ENERGY LABORATORIES-HELENA, MT
QUALITY ASSURANCE MANUAL

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ELI COMMITMENT

Energy Laboratories, Inc. strives toward:

1. Being highly skilled in the field of analytical chemistry.
2. Delivering quality and service with integrity.
3. Encouraging the professional development of our staff.
4. Offering our employees a safe and positive work environment.
5. Being profitable and using resources wisely for a sustainable future.

INTRODUCTION

Energy Laboratories, Inc. provides chemical, and environmental analytical services to private industry, agricultural industry, engineering consultants, government agencies, and private individuals. Analytical services include: analysis of waters and soils for inorganic and organic constituents, aquatic toxicity testing, hazardous waste analysis, radiochemistry, microbiology, soils and water physical parameters, and petroleum analysis.

Founded in 1952, Energy Laboratories currently incorporates four separate testing laboratories. The corporate headquarters are located in Billings, MT, with laboratories located in Casper, WY; Gillette, WY; and Helena, MT.

ELI, as a coordinated company of four participating laboratories, has developed a QA program that takes into account the various method types and EPA programs, while also considering sample matrices, to develop a single comprehensive set of QA guidance. Scientific approaches, Good Laboratory Practices, EPA Methods and Guidance documents, and accreditation audit guidance are used to develop our overall QA Program.

The Quality Assurance Program establishes acceptable performance criteria for all routine analytical procedures being performed by laboratory personnel. The Quality Assurance Assessment Program provides a formal system for evaluating the quality of data being generated and reported. The ELI Laboratory Safety Manual & Chemical Hygiene Plan defines the safety and monitoring procedures used by laboratory personnel in laboratory operations. These, in addition to the experience and expertise of our analysts, provide a comprehensive Quality Assurance Program. Energy Laboratories, Inc., in Helena, Montana, is certified under the Safe Drinking Water Act by Region VIII EPA for Wyoming, and the State of Montana. Individual State approval for RCRA and CWA (NPDES) is managed through the Federal/State DMRQA program or through reciprocal certifications when required by a specific state. ELI obtains these certifications through reciprocal recognition of ELI's primary Montana State. Branch laboratories of ELI are certified in their own state and in additional states. Copies of ELI's certificates for all laboratories are maintained on ELI's website: www.energylab.com.

The ELI Quality Assurance Manual and the Professional Services Guide together are used to outline the ELI Quality Assurance/Quality Control Program. This Quality Assurance Manual is appropriate to all departments of Energy Laboratories-Helena. The procedures discussed or referenced in this manual describe our day-to-day laboratory practices and adhere to USEPA Safe Drinking Water Act, and TNI (The NELAC Institute) requirements as well as Good Laboratory Practices (GLPs). Information on the ELI-Helena and all other ELI branch labs applicable

accreditations and certifications are maintained on the ELI website at www.energylab.com.The State of Montana accreditation for the ELI Helena laboratory can be found in Appendix A of this plan. Where possible, ELI uses EPA, AOAC, ASTM, APHA, NIOSH, OSHA, or published analytical methods and follows the procedures with strict adherence to described protocol and recommended QA/QC parameters. The analytical methods approved and in use are described in Standard Operating Procedures, and are available for review at the laboratory. Vital parts of our Quality Assurance Program, Quality Control and Quality Assessment programs are outlined in Chapters One and Two of this manual.

To generate data that will meet project-specific requirements, it is necessary to define the type of decisions that will be made and identify the intended use of the data. Data Quality Objectives (DQOs) are an integrated set of specifications that define data quality requirements and the intended use of the data. Project-specific DQOs will be established as needed for both field and lab operations. Through the DQO process, appropriate reporting limits, extraction/digestion methods, clean-up methods, analytical methods, target analytes, method quality control samples, sample security requirements, quality control acceptance ranges, corrective action procedures, reporting formats and reporting limits can be specified. Professional laboratory project managers are available to assist clients in specifying appropriate laboratory analyses and reporting procedures necessary to meet project requirements.

