, the documentation must include the following information:

- 7.8.1.1** Sample identification that unambiguously matches the identification on each container of the physical sample, e.g., a field identification code. Currently this is being recorded as the SITE ID number in combination with a SOURCE code, e.g., the DEQ DWQ Storet code.
- 7.8.1.2** Any additional information necessary to describe and characterize the sample.
- 7.8.1.3** Sample matrix description, e.g., drinking water, solid, non-aqueous liquid, aqueous, saline/estuarine, chemical waste, biological tissue. Currently, this is being recorded as the SAMPLE TYPE code.
- 7.8.1.4** Location, date, and time of collection.
- 7.8.1.5** Collector's name, customer's name and customer ID code. Some customers may not know their ID Code. Currently for drinking water samples, the ID code is related to the water system number. The customer ID code will need to be determined and documented during sample check in.
- 7.8.1.6** Regulatory programs requiring compliance, if any. Currently, this is being indicated by the DCP cost code, e.g., CWA (CC 350), SDWA (CC 361), RCRA (CC 365), etc.
- 7.8.1.7** Regulatory methods and target analytes being requested, e.g., EPA525.1; SDWA SVOC organics.

- 7.8.1.8 Preservation applied in the field, e.g., "packed in ice." Currently, chemical Preservation information is printed on most of the sample container labels and the request forms which are provided by DCP to the customer.
- 7.8.1.9 Chain of custody documentation, if indicated by the client and/or regulator. The chain of custody forms and chain of custody seals must be sufficient to meet legal and evidentiary standards.
- 7.8.1.10 Documentation for field QC samples being required by the client to supplement the basic DCP QAPP QC Samples e.g., trip blanks, field blanks, equipment blanks, duplicates or other field-submitted quality control measures.
- 7.8.1.11 Comments recorded by DCP personnel, dated and signed, which detail actions taken at the time of sample receipt to bring a sample/document package into compliance with the DCP QA plan. Currently, these records are made on or attached to the request forms.

**7.8.2 The Physical Sample** must meet the following criteria, in addition to those prescribed in Section 7.5, in order for the CEL to accept the physical sample for regulatory testing without qualifications.

- 7.8.2.1 Container type and volume for both field and QC samples as specified for the test method.
- 7.8.2.2 Container QA/QC identification, e.g., the container provided by DCP with DCP labels.
- 7.8.2.3 Container in satisfactory condition e.g. no cracks, no leaks, etc.,
- 7.8.2.4 Custody Seals, if required, should be tamper proof and intact with date and initials that match those on the chain of custody form. The custody seals may be applied either to the individual caps on each sample container or to the shipping container in which they were delivered.
- 7.8.2.5 Durable sample labels and/or tags affixed and marked with information consistent with that on the accompanying documentation as described in Section 7.7.1.
- 7.8.2.6 The sample identification for each sample container must be unique (e.g., if multiple containers are provided for one test, e.g., VOC analysis, each container will be assigned an additional identifier such as A, B, C, etc.
- 7.8.2.7 Chemical preservatives added in the field should be recorded on each sample container label. Currently, this information for containers pre spiked by DCP with chemical preservatives is being printed on both the container labels and the request forms.
- 7.8.2.8 Preservation characteristics designated for measurement at the time of receipt as found in Section 7.5 of the DCP QA plan, e.g., the temperature and/or pH.

**7.8.3 Samples which do not meet the CEL Acceptance criteria**, may be accepted under the following conditions:

- 7.8.3.1 If the CEL project manager, in contact with the sampler or client, is able to complete the requirements listed in paragraphs 7.7.1 and 7.7.2. All

corrections must be recorded (dated and initialed) in the sample documentation. The sample may then be processed as a compliant sample.

- 7.8.3.2** If the CEL project manager, in consultation with the sampler/client and sample receiving staff, is unable to complete the requirements listed in paragraphs 7.7, the sample may be accepted for provisional testing which must be specifically authorized by the client. All client communications must be recorded (dated and initialed) in the sample documentation. In addition, all test results associated with the non-compliant sample must be flagged in the LIMS indicating that the sample did not meet established acceptance criteria. A COMMENT must be added to the Sample documentation and on all TEST RESULTS reported to the client describing how the sample was deficient.

**7.9 Preservation Check.** Prior to or concurrent with testing (to avoid contamination), the contents of each sample container tested will be checked for preservation.

**7.10 Test Method Requirements.** For test Methods not listed in Section 7.5, the containers and preservatives will be utilized as described in the test Method.

## **8.1 Sample Custody- Storage and Final Disposition**

### **8.2 Sample Custody During Field Operations**

Sample custody during field operations is the responsibility of the using organization and is addressed in their respective Quality Assurance Program Plans.

### **8.3 Sample Receipt At The Laboratory**

Upon arrival at the Utah Public Health Laboratories (UPHL) samples will be logged in and assigned a laboratory sample number, also known as the sample identification number. Inadequate or inappropriate samples will be noted and described upon receipt at the laboratory. Example of Chain of Custody Form is in Appendix C. The log entry recorded in the chain of custody record will show:

- 8.3.1** Laboratory sample number
- 8.3.2** Date and time of collection
- 8.3.3** Exact sampling location
- 8.3.4** Name of sampler
- 8.3.5** Storet or system identification number
- 8.3.6** Source of sample
- 8.3.7** Use of the water when applicable
- 8.3.8** Analyses requested
- 8.3.9** Date and time the sample is transferred to the UPHL custody
- 8.3.10** Signature of the sampler
- 8.3.11** Signature of the receiver
- 8.3.12** Condition of samples as received (sealed, unsealed, broken container, improper container, sample improperly preserved, sample QNS, or other pertinent remarks)

## **8.4 Sample Security**

Ensuring the integrity of the Chain of Custody sample is of utmost importance. The number of individuals handling the sample must be kept to a minimum. The Chain of Custody Custodian or a designated alternate shall review the forms, tags, seals and samples to see that all information described in Section 8.2 is completed. After the review and each entry have been addressed the sample and paperwork will be placed in secure storage.

- 8.4.1 Samples to be analyzed for volatile compounds will be stored in a separate refrigerated environment from the other samples. Sample storage area will remain locked at all times, to be opened only by the Chain of Custody Custodian or one of the designated alternates.
- 8.4.2 When an analyst needs a sample for testing they must contact the Chain of Custody Custodian to arrange for checking out the sample. The sample, or portion of the sample, will be released only to the responsible analyst and by signature with date, time and activity.
- 8.4.3 The analyst is responsible for the care and custody of the sample once it is released to them. They must be prepared to testify that the sample was in their possession and view or secured in the laboratory at all times from the moment it was released from the custodian until it is returned to the custodian.
- 8.4.4 The analyst must return the sample to the custodian or provide secure storage for the sample prior to leaving the area where the sample is being processed.
- 8.4.5 When the analyst has no immediate need for the sample it must be returned to the custodian and received by signature with date, time and action.
- 8.4.6 Samples will be discarded after maximum holding times have been exceeded or after six months from time of receipt unless otherwise directed by client organization. The sample containers will be discarded following current laboratory disposal procedures found in the laboratory safety manual.
- 8.4.7 In order that the Utah Public Health Laboratories demonstrate the reliability of its evidence for enforcement of action, it must be able to prove controlled possession of samples from receipt to discard.

## 8.5 Analytical Result Review

Analytical results will be reviewed by the Section Manager before the final analytical report is submitted to the client. A copy of the final report will be given to the Custodian to be included with the Chain of Custody packet for each sample or sample set.

## 8.6 Report Filing

Copies of the completed reports will be included with the custody form to make up the chain of custody packet and kept in a secure area for 5 years from the date the sample was received.

## 8.7 Authorized Custodians

Following are the staff authorized as custodian or as alternates to the custodian for handling chain of custody samples:

- 8.7.1 Custodian David Dick
- 8.7.2 Alternate ED Harrison

8.6.3	Alternate	Corrine Thomas
8.6.4	Alternate	Alia Rauf
8.6.5	Alternate	Merril Chipman
8.6.6	Alternate	Kyle Ashby

Others authorized only to receive chain-of-custody samples include:

8.6.7 Kyle Ashby

## 9.1 Analytical Procedures – Regulatory Methods and SOPs

### 9.2 CEL Analytical Methods

Since our major clients are State and Federal regulatory agencies, the analytical Methods implemented in the CEL operations are primarily mandated by federally promulgated programs (See Section 5). All analytical methods that are routinely performed by the CEL are cited in the Appendix A of this QAP.

### 9.3 Analytical Methods and their Target Analyte MRLs

It is DCP policy to perform all analytical procedures, regulatory and non-regulatory, as stated in the Client Quality Assurance Objectives (QAOs), established in consultation with the client, to meet client program needs (See QAP Sections 5 and 6).

**9.3.1** If the Client program requires Methods with *minor modifications*, the deviations will be limited to those permitted by regulations, e.g., those that do not affect the chemistry of the procedure, such as changes in scale.

**9.3.2** If the Client program requires a *major modification* of a regulatory analytical procedure, all deviations from the referenced method will be cited in all reports of results produced with the modified procedure.

**9.4 Method Workstation Binder (MWB)** Each workstation where an analytical Method is performed will have a Method Workstation Binder. As defined in QAP Section 4.9.14, this binder will have:

**9.4.1 Referenced Method:** A copy of the current approved regulatory Analytical Method.

**9.4.2 CEL Method SOP:** A copy of the current approved CEL Method SOP implemented at that specific Method Workstation.

**9.4.2.1** At least annually, the Method SOP will be reviewed, updated and signed by the Section Manager, the certified Analysts, and the QA Manager.

**9.4.2.2** Each interim change to the current SOP must be read, initialed and dated by the responsible Section Manager and each certified analyst. The change will be included in the next official review and update of the SOP.

**9.4.2.3** Discontinued SOPs will bear the date of archive.

**9.4.2.4** Discontinued SOPs will be archived in the SOP historical files for three years

**9.4.3 Method-Analyte MRLs:** A list of the Method analyte MRLs, to be specified by the CEL management.

**9.4.4 Instrument QC Control Charts:** These are sequential, *real-time* charts that plot specific instrument raw data found for specific QC samples, e.g., the instrument response factor of a specific component in a low Calibration standard. The particular QC Sample and the associated instrument data may be specified by the referenced method.

**9.4.4.1** Instrument QC Control Charts should be posted in the immediate area of the Instrument work station instead of in the MWB;

**9.4.4.2** Established Control Limits should be plainly indicated.

**9.4.4.3** Copies of Instrument Control Charts for past 12 months should be kept in the MWB. After that, the charts should be placed in section historical files.

**9.4.5 Instrument QC Control Charts Evaluation:** Instrument QC Charts provide visual notification to the Analyst of possible problems with the Analytical Instrumentation.

**9.4.5.1** The Method SOP should have a section describing specific conditions under which the Instrument should be taken out-of-service and preventative maintenance initiated, e.g. 'The last data point entered on the chart exceeds the established operational control limits.'

**9.4.5.2** Instrument QC Charts can be visually scanned for patterns (trends) which are normally associated with changes in the testing system. These changes may, in turn, indicate an abnormal condition in the test system. The Method SOP should have a section describing charted patterns that may be encountered with specific Instrumentation that are acceptable and unacceptable, or acceptable with caution.

**9.4.6 Method QC Decision Charts:** The charts that summarize the QC corrective actions to be followed by analyst as required by the CEL QA Systems (See QAP Section 12).

**9.4.7 Analyst Documentation:** Analysts certified to perform a Method at a certain workstation will insert current copies, along with supporting raw data, of the following items into the MWB:

**9.4.7.1** The analyst Initial Demonstration of Capability (IDC), as specified in regulatory Method.

**9.4.7.2** The analyst current Ongoing Demonstration of Capability (ODC) (Quality Control Samples and PT results).

**9.4.7.3** The analyst current MDLs studies, as specified in regulatory Method.

**9.4.8 Retired Documents:** Retired MWB documents will be archived at the back of the MWB. At a date to be determined, the retired documents may be transferred to State Archives.

## **9.5 Annual Section Review of Each MWB (Method work station binder)**

The MWB will be reviewed annually by the certified analyst and Section Manager for current completeness. This will include:

**9.5.1** The Analytical Method SOP. Signatures will verify that the Analysts and Section Manager have read the most recent revisions;



**9.5.2** The certified Analysts' IDCs, ODCs (PTs), and annual MDL studies.

## **9.6 Annual Internal QA Method Review**

QA/QC personnel will review each Analytical Method annually as part of the Annual Review Cycle for all Lab Systems listed in QAP Appendix A. This will include:

- 9.6.1** Reviewing all the Method MWBs for current, up-to-date completeness
- 9.6.2** Reviewing the annual history of Method QC samples
- 9.6.3** Reviewing the annual history of PT results
- 9.6.4** Reviewing Raw Data Packages of recent QA Batches for errors and completeness.

## **10.1 Analytical Procedures – Calibration and Frequency**

It is the policy of the CEL to follow, at a minimum, the Calibration procedures as specified in the Referenced Methods. In order to accommodate the basic types of instrumentation and testing methodology, the calibration and verification procedures are divided in five categories.

## **10.2 Inorganic Chemistry**

In general, Inorganic methods specify standard calibration curves that are developed using a laboratory reagent blank (LRB) and at least 3 working standard solutions. Calibration will be verified after every ten (10) samples with continuing standard (CSTD) at a mid-range concentration and an Instrument Blank (IB). A reporting limit is verified by performing minimum quantification standard analysis with each batch. Some reference methods specify calibration protocols that differ substantially from the general protocol. Examples of these variations follow.

- 10.2.1** For Biochemical Oxygen Demand and Total Organic Carbon the standard working curve will only consist of a laboratory reagent blank and a working standard solution. Because of the limitation of the working space, availability of equipment and the supply of the reference materials, the whole calibration and verification items will only include one working standard, one standard reference material if the working standard is not run and one laboratory reagent blank.
- 10.2.2** For Chlorophyll-A, Odor and Settleable Solids no calibration is done.
- 10.2.3** For Total Dissolved Solids, Total Suspended Solids, Total Volatile Solids, pH and conductivity, calibration will include standards to bracket the range of samples encountered, but no blank.
- 10.2.4** Color is calibrated based on the comparison of 12 cobalt solutions that have been diluted fresh for each run.
- 10.2.5** Solutions for EPA regulated parameters will be prepared in accordance with the methodologies listed for each parameter in Appendix A.

## **10.3 Organic Chemistry**

Instrument calibration will be accomplished daily (or with each run) in accordance with the referenced method SOP and the instrument manufacturer's instructions. Sample peaks will be matched with standard peaks and a standard calibration curve will be determined in accordance with the method.

**10.3.1** Each day of analysis, or with each run, working standard solutions will be used to tabulate area response versus the concentration of the reference material. The results will be used to prepare a calibration curve. If the ratio of response to concentration (calibration factor) is a constant over the working range (<15% relative standard deviation), linearity through the origin will be assumed and the average ratio or calibration factor will be used in place of a calibration curve. Working standard solutions will be prepared in accordance with the methodologies listed for each parameter in Appendix A.

**10.3.2** The working calibration curve or calibration factor must be verified on each working day by the measurement of one or more calibration standards. If the response for any analyte varies from the predicted response by more than the method dictates, the test must be repeated using a fresh calibration standard. If the results still do not agree, a new calibration curve will be prepared or will use a single point calibration standard. The single point standards should be prepared at a concentration that produces a response close to that of the unknowns.

#### **10.4 Metal Chemistry**

**10.4.1** For Metals by ICP, Calibration includes a Calibration Blank and mixed Standards which include a minimum of two Standards per element. Calibration is verified at the beginning and end of the run and after every 10 samples with an Instrument Blank and a Continuing Working Verification Standard (middle concentration). Method 200.7 calls the CWV STD an LPC (Laboratory Performance Check). Calibration includes a Calibration blank, Calibration Standards (three to five). Calibration is verified after every 10 samples with Continuing Working Verification Standards (mid-range concentration, ) and an Instrument Blank. A reporting limit is verified by performing minimum quantification standard analysis with each batch.

**10.4.2** For Metals by ICPMS, calibration standards will be analyzed following EPA 200.8 unless otherwise specified.

#### **10.5 Radiochemistry**

#### **10.6 Microbiology**

Instrument calibration will be accomplished daily (or with each run) in accordance with the referenced method.

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#### **11.1 Analytical Procedures – Quality Control Sample Types**

#### **11.2 Quality Control for Sampling Procedures**

As stated in Section 7.1, UPHL does not perform sampling in the field. Field QC samples (QCS) and their evaluations are the responsibility of the client organization and must be addressed in the Client Quality Assurance Project Plans and QAOs. UPHL will assist the client in the preparation of transport Trip Blanks.

### **11.3 Laboratory Quality Control Samples (QCS)**

UPHL will include the following QC sample types as specified by the referenced regulatory method.

#### **11.3.1 Working Standard Solutions**

Working standard solutions will be prepared and used in accordance with the approved EPA methodology listed in Appendix A for all parameters. These working standard solutions will be verified by comparison with reference materials. Working standard solutions which do not agree within 10% of reference materials or method specified limits will not be used for analysis. Chlorophyll-A and settleable solids will not have a standard.

**11.3.1.1 Internal/Surrogate Standards.** Internal/surrogate standards will be used during organic analyses to monitor method performance, as per each method's requirements.

**11.3.1.2 Laboratory Reagent Blank (LRB).** LRBs will also be used during parameter analysis to determine interference levels.

**11.3.1.3 Laboratory Instrument Blank (LIB).** LIBs will be used to determine working standard curve for all parameters.

#### **11.3.2 Standard Reference Material**

Reference materials will be acquired for routinely analyzed parameters from sources separate from the standards. These samples will be used to verify working standard curves, except regarding Chlorophyll-A, color, odor, and settleable solids.

#### **11.3.3 Reagent Checks**

Each analyst will prepare and cross check reagents, and document the results. All reagents will contain information relating to documentation of contents, date of preparation/expiration, and analyst's initials. Cross checks will be done according to the SOP.

#### **11.3.4 LFB and LFM Analysis**

For inorganic chemistry an LFM will be analyzed with each run, and an LFB every 20 samples or once per run if fewer than 20 samples are analyzed, except regarding BOD, Chlorophyll-A, suspended solids, specific conductivity and pH.

**11.3.4.1** For organic chemistry LFM and LFBs will be analyzed as required in the methodology.

**11.3.4.2** For metals by ICP and ICP/MS, an LFM, LFMD, and a calibration blank will be analyzed every 10 samples, or once per run, if fewer than ten samples are analyzed. For metals by cold vapor, an LFM, LFB and LFBD will be analyzed every 10 samples, or one per run if fewer than 10 samples are run. For both methods, one SRM and a rinse blank will be analyzed once per run, during the run.

**11.3.4.3** For radiological tests (Gross Alpha & Beta, and Radium 226 and 228), a Laboratory Reagent Blank and sample Duplicate, or Spike Matrix Duplicate

and LFB is analyzed with every batch of samples. However, Radiological testing QC requirements are very Method/Instrument specific and subject to change. Therefore, the current QC requirements of the analytical Method referenced in the Method SOP are the definitive standards and must be met.

### **11.3.5 Duplicate Analysis**

**11.3.5.1** For inorganic chemistry: One duplicate run every 20 samples (or as required by the method), or each run if fewer than 20 samples are analyzed, except for: BOD, Oil and Grease, Cyanide, Phenol, Chlorophyll-A, Suspended Solids, Specific Conductivity, and pH.

**11.3.5.2** For organic chemistry: As required in methodology.

**11.3.5.3** For metals: Duplicate run every 10 samples, or each run if fewer than 10 samples are run.

### **11.4 Instrument Quality Control Charts**

Instrument specific Quality Control Charts will be defined for each Method Workstation and will be posted at the instrument workstation, see QAP Section 9.3. Instrument QC Charts will be updated for each analytical batch.

### **11.5 Method Quality Control Charts**

Quality control charts will be kept for routinely analyzed target analytes.

### **11.6 Microbiology Laboratory Quality Control Checks**

Quality control checks for the microbiology lab will include:

**11.6.1** The quality of reagent water will be tested annually for the 'Quality of Reagent Water Ratio' and Pb, Cd, Cr, Cu, Ni, Zn. The water will be checked monthly for conductivity, total chlorine, and residual and heterotrophic plate count. Results must be within the limits established by the EPA.

**11.6.2** Each batch of dilution/rinse water will be checked for sterility.

**11.6.3** The Inhibitory Residue test is performed whenever a change in washing procedure or washing compound is made.

**11.6.4** Sterility checks will be made on each lot of media prior to reporting results.

### **12.1 Analytical Procedures – Batch QC Decisions & Corrective Action**

#### **12.2 Sample Condition QA/QC**

If the physical condition of a field sample or laboratory sample preparation is compromised, then the reported test result must be qualified. Upon finding one of the following sample conditions, laboratory personnel must notify the CEL management as soon as possible. Upon notification, the CEL management or designated staff members will initiate client relation actions.

**12.2.1** Holding time of field sample or laboratory sample preparation has been exceeded as specified by the method.

**12.2.2** Improperly preserved field sample or improper laboratory sample preparation.

**12.2.3** Non-compatible sample characteristics as defined by the Referenced Analytical Test Method.

**12.2.4** Lost or broken sample container before or during laboratory sample preparation.

### **12.3 QA Batches: Preparation Batches and Analytical Batches**

The basic Quality Control structure in the laboratory is the Quality Assurance (QA) Batch. A QA Batch is composed of test samples and the associated QC samples that are analyzed by the same Analytical Method. The Method SOP specifies the requirements for the association of test samples and QC samples.

#### **12.3.1 Preparation QA Batch**

An Analytical Method may require that a test sample must be preprocessed into a particular form (a preparation) before it can be submitted for instrumental analysis. A preparation batch is a group of test samples and QC samples that are associated for preparation under the same test method SOP. A preparation batch will have at a minimum all of the preparation QC samples as specified in the Method SOP (e.g., LRB, LFB and LFM) which are prepared (e.g., extraction or digestion) and processed along with the field samples.

#### **12.3.2 Analytical QA Batch**

An Analytical Test Series (analytical run) is a collection of samples or sample preparations arranged in the order of analysis (analytical sequence) as specified by the referenced test analytical method.