Client-specific DQOs can be coordinated with the laboratory through Project Managers via quotations or contracts, or with relevant documentation provided to the laboratory prior to (or at time of) sample receipt. Client-specific requirements are communicated to analysts and final report validators through the laboratory LIMS system. By default, our methods, analytes, and QC parameters are set up to meet the DQOs specified in the referenced method and/or federal/state regulations. ELI encourages clients to provide ELI documentation of any client-specific, regulatory or project monitoring requirements.

Certain types of requests may not be suitable to standardized analytical methods. These custom requests are handled individually with laboratory management and staff scientists. Project-specific methods and reporting packages are available. Attention to documentation of the analytical procedure and use of suitable QC parameters is maintained according to good scientific discipline and Good Laboratory Practice guidelines.

The ELI-Helena laboratory manager, or their designee(s), will evaluate all new contracts to determine that the laboratory is capable of performing the requested work. This process includes ensuring that the laboratory maintains the required accreditation, equipment and resources. In the event that sample analysis is not performed at the Helena location, clients are notified on the laboratory analytical report if the work is subcontracted to a qualified ELI laboratory or an outside laboratory (See Subcontracting Policy – Chapter 6 in this QA Manual.).

This Quality Manual and related quality documentation meet requirements of the National Environmental Laboratory Accreditation Program (NELAP), which is an EPA approved accreditation program.

CHAPTER 1 – QUALITY CONTROL PROGRAM

Quality Policy Statement

Energy Laboratories, Inc. is committed to producing laboratory data of known and documented quality that is scientifically valid, meets method specifications, satisfies regulatory requirements, and accomplishes the data quality objectives of the client and project. ELI's management and quality systems ensure the laboratory maintains current certifications and is in compliance with accreditations through USEPA, State Agencies, and NELAP. Those method, regulatory, and client requirements (as well as the policies, procedures, and all referenced documents) are incorporated into our Quality Assurance Program; which is outlined within this Quality Assurance Manual. Our Quality Systems are designed to comply with the standards as defined by the most current version of the TNI accreditation standard (TNI 2016) and includes procedures to manage risk and requirements as discussed in ISO 17025 standards. To ensure compliance with these standards, all laboratory personnel are required to be familiar with quality documentation and implement those policies and procedures in their work. ELI is dedicated to the continual improvement of the management system's effectiveness by providing appropriate corporate resources to set objectives, offering training opportunities, and monitoring the quality performance of our staff. ELI also provides facilities and equipment adequate and appropriate to these objectives.

Quality Assurance Program

The purpose of the Quality Assurance Program is to ensure that the analytical services provided by Energy Laboratories are of high quality, data is within established accuracy and precision limits (required by the referenced method or Standard Operating Procedure), and each analytical result produced meets or exceeds our accreditation requirements. Management ensures that the integrity of the management system is maintained. The Technical Director, or their designee, ensures that changes to the management system are planned, implemented and documented.

Management establishes and maintains data integrity by providing the following to ELI's data integrity system:

1) Data Integrity Training (Including the highest standards of ethical behavior)
2) Periodic review of data integrity procedural documentation
3) Annual review of data integrity procedures with updates as needed
4) Periodic, in-depth monitoring of data integrity
5) Maintenance of signed data integrity documentation for all laboratory employees

All employees are expected to implement and follow the policies contained within the Quality Assurance Program.

The quality systems in the program consist of the policies and procedures, and all referenced documents, described in this Quality Assurance Manual. The Quality Control Program also functions to maintain the laboratory's compliance with accreditations through USEPA, State Agencies, and NELAP.

The Quality Control Program requires that the following points be met for each applicable analytical method:

- Performance of any analytical method requires that the proper equipment and instrumentation are available. A list of major equipment is listed in Appendix E. The procedure for operation of an analytical instrument is described in the equipment manufacturer's operating manual, and may also be supplemented with a specific Standard Operating Procedure (SOP) for the instrument and/or the method.