**12.3.2.1** An Analytical Test Series is composed of samples from one or more Preparation Batches which are analyzed along with instrumental QC samples as specified in the referenced test method.

**12.3.2.2** An Analytical Test Series usually begins with an initial standard calibration curve (STDs) which is followed by discrete groups of prepared samples which are bracketed, before and after, by a calibration verification standard (e.g., CSTD) and an Instrument Blank (IB).

**12.3.2.3** The test method normally requires that the last sample in an Analytical Test Series should be a calibration verification standard (e.g., CSTD) and an Instrument Blank (IB).

**12.3.2.4** If an adjustment is made to the instrumentation while an Analytical Test Series is being tested, it should be made carefully. If the instrumental analyses of an Analytical test Series deviates from the analytical test method SOP such that a new set of initial calibration standards must be performed, then a new analytical test series has been initiated.

**12.4 QA Batch Number.** The LIMS Analytical files contain complete records of test data associated with each analytical test series that is uniquely identified with a QA Batch Number. Each QCS test result is uniquely identified within a QA Batch file with a unique sequence number. Since each sample test result is also identified with a QA Batch number and sequence number, the relationship of Sample test results to QCS test results is maintained within the LIMS system. Whenever a QC comment on a test result needs to be made, e.g., a fixed limit flag, the QC comment is identified by linking the record to the QA Batch No. and the Sequence number.

**12.5 Analytical Batch - QC Responsibilities.** Whenever an Analytical Procedure QC parameter deviates from the range or condition specified in the Reference Analytical

Test Method, the Analyst will initiate an investigation, qualify data (if needed) and document findings in the QA Batch Raw Data Package.

- 12.5.1** Samples in defective QA Batches will be re-analyzed in QA Batches with acceptable QC results.
  - 12.5.2** Samples that cannot be re-analyzed in QA Batches with acceptable QC results will not be reported as acceptable for regulatory use. The Analyst must notify the CEL management as soon as possible. Upon notification, the CEL management will initiate Client relations actions and also initiate Corrective and Preventative Actions (CAPA).
  - 12.5.3** Analytical Method SOPs. Each Method SOP contains method specific summaries which itemize the QC samples, their requirements, and their QC limits as specified by each Reference Analytical Test Method.
- 12.6 QC Decision Instructions.** Appendix A or the individual method SOP outlines the requirements for QC Sample Types in an analytical QA Batch and the appropriate responses to the QC results. Each regulatory Method will specify additional QC samples that must also be analyzed and evaluated. Corrective actions must be taken as specified in the referenced method.

## 12.7 Analytical Batch - Instrumentation QC

- 12.7.1 STD, Initial Calibration Standard.** If the analyst finds that one of the characteristics of the Calibration Curve, e.g., the linear regression coefficient, does not meet the requirement as specified in the referenced analytical test method, the analyst will stop and investigate the working standard solutions and the instrumentation for the cause. Once the cause of the abnormality is corrected, the analyst must reanalyze any samples associated with the defective standard curve.
- 12.7.1.1 STD Data Qualifications.** If insufficient sample volume does not allow for reanalysis, the CEL management must be notified. Management will contact the client and the data will be qualified.
- 12.7.1.2 STD Documentation.** Record findings in instrument logbook or sample logbook. Corrective Action Record is required if reported test data is qualified.
- 12.7.2 IB, Instrument Blank or Solvent Blank.** The purpose of an Instrument Blank is to check the condition of the instrumentation, associated equipment, and the purity of the solvent. If the method requires an Instrument Blank, it must be analyzed. If the instrument blank test indicates a problem with either the equipment or the solvent, the analyst should stop and check for the cause. Possible causes are a contaminated detector, an abnormal baseline, an abnormal signal, or a solvent contaminant that might interfere with the analysis. Once the problem is corrected, the analyses may continue.
- 12.7.3 CSTD, Continuing Standard.** The CSTD is used to periodically verify instrument performance during analysis. If CSTD does not meet the requirements as specified in the referenced analytical test method, the analyst will immediately investigate the possible sources of the failure. No additional samples should be prepared for testing until the source of the failure has been found and eliminated.
- 12.7.3.1 CSTD Data qualifications.** Required if test results are reported from data acquired with a CSTD which does not meet the requirements.
- 12.7.3.2 CSTD Documentation.** Record findings in instrument or sample logbook. Corrective Action Record required if reported test results are qualified.
- 12.7.4 Batch Termination QC.** Each analytical QA Batch sequence must end with both an acceptable IB and an acceptable CSTD.

## 12.8 Analytical Batch - SRM & Reagent Blanks QC

- 12.8.1 LRB, Lab Reagent Blank or Sample Preparation Blank.** If a LRB is required by the test method, the analyst will inspect the LRB for indications of contamination. If the analyst finds contamination as defined in the method, he/she should immediately investigate the possible sources. No additional samples should be prepared for testing until the source of the contamination has been found and eliminated. If possible, new analytical samples should be prepared and analyzed.
- 12.8.1.1 LRB Data Qualifications.** Required if contamination cannot be eliminated and the reported test result is calculated from data acquired with a Preparation Batch containing a contaminated LRB.

- 12.8.1.2 LRB Documentation.** Record findings in sample preparation logbook or on batch summary sheet. Corrective Action Record is required if reported test result is qualified.
- 12.8.2 SRM Standards Reference Material.** The SRM is used for verification of prepared standards (e.g., calibration and spiking standards) and stock standards used for analyses performed by the referenced test method. QA database control limits are derived from the referenced test method, and specified in appendix A of the QA manual.
- 12.8.2.1 SRM, Standards Verification.** If the SRM recovery is not within verification control limits, the analyst will immediately investigate the possible causes (e.g., working standard solutions, source of standards, and instrumentation).
- 12.8.2.1.1** If it can be verified that degradation of the original SRM is the cause, then the original data can be reported without qualification. Verification is achieved through concurrent analysis and comparison of the original SRM, and a new SRM.
- 12.8.2.1.2** If it cannot be verified that degradation of the original SRM is the cause, the associated samples must be re-analyzed, if possible, along with a successful SRM.
- 12.8.2.2 SRM, Data Qualification.** Sample test results should not be reported until they can be associated with, and validated by successful analysis of a SRM. If the SRM recovery is not within the control limits and the sample set cannot be re-analyzed, the associated data may be reported; however, a qualification statement must be included in the final report indicating that the reported data could be suspect and cannot be verified. The analyst must immediately notify the section manager for appropriate customer relation action(s).
- 12.8.2.3 SRM, Documentation.** Record findings in the instrument or sample logbook and in the batch comments file of the QA database or on batch summary sheet. If the sample data has been reported with qualifications, then a Corrective Action Record (CAR) must be initiated by the section manager, or analyst.
- 12.8.3 LFB Laboratory Fortified Blank.** The LFB is used for assessment of method accuracy performance. QA database control limits are derived from the referenced test method, and specified in Appendix A of the QA manual. If the LFB is derived from an alternate standard source, and is also intended to satisfy the SRM function, SRM QA database control limits must be applied to the LFB for performing verification of standards (section 12.7.2.2 and section 12.7.2.3).
- 12.8.3.1 LFB, Method Accuracy** If the LFB recovery is not within accuracy control limits, the analyst will immediately investigate the possible causes (e.g., spiking solution, calibration standard(s), and instrument performance associated with the analysis), and perform the following actions:
- 12.8.3.1.1 LFBs not involving sample preparation steps.** If possible, a new LFB, and the samples associated with the original LFB must be re-analyzed.
- 12.8.3.1.2 LFBs involving sample preparation steps.** If it can be verified that instrument performance is the cause (e.g., instrument maintenance, calibration drift, etc.), and successful re-analysis of the original LFB and



associated samples has been performed, the re-analyzed data may be reported without qualification. If re-analysis of the original LFB and associated samples is unsuccessful, then the section manager must be notified, and if possible, a new sample set prepared and analyzed.

- 12.8.3.2 LFB, Accuracy Qualification.** Sample test results should not be reported until they can be associated with, and validated by successful analysis of a LFB. If the LFB recovery is not within the accuracy control limits *and* the sample set cannot be re-analyzed, the data may be reported; however, a qualification statement must be included in the final report indicating that the reported data could be suspect, and cannot be verified. The analyst must immediately notify the section manager for appropriate customer relation action(s).
- 12.8.3.3 LFB, Documentation.** Record findings in the instrument or sample logbook and in the batch comments file of the QA database. If the data has been reported with accuracy qualification statements, a Corrective Action Record (CAR) must be initiated by the section manager, or analyst.
- 12.8.4 LFBD, Lab Fortified Blank Duplicate.** When the referenced analytical test method requires a LFBD, the percent difference (%D) between the LFB and the LFBD values is used to calculate the precision.
  - 12.8.4.1 LFBD, Precision.** The determination of the precision is defined in greater detail in Section 14.2. The precision, in general, is the range of %D values which the method or program defines as acceptable. If the %D for the LFBD is not within the precision control limits (the calculated range), then the analyst shall investigate the possible causes of the inconsistent spike recovery. If the cause cannot be determined and/or the spike results cannot be verified then the analyst should reanalyze all of the samples in the Preparation Batch if possible.
  - 12.8.4.2 LFBD, Precision Qualification.** If reanalysis does not verify the validity of the original data *and* the sample set can neither be reanalyzed nor resampled, the data may be reported but only with the qualification that the reported data is suspect and cannot be verified. The analyst must immediately notify the lab supervisor for appropriate customer relation actions.
  - 12.8.4.3 LFBD Documentation.** If reanalysis of the original standard(s) and spiking solution is performed, the data shall be recorded and archived (Chemist notebook, bench sheet). If the data has been reported with qualifications, then a Corrective Action Record must be initiated.

## **12.9 Analytical Batch - Sample Matrix and Sampling QC**

- 12.9.1 LFM, Lab Fortified Matrix or Matrix Spike.** The LFM can have a two-fold purpose. The LFM is used primarily to detect matrix interference. In addition, the LFM percent recovery data can be specified by the referenced analytical test method for calculating the accuracy instead of using Lab Fortified Blank data.
  - 12.9.1.1 LFM, Matrix Effect.** If the LFM percent recovery is low as defined in the reference method then a matrix interference must be confirmed by comparison of the LFM data with the LFMD data.(For further instructions see section 12.8.2.1)

- 12.9.1.2 LFM, If used for Accuracy.** If the LFM found value is not within the calculated accuracy limits and if the LFMD is also not within the accuracy limits, then the analyst will examine the spiking solution and the standard(s) used for the analysis. If the cause of the inconsistent spike recovery cannot be determined and the accuracy verified, then the sample set must be reanalyzed, if possible, using an LFB for the calculation of the accuracy.
- 12.9.1.2.1 LFM, Accuracy Qualification.** If reanalysis is not possible and the samples cannot be resampled, the original Preparation Batch data can be reported but only with the qualification that the accuracy of the reported data cannot be verified.
- 12.9.2 LFMD, Lab Fortified Matrix Duplicate or Matrix Spike Duplicate.** The LFMD data is used primarily to check for and to confirm matrix interference. If the LFM percent recovery data is used to calculate the accuracy then the LFMD percent difference (%D) data is also used to calculate the precision.
- 12.9.2.1 LFMD, Matrix Effect.** If the LFM and LFMD percent recoveries are consistently low or high as specified in the referenced analytical test method for matrix interference, then the sample data for that Preparation Batch may be reported with a sample specific qualification.
- 12.9.2.1.1 LFMD, Matrix Effect Qualification.** If the sample result being reported has been demonstrated to exhibit matrix interference, then the result for that one sample must be qualified. If the reference analytical test method requires that a matrix effect must be confirmed, then the qualification should state that a Matrix interference (or Matrix effect, or method non-compatibility) has been confirmed for the testing of this sample using the referenced analytical test method. If the referenced analytical test method does not require confirmation, the qualification must say that there is a possible matrix effect. A matrix interference is not a system failure, therefore a Corrective Action Record is not required.
- 12.9.2.2 LFMD, If used for Precision.** The determination of the currently acceptable range for the precision is defined in greater detail in Section 14.2.1. If the %D for the LFMD is used for precision and is not within the current acceptable range of precision, then the analyst shall investigate the possible causes of the inconsistent spike recovery. If the cause cannot be determined and/or the results cannot be verified, then the analyst should reanalyze all of the samples in the Preparation Batch.
- 12.9.2.2.1 LFMD, Precision Qualification.** If reanalysis is not possible and the samples cannot be resampled, the original data can be reported but only with the qualification that the reported data is suspect and cannot be verified.
- 12.9.3 DUP, Duplicate Sample (Matrix Duplicate).** The result of the sample Duplicate analysis is compared with the result found for the original sample analysis. The Percent Difference is calculated. If the Percent Difference is not within the range specified in the reference method then the analyst must examine the sample collection and preparation records for possible causes. Large variations in results found for the same sample can be caused by a variety of conditions including but

not limited to the following. The original field sample may be physically non-homogeneous. In which case the sample splitting procedure used to prepare the samples may not have produced a true, representative sample. If the results for the sample and its duplicate are low and near the MRL, the standard deviation of results at this concentration will give large Percent Differences even on replicate analyses.

**12.9.3.1 DUP, Duplicate Data Documentation and Qualification.** If inconsistent duplicate results cannot be resolved by reanalysis, all the data should be documented and the sample result and sample duplicate result reported with the qualification that the results for that one sample are suspect due to a non-homogeneous sample matrix and the referenced sampling procedure or sample splitting procedure. A Corrective Action Record is only necessary if an in-house system error has been identified.

**12.10 The Analyst's Responsibility for Notification.** The Analyst will notify the Section Manager as soon as possible when he/she has determined that one or more of the conditions described above will cause the final test results to be reported with flags, comments, or other qualifications.

**12.11 The Section Manager Corrective Actions.** The Lab Supervisor is responsible for filing the Corrective Action Record (CAR) form documenting any condition which has affected the quality of analytical data including the following events. The Corrective Action Record should include the steps being taken to prevent future occurrences of these events.

**12.11.1** Notification by the analyst or upon becoming aware that one of the QC conditions described in sections 12.6-12.8 has occurred.

**12.11.2** Review of the final results reveals the existence of one of the QC conditions described in section 12.6-12.8 which has not been previously identified or documented.

**12.11.3** Review of the final data and/or the final report reveals a computer file error.

**12.12 The Chemical and Environmental Laboratory Corrective Actions Documentation and Report.** The Chemical and Environmental Laboratory Manager and QA Manager will investigate and take appropriate action including filing a CAR if any of the following events occur. The Chemical and Environmental Laboratory Manager may delegate responsibility to staff if he/she feels that it is necessary.

**12.12.1** EPA Region VIII program audits which indicate deficiencies.

**12.12.2** Client Complaints which relate to the quality of the laboratory analytical systems.

**12.12.3** The Chemical and Environmental Laboratory Section Manager /QA Manager Corrective Action Follow-up. The Chemical and Environmental Laboratory QA manager or his/her designee will document in a Corrective Action Record all corrective actions which have been implemented or proposed.

**12.12.4** The Chemical and Environmental Laboratory QA Manager and Section Manager is responsible for documenting and reporting to the Laboratory Director any QA issues that are not resolved and need immediate attention.

**12.13 The QA Manager Responsibilities.** The QA manager will be responsible for monitoring ongoing quality by performing follow-up method and blind audits and report to the Chemical and Environmental Laboratory Section Managers. The QA manager investigates and takes appropriate action including filing a CAR if any of the following events occur:

- 12.13.1** Performance Evaluation (PE) Study audits have results that indicate unacceptable values.
- 12.13.2** In-house System Audits by the QA manager which indicate unacceptable conditions.
- 12.13.3** Intra-laboratory comparison studies which indicate out of normal range results.
- 12.13.4** EPA Region VIII program audits that indicate deficiencies.
- 12.13.5** Final Reports that require corrections after being transmitted out of the Lab.
- 12.13.6** Verify the implementation and documentation of the corrective actions proposed in Corrective Action Records filed by the Laboratory Supervisor and/or the Chemical and Laboratory Analyst. The QA manager is responsible for reporting to the Laboratory Director any QA issues that are not, in the opinion of the QA manager, being addressed in a timely manner by the Chemical and Environmental supervisory staff.

### **13.1 Analytical Procedures - Data Reduction and Validation, LIMS Processes, Client Reports and Retention of Records**

**13.2 Client Project Sampling Data.** Data validation and Data integrity during sample collection and associated data reduction are the responsibility of the (Client) using organization and is addressed in their respective Quality Assurance Project Plans.

**13.3 Lab Data Reduction and Peer Review.** For all CEL Analytical Sections, Inorganic, Metals, Organics, and Radiologic, each analyst will review the raw data and verify that the analytical data produced for all parameters is within prescribed control limits, as defined by the reference Methods, and SOPs before entering the data onto the Laboratory Permanent Databases (APPX, LIMS and ACCESS). Preliminary test results will not be entered into the LIMS such that the results are made available for reporting. A corrective action will be initiated by the analyst when QC results do not fall within the prescribed control limits. The completed analytical QA Batch Raw Data Package, including any Corrective Action records, is authorized by the analyst, initialed and dated, as complete and accurate. After the QA Batch Raw Data Package has been reviewed by the assigned peer reviewer for completeness and correctness, the QA Batch Raw Data Package is filed in the CEL on-site archives.

**13.4 Automated Data Consistency Checks.** After all Inorganic & Metals tests for a sample have been completed, the test results are checked for interdependent consistency. The Inorganic Section Manager performs a final review of the results following an application of Standard Methods 1030 F, 19<sup>TH</sup> edition, "Data Quality: Checking Correctness of Analyses". The various checks involved have been automated in the LIMS system.

Depending on the tests requested and performed for a sample, these checks include the following:

- 13.4.1 Anion-Cation Balance;
- 13.4.2 Anion Sum and Cation Sum versus the Electrical Conductivity;
- 13.4.3 Anion-Cation Sum versus the TDS;
- 13.4.4 TDS versus the Electrical Conductivity;
- 13.4.5 Analyte Results for the sample Filtered versus Unfiltered;
- 13.4.6 Analyte Result Found versus Historical average for the sample type;
- 13.4.7 QA/QC Flags set either by Analysts or automatically by the LIMS.

**13.5 Manual Automated Data Consistency Checks.** The QC details of the automated checks are prescribed in the SOP for SM1030F. The LIMS system is designed such that the Section Manager must manually review all results that do not pass the Check for Correctness of Analyses. After the results have been verified and/or corrected, the results are released for transmission to the client. The results of the analytical checks and the actions taken by the Section Manager are recorded and the hardcopy is filed.

**13.6 Sample Reanalysis.** When testing is repeated for any reason and data that has been entered in the LIMS needs to be changed to reflect a higher quality result, the access to change the previously entered results is limited to the CEL Managers. After results are initially entered the following individuals are the only ones authorized to make changes:

- 13.6.1 Organic Chemistry - Organic Section Manager
- 13.6.2 Inorganic Chemistry – Inorganic Section Manager
- 13.6.3 Metals – Organic Section Manager
- 13.6.4 Microbiology – Environmental Microbiology Section Manager
- 13.6.5 Radiochemistry – Organic Section Manager

**13.7 Transmission of Final Results.** After all test requests for a sample are completed and reviewed, the results are reported to the customer. The format of results reported to the customer is determined during the consultation with the customer defining the Data Quality Objectives. These formats may take the form of hardcopy or of electronic file transfers. In no instance will data with suspect QC results be transferred without the qualifying statement. Results with special formats such as Radiological analyses will follow the formats specified in the Method reference by the Method SOP.

**13.8 Amended Reports.** When any result that has been reported to the customer is changed, a comment must be added to an “Amended” report indicating that the result was changed, the previously reported values, and the initials of the individual making the change. The report must then be printed and mailed or electronically resent to the customer. Changed reports require formal corrective action and review by the QA committee.

**13.9 Completed Raw Data Record Archives.** Archived Records shall be kept for not less than 12 years with the two most current years kept on-site. These records shall include final reports with documentation of the technical review, all raw data, data collection

sheets, calculations, instrument calibration/tuning and quality assurance in sufficient detail to validate each reported result. Prior to scheduled disposal of archived data, the CEL will notify the customer. Archived data associated with litigation will be stored until the customer requests disposal.

**13.10 Data Management record keeping.** Reference SOP: Data Reduction and Validation, LIMS Processes, Client Reports and Retention of Records Mailing and Tracking, Data Management (electronic)

File Reference: G:\Bureau of Chem & Env Services\2013 QA Manual\SOPs

**14.1 QA Systems - Statistical Concepts and Definitions**

**14.2 Standard Deviation.** When the same test is performed repeatedly on the same type of sample under approximately the same conditions, the resulting group of data points will be scattered around an average value, due to noise in the analytical system. The standard deviation,  $s$ , is a calculated estimation of how widely the data points are scattered around their average value, the mean.