- Specific SOPs cover operation of the instrument including the sequence of operations involved in instrument start-up, calibration, analysis, and shut down. Chapter 13 of this manual includes recommended preventative maintenance, and/or a list of parameters used to identify other types of maintenance. Instrument specific preventative maintenance and routine maintenance is documented in the Instruments Module. SOPs outline any special safety precautions for operation of the instrumentation.

- SOPs of detailed EPA, AWWA Standard Methods, ASTM, NIOSH, APHA, OSHA, or other published procedures include, as appropriate, a list of any method-specific items or variances, a list of QC parameters and their recommended method performance ranges, recommended or example analytical sequences, specific or unique safety information, method references, and a signed signature page. SOPs details, and format of method SOPs, follow NELAP requirements. Detailed SOPs may be prepared for those procedures that do not have published methods. Further details of SOP format and information required in method SOPs can be found in the ELI SOP, *Preparation, Numbering, Use, and Revision of Standard Operating Procedures.* Written Standard Operating Procedures referenced within this manual are available at the laboratory for review. (ELI SOPs are considered confidential proprietary information).

- For radiochemical analysis performed at the ELI-Casper laboratory, each method undergoes Method Validation as outlined in EPA's specific method and/or the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP), Chapter 6.

- The required detection level (RDL) for radiochemical analysis of drinking water samples is calculated based on the requirements in 40 CFR 141.25(c), which is a sample specific determination. The equation is specific for each method and noted in the method-specific SOP where appropriate.

- The initial test method evaluation for chemical analysis involves Method Detection Limit (MDL) studies, (refer to ELI SOP, *Determination of Method Detection Limits (MDL) and Quantitation Limits*), confirmation of the Limit of Detection (LOD) and/or Practical Quantitation Limit (PQL), also known as the Limit of Quantitation (LOQ), an evaluation of method performance by successful completion of an Initial Demonstration of Capability (refer to ELI SOP, *Personnel Training and Training Records),* the successful completion of appropriate performance evaluation (PT) studies (when available) , evaluation of the selectivity of the method, and any additional method or client -specific requirements

- ELI demonstrates that laboratory staff is qualified and capable of performing the method. Analysts are assigned duties based on their skills and experience. Training records are maintained for all analysts. Curricula vitae of key management and personnel are described in Appendix D.

- It is the responsibility of the analyst to become thoroughly familiar with the methodology and instrument operation before performing the analysis. It is the responsibility of the person

providing training to monitor all laboratory results generated for a reasonable time. The amount of time necessary may vary depending on the method and the experience of the analyst. At a minimum, the analyst's performance is to be monitored until the analyst demonstrates the ability to generate results of acceptable accuracy and precision according to the method.

- All analysts are required to demonstrate and maintain a record of proof of competency by routinely analyzing quality control samples appropriate to the analytical procedures they perform. Proof of competency in analyzing these control samples is documented in analysts' training files per NELAP requirements (for more information, see ELI SOP, *Personnel Training and Training Records*). For those analyses where external proficiency testing (PT) samples are not routinely analyzed, competency is documented by including the results of routine analysis of method-specific quality control samples (prepared by laboratory staff) and/or a verifying statement of procedural review by a supervisor or trained analyst.

- Each analytical method is subjected to quality control monitoring. The purpose is to demonstrate that results generated meet acceptable accuracy and precision criteria for the method. Precision and bias are determined for standard and non-standard methods. Precision and bias are determined for standard methods through control charting of data from quality control samples. Precision and bias using non-standard, modified standard or laboratory-developed methods are compared to the criteria established by the client (when requested), the method, or the laboratory.

- Quality control requirements are outlined in the methods and ELI, at a minimum, follows the guidelines specified in the methods used. Additional QC requirements are also added as appropriate. Statistical method performance is periodically evaluated against method requirements using control charts.

- Quality control monitoring to measure accuracy for each method generally requires that five to ten percent of all samples analyzed be fortified (spiked) with a known concentration of target analytes tested by the method. The percent recovery is then calculated. This provides a means for monitoring method accuracy and evaluating sample matrix effects. Where appropriate, surrogates are included in the method to monitor method performance on each individual sample. Blank spike samples replace matrix spike samples for certain methods, or when there is insufficient sample for a matrix spike analysis. Historical, routine batch QC sample performance can be used to estimate the precision and accuracy of the method.

- Quality control monitoring to measure precision for each method requires replicate samples be prepared and analyzed when appropriate. Actual requirements are outlined in the specific SOP. When replicate samples or matrix spike duplicates are analyzed, relative percent difference is calculated and used to monitor precision of the method. In instances where there are no specific method requirements, it is the policy of this laboratory to analyze five to ten percent of all samples in duplicate. Duplicate test results must be within the control limits established for each analysis type or data is qualified. Acceptance limits generally follow specifications listed in the method. Matrix spike duplicates replace sample duplicates for most methods.

- When not defined in the method, and as appropriate, method blanks and/or instrument blanks are analyzed one in every 20 samples at a minimum. Method blanks are used to verify that contamination from laboratory reagents and glassware is not present in the analytical sample process. Generally, the method blank should be less than the reporting limit, or 10 times less than the concentration amount in the sample, for the analytical parameter being tested, whichever is greater.

When method spike frequency is not defined in the method, and as appropriate, method spikes (blank spikes) are analyzed, at a minimum, one in every 20 samples.

- Calibration standards are analyzed and calibration curves are developed for all applicable methods. For additional information on instrument calibration, see Chapter 7 of this QA manual.

- The initial calibration is continuously monitored by analyzing a continuing calibration standard every 10 to 20 samples, or within a specified time frequency, and at the end of each analytical sequence; depending on the method and instrumentation. Results must be within an established range as described by the method SOP. Initial calibrations are verified against a standard from a second source.

- Proficiency testing samples and further quality control check samples may be required for various methods. Refer to Chapter 2 of this QA Manual for further details.

Estimation of Uncertainty

The estimation of uncertainty consists of the sum of the uncertainties of the individual steps or processes of an analytical procedure and the field sampling variabilities. The variability of the sampling plan, sample heterogeneity, extraction procedure, instrument calibration, instrument drift, systematic bias, and many other factors all contribute to the uncertainty of a measurement or result.

ELI estimates uncertainty utilizing Confidence Intervals defined as ±2σ (95%) and ±3σ (99%) where σ is the standard deviation of the recovery of quality control samples. The confidence intervals calculated from these QC samples are based on the spike level concentrations for each method. For most procedures, uncertainty at the reporting limit or Limit of Quantitation (LOQ) is determined by Limit of Quantitation spike recovery studies or by MDL study spike recovery evaluations. LOQ/MDL verifications are performed quarterly to verify ongoing method accuracy, precision and sensitivity. LCS limits are used to set method accuracy and precision overall. PT Acceptance criteria are also a guide for evaluating interlaboratory method accuracy, and the reasonableness of ELI assigned method QC limits. Real world samples, depending on matrix interferences, may have a greater amount of uncertainty associated. Due to limitations in assessing the uncertainty for each matrix type, the confidence intervals calculated from method QC samples provides an estimate of laboratory method uncertainty.

Energy Laboratories, Inc. uses the procedures outlined in ELI SOP, *Control Chart Generation and Maintenance*, for the purpose of evaluating estimation of uncertainty for chemical analyses and uses the determination of uncertainty on a sample-specific basis for all radiochemistry measurements. These estimates of uncertainty have formulas documented in the individual SOP.

Maintenance of Performance Records

All quality control monitoring is recorded and documented. Quality control data is recorded in laboratory notebooks, electronic summary files, and/or analysis sheets. Generally, review of QC data and trends is managed within the Laboratory LIMS system. QC data management and control chart generation, maintenance, and usage are described in ELI SOP, *Control Chart Generation and Maintenance*. It is the responsibility of the analyst to see that all results are recorded in a timely manner.