**14.2.1 Calculation.** The equation used by the LIMS to calculate an estimate of a standard deviation ( $S$ ) is:

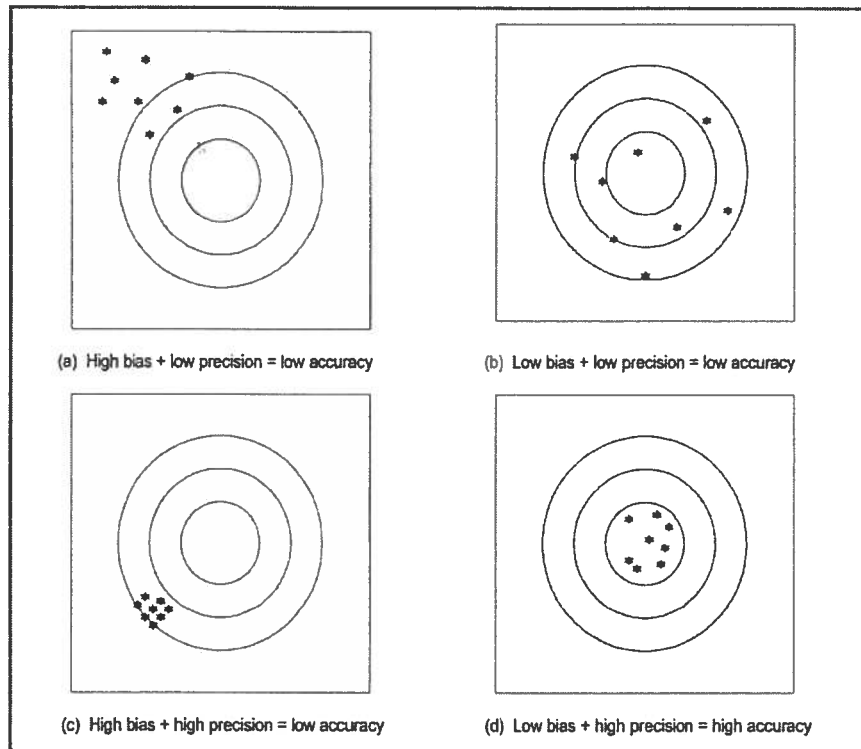
$$S^2 = \frac{1}{n-1} \left[ \sum_{i=1}^n X_i^2 - \frac{\left( \sum_{i=1}^n X_i \right)^2}{n} \right]$$

**14.2.2 Database assumptions.** The use of this equation assumes that all available data points are being used to calculate the standard deviation. For example, eliminating data points which do not appear to be grouped around the average value can result in the calculation of a standard deviation which describes a smaller set of data points which is tighter and less scattered than the actual set of data points.

**14.2.3 Testing Assumptions.** The equation also assumes that the data points are distributed in a normal distribution around an average. This means that all aspects of the test, and its environment, always re-occur in exactly the same manner. In practical reality, things in the environment are always undergoing small changes, e.g., the room temperature, the light coming through a window, the building air pressure, the temperature of the sample, the temperature of the instrument, etc. When even small changes occur in the test conditions, the resulting distribution pattern of the measured data points can be very different from the normal pattern produced under extreme conditions of isolation and control. Therefore it is very important that environmental conditions should be kept constant whenever a

particular analytical test method is being performed, i.e., *a/ways* follow the method SOP.

**14.3 Precision, Bias, and Accuracy.** The following Chart demonstrates visually the relationship that exists between Precision, Bias and Accuracy for a group of points found on a scatter plot where the central point is the goal, the target.



**14.3.1 Precision.** The Precision is a measure of the average percent difference between duplicate test results, without regard to how close their average found value is to the actual known concentration. For example, data sets represented by C and D in the diagram are both tightly grouped and are equally high precision but the average of set C is far from the center, true value. Currently the computer QC program determines the precision for a data set by calculating the difference between the results found for the Laboratory Fortified Blank (LFB) and its Duplicate, (LFB<sub>D</sub>), and then dividing the difference by the average of the two results. This is sometimes referred to as the relative percent difference, (RPD or %D). However, it is the referenced analytical test method that specifies how the Precision should be determined. In addition, most analytical test methods require that a QC Chart be plotted showing the standard deviation of the most recent precision determinations. Most analytical test methods also require that Fixed Limits be established for monitoring the Precision of a testing process and for determining the acceptability of the test data.

**14.3.2 Bias.** Bias is a measure of systematic error. When a sample of known concentration is tested repeatedly, the Bias is determined by how close the average test value is coming to the actual, known value. For example, the data sets represented by A and B in figure 14.2 are both very scattered showing low precision but the data in set D is averaged around the true value and therefore has a lower bias than the data in set B. A data set with low bias, such as in Panel D, is sometimes referred to as unbiased.

**14.3.3 Accuracy.** Accuracy is a measure of a test's ability to produce a result that on average is close to the true value. Accuracy can be measured by determining the percent recovery (%R) by testing either a spiked blank, i.e., a LFB, or a spiked sample, i.e., a LFM. Unless the referenced analytical test method prescribes otherwise, only spiked blank test results will be used to calculate accuracy. Some analytical test methods require that a chart plotting the standard deviation of sequential accuracy measurements be maintained for monitoring the test system or for determining the acceptability of the data. Example calculation:

$$\begin{aligned} \text{IF [LFB] true} &= 14.2 \text{ and} \\ \text{IF [LFB] found} &= 15.2 \text{ then} \\ \%R \text{ found} &= (15.2/14.2) \times 100\% \\ \%R &= 107\% \end{aligned}$$

**14.4 Method Detection Limit (MDL).** The MDL, in general terms, is the minimum concentration of a specific material which when spiked into a specific matrix and tested, using a specific method, can be statistically recognized 99% of the time as actually being present and not just random background noise.

**14.4.1 MDL vs. Reality.** The MDL is estimated using statistical calculations. The MDL determination is therefore sensitive to all of the limitations and assumptions of statistics which are detailed in section 14.3.2. The analyst who is familiar with the test makes educated guesses for the initial test conditions. The initial spiking concentration which is recommended to be set at one to five times the target MDL. However, more than one series of different spiking concentrations may be required before test conditions are found which will yield a reliable standard deviation and a reasonable MDL.

**14.4.2 MDL Determination.** The MDL can be achieved by an experienced analyst operating a well-calibrated instrument on a routine basis. To determine the MDL, spike a blank or the matrix of interest, to make a solution containing each method analyte at a concentration which is near the analyte estimated MDL. Analyze seven portions (or more) of this solution. Each solution is sent through the entire analytical test method procedure. This is not the same as testing seven spiked instrument blanks. The standard deviation for each analyte is then calculated.

From a table of the one-sided *t* distribution, select the value of *t* for 6 degrees of freedom (one less than the number of portions analyzed) at the 99% confidence level. This (6 degrees of freedom) gives a value of 3.14 for *t*. The product of 3.14 times each standard deviation *s* is the MDL for that analyte. Appendix B to Part



136 of Code of Federal Regulation explains in detail the official procedure for determining an MDL.

**14.4.3 MDL Application Restrictions.** An MDL found by the procedure referenced will be specific and will apply only to test data acquired under the same conditions that were present during the original MDL determination. These limitations on the MDL include:

**14.4.3.1** the specific analytical test method;

**14.4.3.2** the specific method SOP followed;

**14.4.3.3** the specific method options followed; the specific sample matrix type;

**14.4.3.4** the specified instrument;

**14.4.3.5** the specific lab personnel.

**14.4.4 MDL Limitation on the MRL.** The Method Reporting Limit (MRL) for an analyte shall be the lowest concentration which can be indicated on a final Analytical Report for a particular method and matrix. The MRL must be greater than the experimental MDL. However, if the analyte and method are for SDWA, then the MRL should be established at the program required detection limit, DL, or the method specified MDL, whichever is lowest. All results found below the MRL shall be reported as less than (<) the MRL. The MRL can be raised to account for matrix effects or dilutions if necessary. If the MRL is changed from the Quality Assurance Program Plan MRL for a particular analyte, an explanation *must* be included in the final report.

**14.5 Quality Control Limits.** When QC samples are analyzed, the test results can be evaluated against two different types of QC limits. The first type is the fixed QC Limit. Fixed control limits are employed as required by the Reference Test Method. The second type of QC limit is the statistical limit. In this type, the QC sample results are evaluated against statistically calculated limits in order to detect possible weaknesses in the test system before the system has a chance to fail. These monitoring criteria are normally expressed as statistical warning limits, normally set at the statistical average  $\pm 2s$ , and statistical trends. Appendix A contains method specific summaries which itemize the QC samples, their requirements, and their QC limits as specified by each reference analytical test method.

**14.5.1 Fixed Limits and Data Acceptability.** Fixed control limits are usually stated as very specific ranges of concentrations or percentages of concentrations. The acceptable range is bounded by an Upper Control Limit, UCL, and a Lower Control Limit, LCL. The LIMS QC program automatically compares QCS Test results with these limits and flags QC points which exceed these limits. When specified in the referenced analytical test method, the fixed limits for most methods must be met for the test results to be acceptable under a regulatory program QA Project Plan such as RCRA. Therefore, if a QC measurement exceeds the analytical test method specified fixed QC Limits, the data is considered suspect and should be immediately evaluated for acceptance or rejection following the procedures described in Section 12. However, even if the associated sample results are subsequently rejected and not reported, the QCS test data should be retained in the QC Files for calculation of future standard deviations.

- 14.5.2 Statistical limits and Test Monitoring.** In practice, statistical limits are used to monitor an analytical Test Series as each QC Sample is processed. For most analytical test methods, the statistical limits are defined as the average of a fixed number of the most recent computer QC File data points plus or minus two standard deviations. The number of QC data points used to calculate the current standard deviation "s" will be defined for each analytical test method and listed by the Method SOP.
- 14.5.3 Outlier Limits.** Theoretically, an "Outlier" is a term which should be limited to describing a test result which is known to be a false reading due to an isolated failure in the testing system, i.e., broken instrumentation, mixed up sample containers, contaminated samples, etc. In practice, a system failure may not always be noticeable at the time of testing. Therefore various statistical methods have been defined for detecting outliers. For this document, a statistical outlier is defined as a point which falls outside of an acceptable statistical limit, normally +/- five standard deviations. If a QCS test measurement exceeds the Outlier QC limits specified for the analytical test method, the data is considered invalid and an action appropriate to that QC sample type should be taken as specified in Section 12. The outlier QC data point can be entered into the LIMS QC Files but the data point will not be used to calculate the standard deviation by the LIMS QC programs.
- 14.6 Standard Quality Control Charts.** Due to the quantity and detail of the QC data used for statistical monitoring, a visual format is generally required for displaying the current QC statistical monitoring limits. The LIMS can generate three basic types of QC Charts for standard QC Sample Types: the Means Chart; the Precision Chart; and the Accuracy Chart. The LIMS Charts display the current Fixed Limits and the calculated Statistical Limits plotted against the respective QC File batch number.
- 14.7 Instrument Quality Control Charts.** Most of the referenced test methods also require QC Charts that monitor the real-time condition of the analytical instrumentation. This often requires plotting instrument specific information associated with a QCS sample, e.g. the instrument response factor found for the target analyte in a specific calibration Standard. This type of QC Chart should be posted at each instrument workstation, see the MWB in Section 9.3. This type of QC Chart can be visually scanned for patterns, trends, which are normally associated with changes in the testing system. These changes, in turn, may indicate an abnormal condition in the testing system that should be closely monitored. In addition to prescribed control limits and Corrective Actions, Instrument specific Control Conditions (patterns) should also be established and recorded in the MWB Method SOP. The test data produced under these conditions are acceptable unless indicated otherwise in the SOP. The following paragraphs describe examples of those types of patterns.
- 14.7.1 Group Bias Pattern.** When six successive instrument QC points are consistently greater than or less than one s sigma of the historical average value, then the testing system is exhibiting characteristics that are possibly different from the system that generated the previous test system Control data. If Fixed Control

Limits are not in danger of being exceeded, continue with the testing sequence. If this is an unusual condition for this test, the analyst should record his/her findings on the associated bench sheets and make a note in the MWB Method SOP for evaluation at the annual review of the SOP.

**14.7.2 Sequential Drift Pattern.** If an instrument QC test measurement is consistently rising or falling faster than historically "normal" as described in the SOP for the testing system, the analyst should examine the rate of drift to determine if the system is in imminent danger of exceeding the Fixed Control limit. If Fixed QC limits are not in danger of being exceeded, continue with the testing sequence. Upon completion of the test sequence, the analyst should examine the analytical test system and determine if maintenance is required. If this is an unusual condition for the analytical test method, the analyst should record his/her findings on the associated bench sheets and make a note in the MWB Method SOP for evaluation at the annual review of the SOP.

## **15.1 QA Systems - Performance and System Audits**

**15.2 The Utah Public Health Laboratory** will participate in performance evaluation audits, both internal and external, in sufficient quantity to ensure the reliability of data quality. The laboratory shall ensure the quality of results provided to clients by implementing checks to monitor the quality of the laboratory's analytical activities.

**15.3 External Performance Evaluation (PE) Audits.** The UPHL will participate in a proficiency testing (PT) study for all target analytes, where proficiency testing material is available, in each field of testing at least twice each year.

**15.3.1** The Quality Assurance Manager will order, distribute and monitor and follow up all PT studies.

**15.3.2** The CEL will order and participate in a supplemental PT study for each target analyte that fails.

**15.4 Internal Performance Evaluation (PE) Audits.** Project specific PE audits prepared in the field are the responsibility of the using organization and are addressed in their respective Quality Assurance Project Plans. These performance audits include "blind" audit samples, spiked samples, split samples, and blanks.

**15.4.1** The Quality Assurance Officer (or Quality Assurance Manager) may arrange for blind PE audit samples for routine parameters. The audit may be prepared, using appropriate reference material, and submitted by the UPHL QA officer; or by the using organization.

**15.4.2** Internal Performance audits will be prepared from reference material stock separate from the materials used for calibration of the method. The QA officer will evaluate the results of internal performance audits and report in QA meeting to the QA staff and chemical and environmental laboratory managers. The QA coordinator will send final report to DEQ and Laboratory Director at the end of each audit when sample was submitted by DEQ.

**15.4.3** This report will contain specific corrective actions taken to correct methodologies when results fall outside the 95% confidence acceptance limits.

**15.5 Additional Internal QA/QC Checks** may be used to ensure quality results such as:

**15.5.1** Internal quality control procedures using statistical techniques;

**15.5.2** Use of certified reference materials and/or in-house quality control using secondary reference materials;

**15.5.3** Replicate testing using the same or different test methods;

**15.5.4** Re-testing of retained samples;

**15.5.5** Correlation of results for different but related analysis of a sample (for example, total phosphorus should be greater than or equal to orthophosphate).

**15.6 External System Audits.** The Utah Public Health Laboratories will participate in a triennial external systems audit performed by the EPA.

**15.7 Internal System Audits.** Routine internal system audits will be performed by the Quality Assurance Officer, and/or other trained and qualified personnel who are independent of the activity to be audited.

**15.7.1** The routine system audit will follow a predetermined schedule and include audit of test methods, associated sample receiving processes, sample preservation, method SOPs, sample preparation logs, instrument logs, standards, QA/QC samples, data packages, and final reports.

**15.7.2** Where the audit findings cast doubt on the correctness or validity of the laboratory's test results, the laboratory shall take immediate corrective action and shall immediately notify, in writing, any client whose work was involved.

An internal audit schedule is made each year. Internal Audit findings are addressed by corrective action for related methods or procedures. Documents for internal schedule can be found in Appendix E (Policy# 22)

**15.8 QA Systems Annual Management Review.** The Chemical and Environmental QA Manager or Laboratory Director will arrange an annual review of the quality system and testing activities to ensure continuing suitability and effectiveness and to introduce any necessary changes or improvements in the quality system and laboratory operations.

**15.8.1** The review shall include:

**15.8.1.1** Reports from managerial and supervisory personnel,

**15.8.1.2** Results of recent internal audits,

**15.8.1.3** EPA assessments,

**15.8.1.4** Results of laboratory comparisons/proficiency testing,

**15.8.1.5** Changes in the volume and type of work undertaken,

**15.8.1.6** Clients feedback,

**15.8.1.7** Client complaints,

**15.8.1.8** Corrective Action and Preventative Action Reports

**15.8.1.9** Other relevant factors and QA issues

**15.8.1.10** Staff training

**15.8.2** Management should provide an outline for the final report.

**15.8.3** Investigation Records and Files will be maintained and archived.

- 15.8.4** Specific Findings and Recommendations will be documented in the final report.
- 15.8.5** The Laboratory Director in cooperation with the Chemical and Environmental Laboratory Managers shall ensure that appropriate actions are discharged within an established time frame.

**15.9 Corrective Actions.** A Corrective Action Report is required for a PT study when any analyte fails. A corrective action is required for other performance audits when results fall outside of acceptance limits. Corrective action is required when procedures, quality control or processes are found to deviate from the QA plan requirements, see QAP Section 17.

#### **16.1 0 Preventive Maintenance Logs and Manuals**

All instrument maintenance logs for organic and metal sections are compiled with the Method Workstation Binder. All instruments manual electronic or paper are kept in the laboratories where the instruments are located.

Inorganic section is compiling all their instrument maintenance logs in one binder in the inorganic chemistry laboratory.

No instrument is under service contract from vendor. Service requests are performed for any broken instruments. The record of the service performed on the instrument is kept with maintenance log binder.

Appendix I details the instrument maintenance processes.

**16.2 The preventive maintenance tasks** and schedules recommended by the manufacturers will be followed for all instrumentation. Documentation of preventive maintenance performed will be recorded.

**16.3 Replacement parts** essential for instrument operation will be kept on hand to eliminate costly delays. The supply of these essential parts will be the responsibility of each individual analyst and the Section Manager.

**16.4 Reagent Water Testing.** Within the first two weeks of each month one sample must be collected from the third floor water system for microbiology and one sample from the second floor water system for chemistry. The chemistry sample shall be tested for conductivity and total residual chlorine and a heterotrophic plate count. Within the first two weeks of each fiscal year, a sample from the third floor water system shall be tested for Pb, Cd, Cr, Ni, Zn and the "quality of reagent water". The sampling and documentation of results is the responsibility of Technical Services. Summary results must be sent to QA for review.

**16.5 The quality of the reverse osmosis (RO) treated water for laboratory (DI water) is checked by recording the conductance of the product water from the RO system on each working day. Tanks are replaced when the conductance exceeds 0.1 micro siemens (usually every three months). Indication of increased conductance indicates that the deionizing tanks should be changed.**

**16.6 Support Equipment.** These standards apply to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices (including thermometers and thermistors), thermal/pressure sample preparation devices and volumetric dispensing devices (such as Eppendorf®, or automatic dilutor/dispensing devices) if quantitative results are dependent upon their accuracy, as in standard preparation and dispensing or dilution into a specified volume.

**16.7 All support equipment shall be:**

- 16.7.1** Maintained in proper working order. The records of all repair and maintenance activities including service calls shall be kept.
- 16.7.2** All support equipment shall be calibrated or verified at least annually, using NIST traceable references when available, over the entire range of use. The results of such calibration shall be within the specifications required of the application for which this equipment is used or:
- 16.7.3** The equipment shall be removed from service until repaired; or
- 16.7.4** The laboratory shall maintain records of established correction factors to correct all measurements. Prior to use on each working day, balances, ovens, refrigerators, freezers, incubators and water baths shall be checked in the expected use range, with NIST traceable references (where possible) in the expected use range. Additional monitoring as prescribed by the test method shall be performed for any device that is used in a critical test (such as incubators or water baths) where available. The acceptability for use or continued use shall be according to the needs of the analysis or application for which the equipment is being used.
- 16.7.5** Mechanical volumetric dispensing devices including burettes (except Class A glassware) shall be checked for accuracy on at least an annual use basis.
- 16.7.6** For biological tests the sterilization temperature, cycle time, sterilization time, and pressure of each run of autoclaves must be documented by the use of appropriate chemical or biological sterilization indicators. Autoclave tape may be used to indicate by color change that a load has been processed, but not to demonstrate completion of an acceptable sterilization cycle. Demonstration of sterilization shall be provided by a continuous temperature recording.

## **17.1 QA Systems – Corrective And Preventative Actions (CAPA)**

**17.2 CEL Quality Assurance Committee.** It is the goal of the CEL to provide services that meet the exacting QAO requirements of our Client projects. In order to meet the challenge of managing QA and QC requirements as they change and develop, the CEL has established an Environmental Quality Assurance Committee. The members of this committee meet monthly basis to discuss the current status of the CEL Lab and Client Services operations. Specific assignments are made for QA System problems and for QA System developments.

**17.3 Scheduled Quality Assurance Reports.** *The Quality Assurance Manager and Section Managers* will schedule regular QA/QC Summary Reports to the Environmental Quality Assurance Committee and to the Laboratory Director. These will include:

- 17.3.1 Any new significant QA problems;
- 17.3.2 Current QA problems being tracked;
- 17.3.3 Current QA problems discussed and acted on;
- 17.3.4 Current Corrective Actions in progress;
- 17.3.5 Current Client complaint summaries;
- 17.3.6 Current QA assignments and their status;
- 17.3.7 Listing of new test protocols and changes to old tests;
- 17.3.8 Proficiency Testing and makeup audits;
- 17.3.9 Internal audit findings;
- 17.3.10 QA Manual proposed amendments.

**17.4 QA System Corrective Actions.** In order to pursue QA Problems in a timely manner, the Quality Assurance Manager will provide assistance to the Chemical and Environmental Laboratory Staff and Supervisors for internal method audits. As the needs arise, status reports and recommendations for solutions will be provided both verbally and in writing.

A corrective action is required for all failed Performance Testing (PT) samples. Analysts and section managers help generate a CAR for failed PT samples after a root cause is determined. A reanalysis of failed PT samples or unknown QC sample is performed to evaluate the effectiveness of corrective action after preventive action.

All corrective action reports are presented to the QA committee for evaluation and for effectiveness of corrective action. A corrective Action form has been attached in Appendix H.

#### PT Corrective Action Check

It is recommended that analysts perform the following checks in reviewing data for any proficiency test samples that are missed. To evaluate the cause of a failed PT, a raw sample data QC check is the first step.

#### Additional Items to Check: (Form 012)

1. Calibration Standards
2. Laboratory Reagent Blank (LRB)
3. SRM/LFB
4. PT Samples Preparation
5. LFM

6. Check LRB, STDs and SRM for contamination
7. Check LFB and LFM recoveries are within published method limits
8. Check for error in dilution
9. Check for a transcription error between your raw data and the final data
10. Any other possible error.
11. Comment.

**17.5 Corrective and Preventive Action (CAPA).** An effective Corrective Action and/or Preventive Action capable of satisfying the Client QAO needs and the basic Regulatory requirements is accomplished by implementing and fully documenting the following seven basic steps:

- 17.5.1** Identification of the problem, nonconformity, or incident or the potential problem, nonconformity, or incident.
- 17.5.2** Evaluation of the impact of the problem and potential impact on the laboratory operations and client services.
- 17.5.3** Develop an Investigation Protocol and assign responsibilities.
- 17.5.4** Analysis of Investigation results with appropriate documentation.
- 17.5.5** Create an Action Plan listing all the tasks that must be completed to correct and/or prevent the problem.
- 17.5.6** Implementation of the Action Plan.
- 17.5.7** Follow-up actions with verification of the completion of all tasks, and an assessment of the appropriateness and effectiveness of the actions taken.