All quality control data is filed and available for inspection and assessment by analysts, supervisors, management, and quality control personnel.

Method Quality Control Specifications

Summaries of Quality Assurance/Quality Control specifications for a selected subset of procedures offered by ELI are outlined in Appendix B. These types of method QC Element tables are available upon request for our clients to use in the preparation of Quality Assurance Project Plans (QAPPs). Exact details of method QC can be found in the applicable method SOPs.

CHAPTER 2 – QUALITY ASSESSMENT PROGRAM

The function of the Quality Assessment Program is to provide formal evaluation of the quality of data being generated and reported by the laboratory. External and internal quality control measures are used in this assessment. These measures include proficiency testing samples, laboratory quality control check samples, and routine internal and external audits on methodology and documentation procedures.

Proficiency Testing (PT) Samples

PT samples are supplied by an outside entity and contain known amounts of constituents. The laboratory does not have access to known values of the samples. Only the PT provider has knowledge of constituent levels prior to the formal publishing of the test results.

PT samples are received on a routine basis, with results sent to the providing entity for evaluation. Proficiency Testing (PT) samples for USEPA and various State certifications are Water Pollution Study samples (WP or DMRQA), Water Supply Study samples (WS), and Soil PT samples provided by NELAP approved PT providers - Resource Technology Corporation (RTC), Environmental Resource Associates (ERA) or alternate approved providers. Routine participation in Soil, WS and WP PT sample studies is used to maintain certifications for Safe Drinking Water Act (SDWA), Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES), Discharge Monitoring Report Quality Assurance (DMRQA), permit monitoring analyses, Resource Conservation and Recovery Act (RCRA) analyses, as well as other states and projects requiring method accredited parameter analyses. The samples are analyzed in the same manner as any routine sample in the laboratory. Acceptable results are those that fall within a defined range as determined by the vendor; based on multi-laboratory study results. The provider sends results to the appropriate certifying agencies as requested by the laboratory. PT study results are posted on the ELI website www.energylab.com.

A copy of the certificate for our primary certification to perform drinking water analyses issued by the State of Montana is included in Appendix A. The Montana certification includes a list of parameters/methods for which drinking water certification has been granted. ELI also participates in the Federal/State DMRQA programs for clients which require/request this with their NPDES permits. Reciprocal accreditation in other states is based on either of these, or both, depending on specific state certification requirements/parameters. A list of current certifications is maintained on the ELI website at www.energylab.com.

Blind Quality Control Check Samples are samples submitted as regular lab samples and are processed through the system in the same manner as any other routine environmental sample. The analysts do not know the true values of these samples when performing the analyses. Method performance reports are returned to the analysts. Clients occasionally submit these types of samples for their QAPP.

Inter-Laboratory comparison samples are samples containing known or unknown concentrations of analytes that are split and analyzed by more than one laboratory.

Quality Control Check Samples

Quality Control Check Samples are performance evaluation samples used for routine method performance monitoring. As appropriate, analytical procedures include the analysis of a quality

control sample with every sample batch analyzed. The materials are obtained from a commercial source when available, or they may be prepared in-house. Acceptable results are within a defined range based on certified ranges, or against statistically determined control limits, method-defined criteria or client defined Data Quality Objectives. Routinely used methods not subjected to PT sample monitoring are evaluated with Quality Control Check Samples, as appropriate.

QC samples are processed through the system in the same manner as any other sample, except the analyst is aware of the source, concentration, and acceptance ranges of target analytes and calculates analyte recoveries to evaluate method performance in real time.

Quality Assurance Audits

Quality Assurance Audits consist of internal and external laboratory inspections designed to monitor adherence to Quality Systems and quality control requirements. These audits check general laboratory operations, overall Quality Systems, adherence to QA program requirements, sample tracking procedures, sample holding times, storage requirements, adherence to procedures during analysis, calculations, completion of required quality control samples within the group surrounding the sample, and proper record-keeping.