**17.6 Corrective Action Reports and Archives.** A Corrective Action Report, summarizing each step of a CA or PA procedure, must be prepared and put into the CEL permanent archives. The hardcopy documentation acquired during the Investigation and Analysis must be placed in a CAR raw data package, cross-indexed and stored in archives. The end result will be a complete, well-documented investigation and solution that will satisfy regulatory requirements and form the basis for an effective, continuous improvement plan.

**17.7 Proficiency Testing Summary Reports.** The Quality Assurance Manager will provide the Chemical and Environmental Laboratory Director and supervisors with current summary reports of Laboratory performance status in proficiency testing (PT).

**17.8 The CEL Quality Assurance Plan (QAP, QA Manual).** The CEL QA Plan will be reviewed annually by the CEL Management and CEL Lab staff. This review will be coordinated with the ongoing communications with the laboratory Clients about their current and proposed Data Quality Objectives.



## 5 QAP

### Appendices

- A QA Systems - Lab Operations and Test Methods
- B Plan Recipients
- C Chain of Custody Form
- D Employee Training
- E Policies
- F QAP Changes to be incorporated during Annual QAP Review
- G Environmental Laboratory Organization Chart
- H Corrective Action
- I Index Document Control Tracking
- J Instrument Maintenance (Section 23)

## APPENDIX A

### QA Systems –Lab Operations and Test Methods

The Quality Control and Quality Assurance for lab operations and test methods are incorporated in the respective Method's Standard Operating Procedure (SOPs)

- SOP for the CEL wash room procedure (Glassware cleaning) is on the Chemical and Environmental Laboratory Services \*shared drive  
G:\Bureau of Chem & Env Services\SOPs
- Sample receiving acceptance criteria in Chapter 7 of QAP and sample receiving SOP is on Shared drive Chemical and Environmental Laboratory Services shared drive  
G:\Bureau of Chem & Env Services\SOPs
- SOP for Data Reduction and Validation, LIMS Processes, Client Reports and Retention of Records mailing and Tracking, Data Management is on Chemical and Environmental Laboratory Services shared drive at G:\Bureau of Chem & Env Services\SOPs
- SOP for test methods are placed in the Chemical and Environmental Laboratory Services\*shared drive  
G:\ Chem & Env Services\SOPs

\* All Analysts have access to the shared drive

## Method List Utah Public Health Laboratory

Section	Method Description	Method #	Revision
Inorganic	Alkalinity	SM 2320B	<b>22 edition , 2011 21, 2000</b>
Inorganic	Color	<i>Standard Method 2120B</i>	<i>22nd Edition, Editorial Revision 2011</i>
Inorganic	Ammonia (Automated Colorimetry)	EPA 350.1	Rev 2.0 (1993)
Inorganic	BOD5 (Biochemical Oxygen Demand (BOD) 5 Day (CBOD)	SM 5210 B	21 edition, 2000
Inorganic	Chloride( by Automated Colorimetry)	325.2	EPA Method 325.2, Dated: 1998
Inorganic	Chlorophyll (Spectrophotometric)	SM10200H (This is Modified because of client's request) Chlorophyll Method (and Biomass/Periphyton Method) October 5, 2012 DEQ Proposed a modification to Method: Standard Methods 10200H – Chlorophyll a, corrected for Pheophytin (paper in file)	21th Edition, 2000
Inorganic	Chlorate (ClO <sub>3</sub> ) by IC	EPA 300.1 (UCMR3)	Revision 1.0, 1993 ( Extra cover sheet in 1997)
Inorganic	Color, Colorimetric	SM 2120B	21 Edition, 2000
Inorganic	Hexavalent Chromium (Cr <sup>+6</sup> )	(Cr+6 ) by IC - EPA 218.7 (This is drinking Water method)218.6 is for the dissolved Cr +6 for waste effluent, drinking water, ground water	218.7 is Revision 1, 2011 Method 218.6 Revision 3.3, 1994
Inorganic	Cyanide ( Total Cyanide by Semi-Automated Colorimetry)	EPA 335.4	Revision 1, 1993
Inorganic	DBP (IC) (Disinfection Byproducts)-by IC (bromate, chlorite) and also bromide, chlorate	EPA 300.1	Revision 1.0, 1993 ( Extra cover sheet in 1997)

Inorganic	D-Total Nitrogen	Lachat Method,,QuickChem Method 10-107-04-3-P	Lachat Method, Revision Date 29 June 2007
Inorganic	T-total nitrogen	Lachat Method, QuickChem Method 10-107-04-3-P	Lachat Method Revision Date 29 June 2007
Inorganic	Fluoride (Primary)Inorganic Anions by Ion Chromatography	EPA 300.0	Revision 2.1, 1993
Inorganic	Fluoride, anions by selective ion electrode	SM4500 (Not in use)	
Inorganic	Nitrate/Nitrite Nitrogen - Automated, Cadmium (NO2+NO3)	EPA 353.2	Revision 2, 1993
Inorganic	Odor	EPA 140.1	1971
Inorganic	Perchlorate in DW by IC	EPA 314.0	1999
Inorganic	Perchlorate in DW by IC	EPA 314.1(don't use)	
Inorganic	Periphyton	SM 10300 (this method because of DWQ sampling is not using the filter which burn and using glass fiber whatman, subtracting from final results. We need documentation from client	SM 21th Edition , 2000
Inorganic	pH (Manual pH, Electrometric Measurement)	EPA 150.1	Current Revision Issued 1971; Editorial Revision 1978 and 1982
Inorganic	Carboxylic acid (Acetate, Formate, Oxalate) by IC	This Method developed by Utah Stae Health Lab for (Acetate, Formate, Oxalate) Analysis by IC	Analysis by IC
Inorganic	pH in Oil pH measurement by ph paper	9041A (SW846)	Revision 1 1992 pH paper is not considered to be as accurate form of pH measurement as pH meters. For this reason, pH measurements taken with Method 9041 cannot be used to define a waste as corrosive or noncorrosive
Inorganic	pH in Soil, SOIL AND WASTE pH	9045D(SW846)	2004 (Revision 4)

Inorganic	Phosphorous, Digestion (Phosphorus. All Forms (Colorimetric, Automated)	EPA 365.1	Revision 2.0, August 1993
Inorganic	Silica, , Dissolved (Colorimetric)	EPA 370.1	Issued 1971; Editorial Revision 1978
Inorganic	SO <sub>4</sub> (Sulfate - Colorimetric, Automated, Methylthymol)	EPA 375.2	Revision 2.0, August 1993
Inorganic	SO <sub>4</sub> , Cl, F	EPA 300.0	Revision 2.1, August 1993
Inorganic	Specific Conductivity (Specific Conductance, umhos at 25C)	EPA 120..1	Issued 1971; Editorial Revision 1982
Inorganic	SS (Settleable Solids)	SM 2540F	Issued 1997 SM 22 edition , editorial Revision 2011
Inorganic	Sulfide, Photometric Methylene Blue	Hach 8131	Hach Method 8131 Revision 9 February 2009
Inorganic	TDS (Total Dissolved Solids [filterable residue)Residue, Filterable (Gravimetric, Dried at 180 C)	SM 2540C	Issued 1997 SM 22 edition, editorial Revision 2011
Inorganic	DBP (IC) (Disinfection Byproducts)-by IC (bromate,bromide,chlorate, chlorite)	EPA 300.1	Revision 1.0, 1993 ( Extra cover sheet in 1997)
Inorganic	TKN (Total Kjedal Nit)	EPA 351.2, 351.4 is not active	Issued 1993, Revision 2
Inorganic	TOC (Total Organic Carbon)	SM 5310B	21 edition, 2000
Inorganic	TSS (Total Suspended Solids [Non filterable and TSS])Dried @ 103-105C	SM 2540D	21st Edition 2000
Inorganic	Determination of Turbidity by Nephelometry	EPA 180.1	Revision 2.0, August 1993
Inorganic	TVS (Total Volatile Solids)Residue, Volatile (Gravimetric, Ignition at 550 oC)	EPA 160.4	Issued 1971
Inorganic	UV-254(UV Absorbing Organic Constituents - Ultraviolet Absorption Method	SM 5910B	21 edition, 2000
Metals	Air Pb Filter Analysis	Digestion is by compendium Method IO-3.1 Analysis method is EPA 200.8	200.8, Revision 5.4, 1994
Metals	ICP Metals in W and Soil by	EPA 6010 C	Revision 3.0, 2007

	ICP-AES		
Metals	Hardness Calculated (Based on Ca and Mg results)	SM 2320B	22nd Edition, editorial revision 2011
Metals	Mercury in Solid Waste	EPA 7471B	Revision 2, 2007
Metals	Mercury in Water by Cold Vapor AAS	EPA 245.1	Revision 3.0, 1994
Metals	Metals ICP-AES	EPA 200.7	Revision 4.4, 1994
Metals	Metals ICPMS Instrument DRC	EPA 200.8	Revision 5.4, 1994
Metals	Metals ICPMS Instrument (Agilent)	EPA 200.8	Revision 5.4, 1994
Metals	Metals ICPMS Instrument (Agilent) Hg	EPA 200.8	Revision 5.4, 1994
Metals	Metals In Soil by ICP MS, SW 846 (Ailent)	EPA 6020A	Revision 6, November 2004. Revision 1, 2007.
Metals	Preparation for Metals in Soil	EPA 3050B	Revision 2, 1996
Metals	Selenium by Hydride	SM 3114 C	SM 21 edition (approved 1997)
Metals	UCMR3 Metals	Metals by EPA 200.8 for UCMR3	Revision 5.4, 1994
Micro	Heterotrophic Plate Count	SM 9215 B Heterotrophic :Plate Count Pour Plate (NWRI agar)	22nd Edition (approved 2011)
Micro	Legionella	SM 9260 J	22nd Edition (approved 2011)
Micro	SM 9223 B (Colilert®-18)	SM 9223 B, (Colilert®-18) Chromogenic/Fluorogenic Qualitative : Total Coliform and E. coli	22nd Edition (approved 2011)
Micro	Total Coliform and E. Coli by Colilert (24)	SM 9223 B, Chromogenic/Fluorogenic Qualitative : Total Coliform and E. coli	22nd Edition (approved 2011)
Micro	SM 9223 B (Colisure® Quanti-Tray®)	SM 9223 B, Chromogenic/Fluorogenic Qualitative (Colisure®): Total Coliform and E. coli	22nd Edition (approved 2011)
22nd Edition (approved 2011)	22nd Edition (approved 2011)	22nd Edition (approved 2011)	22nd Edition (approved 2011)

Organic	Carbamates	EPA 531.1	Revision 3.1, 1995
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## APPENDIX B

### List of Recipients for this Program Plan

1. EPA Region VIII QAO
2. Director – Division of Air Quality, Utah Department of Environmental Quality
3. Director – Division of Drinking Water, Utah Department of Environmental Quality
4. Director – Division of Environmental Response & Remediation, Utah Department of Environmental Quality
5. Director – Division of Radiation Control, Utah Department of Environmental Quality
6. Director– Division of Solid and Hazardous Waste, Utah Department of Environmental Quality
7. Director – Division of Water Quality, Utah Department of Environmental Quality
8. Director –Utah Public Health Laboratories, Utah Department of Health
9. Director - Chemical and Environmental Laboratory Services, Utah Department of Health
10. Chemical and Environmental Laboratory Services Quality Assurance Manager
11. Section Manager Inorganic Chemistry
12. Section Manager Organic Chemistry
13. Section Manager Metals
14. Director - Chemical and Environmental Laboratory Operations
15. Section Manager Technical Services









## Employee Training

Training is required to develop and maintain proficiency, to promote and to ensure quality analytical results. The quality and consistency of the data produced should be independent of the analyst performing the analysis. Each section manager has the responsibility to train staff in his/her section. Form 003 can be filled for the employee training documentation.

### **1.1 New Employee Orientation**

- 1.2 The orientation of a new analyst will include familiarization with the QA/QC program manual, the laboratory safety manual, chemical hygiene plan, and hazardous waste disposal protocol.
- 1.3 The training is given by a member of the QA team and a member of the Safety team.
- 1.4 The new employee must read the QA/QC and safety manuals and sign the annual review sheets within 2 weeks from the date of employment.
- 1.5 The section manager is responsible for training the analyst in safe testing procedures, safe handling of samples and materials, and personal protective equipment that must be used in the lab.
- 1.6 A review of laboratory safety rules must be done before any lab work can start.
- 1.7 All new employees must have a baseline serum specimen drawn and a baseline tuberculosis skin test within 10 working days. If the employee's skin test is positive, a chest X-ray may be required.

**2.1 Health and Safety Training.** This training is to ensure that laboratory personnel have adequate knowledge to safely perform their assigned tasks.

- 2.2 The Laboratory chemical hygiene plan: This document describes proper procedures for material handling, how to read MSDS sheets, storage of chemicals, use of personal protective clothing, and managing chemical spills. This training is given by a member of the laboratory safety team within 3 months of hire date for new employees and as ongoing refresher courses to the entire laboratory annually.
- 2.3 Hazardous waste storage and disposal protocol: The laboratory hazardous waste officer and/or hazardous waste technician provide training to new employees within three months of their hire date and a refresher course to all laboratory staff on an annual basis.
- 2.4 All staff must review the appropriate sections of the laboratory safety manual each year and sign the annual review sheet.

### **3.1 Training for Specific Analytical Procedures and Methods**

- 3.2 Analysts shall be qualified to perform specific analytical procedures and methods after having demonstrated proficiency with the analyses. The following process will be used.

**3.3 Familiarization with Methods or Procedures.** The section manager and/or an experienced analyst instruct the new analyst on how to perform the procedure or method.

This includes the following steps:

- 3.3.1 Read the method SOP.
- 3.3.2 Observe the method being performed.
- 3.3.3 Perform the method with supervision.
- 3.3.4 Perform the analysis independently.
- 3.3.5 Analyze QC audit samples with acceptable results.
- 3.3.6 Perform an Initial Demonstration of Capability (IDC). From 003 to document IDC
- 3.3.7 A package, dictated by the method and/or program, containing the following items should be prepared:
  - 3.3.7.1. IDC documentation
  - 3.3.7.2. Proper documentation of QC for the batch

After successful completion of the above steps the analyst can be considered qualified to produce sample data. A training form noting the completion of the above steps is generated by the person responsible for the training and maintained by the section manager.

#### **4.1 Training for New Instrumentation or New Procedures**

- 4.2 Initial demonstration of capability must be documented when implementing new methods or using new instruments.
- 4.3 Instrument manufacturers usually provide training courses for their equipment. The section manager and/or the analyst who is trained by the manufacturer are responsible for instructing and training other employees. New procedures are first performed by Section manager or experienced analysts. After documentation of successfully meeting the training requirements, they are responsible for instructing and training other employees in the procedures and then updating the employee's training records.

#### **5.1 Continuing Education**

- 5.2 Employees are encouraged to participate in continuing education. The continuing education may be of several forms. Intra-group or laboratory educational or review sessions conducted by the section manager or others. Local and national seminars, workshops, and lectures are sometimes available to the employees. Attendees to the seminars, workshops and lectures are to report to other employees on their content in seminar. The attendees document and track continuing education by submitting a completed *Division of Epidemiology and Laboratory Services Laboratory Training Record* to their supervisor following any outside training.
- 5.3 If a person has not performed an analysis within the past year, he/she will need to be retrained according to the process described for training new analysts.

## **6.1 Quality Assurance Training**

**6.2** A formal program of QA/QC training will be provided for all of the staff. The program is available as a refresher course for existing staff. The section manager sets up and schedules the training, which may be taught by the QA officer, section manager, and or an experienced analyst(s). The following are QA topics that may be covered in the training.

**6.2.1** EPA Regulatory requirements

**6.2.2** Basic QC practices

**6.2.3** QC Charts

**6.2.4** Chain of custody

**6.2.5** Corrective Action

**6.2.6** Data integrity

**6.2.7** Fixed Limits

**6.2.8** Statistical limits

**6.2.9** Control limits

**6.2.10** Statistics for chemists

**6.2.11** Items suggested by the staff

**6.3** All staff are encouraged to participate in the annual review of the QA program plan. When changes are made in the QA program plan, laboratory management will communicate these changes to staff and provide training as needed. It is recommended that each analyst review the QA program plan frequently to ensure that they are in compliance.

## **7.1 Training Records**

**7.2** The employee *Training Form* and *Continuing Performance Sample Evaluation* forms are maintained by the section manager.

**7.3** The chemical and environmental laboratory will maintain an archive of all general training materials.

**7.4** Each section will maintain a file of their training documents.

## 6 Appendix E

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## APPENDIX F

7 ..... QAP

**Changes to be incorporated during Annual Review**

The QAP will be reviewed at least once a year by CEL Management and CEL staff. Any major changes in responsibility policy will be identified and tracked during biweekly quality assurance meetings.

All changes identified will be incorporated in the annual updated version of the QAP by CEL management during the final review. The Annual updated version will be named as "December, YYYY".

Interim Modifications/Changes		
Date	Description of Change	Initials
03/10/2014	Inserted the chief chemist name to cover page (Bret Van Ausdall)	AR
3/15/2014	Add section to incorporate IDC/MDL to workstation binders	AR
11/6/2014	Method and SOP's updates are listed in QA Manual.	AR
01-20-2015	Organization Chart is added as Appendix G	AR
11/6/2014	Policies E-21 and E-22 added in Appendix E (sample acceptance, internal Audit schedule)	AR
01/27/2015	Corrective Action Form (Appendix H ) added	AR
01/27/2015	Description of instrument manual and documentation of routine maintenance added section 16.1	AR
1/28/2015	"S": drive Changed to "G":	AR
1/28/2015	Updated Samples Receiving Forms added	AR
07/05/2015	Section 7.5 updated Nitrite and Nitrite preservation and documentation <sup>3</sup>	AR
01/26/16	Chief Chemist name and responsibilities removed distributed to QA manager and section Manager and Laboratory Director.  7.1,6.1,3.5,8.6.8,17.7.4.2,12.12.6,15.7,15.7.5,71.6, Appendix D, CAR Form	AR
01/26/2015	Org Chart removed link provided	AR
01/26/2015	E17 Removed (Asbestos Samples)	AR
01/26/2015	Lab document List revised	AR
01/26/2015	Document Control Index Appendix I	AR
01/26/2015	Instrument Maintenance (Section 23)	AR
01/26/2015	Forms and SOP Link provided in appendix I	AR
01126/2015	Training form # and Corrective action Form #	AR



**APPENDIX G**  
**Environmental Laboratory Organization Chart**

**Current Organization Chart can be received from Laboratory Director's office from Administration Secretary.**

APPENDIX

H

CORRECTIVE ACTION (CA) FORM

LABORATORY/SECTION NAME: \_\_\_\_\_ LOG# \_\_\_\_\_

ANALYSIS TYPE / EVENT TYPE: \_\_\_\_\_ CA EVENT DATE: \_\_\_\_\_

PERSON COMPLETING CA FORM (NAME): \_\_\_\_\_ DATE: \_\_\_\_\_

RESPONSIBLE SUPERVISOR: \_\_\_\_\_

NON-CONFORMANCE DESCRIPTION:

Indicate the problem / nonconformance. Describe the nonconforming event or analysis result. Attach any documentation that supports and/or supplements this description.

If PT failure, name the PT study failed and attach the PT results sheet and circle the method/result failed, then list possible reasons leading to PT failure.

RESPONSE / INVESTIGATION STEPS: (What was the Response for Malfunction?)

Describe the nonconforming event or analysis result. Include details of staff member notified, date and time of notification, customer or outside involvement, analysis data, etc., (as applicable).

Attach any documentation that supports and/or supplements this description including all processes or raw data reviewed, QA or Management staff notified, analysis repeated, analysis halted, etc.

CUSTOMER REPORT OR BATCH DATA AFFECTED:

ROOT CAUSE DETERMINATION:

Man	Material	Method	Machine	PT
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Once we identify the problem, state the root cause (reason) for the nonconformance with the analysis or process by asking 5 whys.

Did you ask 5 Whys? (e.g., Why did the instrument fail? Why did that part fail? Why was a QC out of range?)

- 1
- 2
- 3
- 4
- 5

ACTION(S) TAKEN TO RESOLVE ISSUE AND PREVENT RECURRENCE: Include SOP revision, staff training, purchase of standards or equipment, document/form revision, etc.

**Corrective Action Steps Taken to Prevent Recurrence (Plan and Performance of CA)**

**Effectiveness of Corrective Action Checked by and date:  
Reviewer Comments or Additional Actions Recommended:**

**Submitted By:** \_\_\_\_\_ **Print Name:** \_\_\_\_\_ **Signature:** \_\_\_\_\_ **Date:** \_\_\_\_/\_\_\_\_/\_\_\_\_  
**Reviewed By:** \_\_\_\_\_ **Print Name:** \_\_\_\_\_ **Signature:** \_\_\_\_\_ **Date:** \_\_\_\_/\_\_\_\_/\_\_\_\_  
**(Supervisor)**

**Attendees who discussed at 1st QA meeting  
(print names)**

**Date:** \_\_\_\_/\_\_\_\_/\_\_\_\_

**Approved By:**  
**(CA Committee, signatures)**  
**Organic Section Manager**

**Inorganic Section Manger:**

**Metals Section Manger:**

**QA Manger:**

**Follow-up Attendees at 2nd QA meeting  
(print names)**

**Date:** \_\_\_\_/\_\_\_\_/\_\_\_\_

**Reviewer Comments or additional actions recommended:**

**Closing the Corrective Action: The QA Manager is responsible for effectiveness review. The CA should stay OPEN for a sufficient time to ensure all stated actions were taken and address/solve the initial issue.**

**Corrective Action Closed By QA Manager: Signature: \_\_\_\_\_ Date: \_\_\_\_\_**

## **APPENDIX I**

**This Index keeps track of the list of the procedural SOPs revision history and the list of forms.**

**SOP Update Tracking List can be found at**

**G:\Bureau of Chem & Env Services\SOPs\Final SOPs\**

**List of Forms can be found at location**

**G:\Bureau of Chem & Env Services\Document Control\Forms**