Internal quality control audits are conducted or coordinated by the Quality Assurance Officer of the laboratory. See ELI SOP, *Internal Audits*, for further information. ELI conducts internal inspections on a regular basis to monitor adherence to quality control requirements. Results of formal audits are given to management with possible recommendations for corrective action in the event any discrepancies are found. As necessary, a follow-up review is conducted to determine that identified problems have been addressed. Annually, the overall quality systems of the laboratory are reviewed and a summary report is prepared.

Per NELAP/ISO 17025 requirements, the management of the laboratory will conduct an annual review of the Quality System, including policies, procedures and environmental testing activities in a meeting with key laboratory management and supervisory staff. This is done to ensure the continuing suitability and effectiveness of the QA systems, as well as provide the opportunity to introduce necessary changes or improvements. The review shall take into account, at a minimum, the following:

- Changes in internal and external issues that are relevant to the laboratory
- Fulfillment of objectives
- The suitability of policies and procedures
- Status of Actions from previous management reviews
- Reports from managerial and supervisory personnel
- The outcome of recent internal audits
- Corrective and preventative actions
- Assessments by external bodies
- The results of inter-laboratory comparisons or proficiency tests
- Changes in the volume and type of work
- Client and personnel feedback
- Complaints
- Recommendations for improvement and effectiveness of any implemented improvements
- Results of risk identification
- Other relevant factors, such as quality control monitoring, resources and staff training, data integrity, data accuracy and precision, and risks to impartiality.

The findings from management reviews and the corrective actions that arise from these findings shall be recorded. The management shall ensure that any corrective actions are carried out within an appropriate, pre-determined time frame and with provision of required resources.

ELI welcomes external Quality Assurance Audits, by qualified outside auditors, for review and comment on the overall QA program. To maintain certifications, accrediting authorities from the State of Montana conduct periodic comprehensive external audits. External audits to meet Quality Assurance Project Plans (QAPPs), as applicable to environmental remediation projects, or for major industries, are conducted as requested. For more information, see ELI SOP, *External Audits*.

CHAPTER 3 – LABORATORY FACILITIES

The facility for Energy Laboratories, Inc. – Helena, MT consists of multiple buildings with over 10,000 square feet of total space; these buildings are located in Helena at 3161 East Lyndale, Helena, MT 59601.

The phone number for Helena Energy Laboratories, Inc. is (406) 442-0711, the fax number is 406-442-0712, and the email address is Helena@energylab.com.

Laboratory space includes adequate bench top and floor space to accommodate periods of peak work load. Working space includes sufficient bench top area for processing samples; storage space for reagents, chemicals, glassware, bench and portable equipment items; floor space for stationary equipment; and adequate associated area for cleaning glassware. Laboratory departments are organized and the facilities are designed for specific laboratory operations in order to protect the safety of analysts and to minimize potential sources of contamination between and within department areas (for more information, see ELI SOP, *Facility Description, Access, and Security*).

The laboratory is appropriately ventilated and illuminated, and is not subject to excessive temperature changes. Specific laboratory areas are temperature and humidity controlled as required. Ample cabinets, drawers and shelves are available for storage and protection of glassware. Exhaust fume hoods are available as needed for use during preparation, extraction, and analysis of samples. Employee exposure monitoring is conducted to provide a safe working environment.

To maintain security, all visitors must enter their name on the ELI sign-in log at the front desk and wear a visitor's badge.

The laboratory has provisions for the disposal of chemical and microbiological wastes. These provisions are described in Standard Operating Procedures as well as outlined in the Laboratory Safety Manual & Chemical Hygiene Plan along with other safety and health guidelines. For more information, see ELI SOP, *General Laboratory Waste Disposal*.

CHAPTER 4 – PERSONNEL REQUIREMENTS AND LABORATORY ORGANIZATION

Relationship between Management, Technical Operations, Support Services and the Quality System

Laboratory Organization

The corporate organization of the four ELI laboratories located in Montana (2), and Wyoming (2), is provided in Appendix C. The Billings laboratory is the center for all corporate functions. Each laboratory is managed and operated individually under the supervision of a Laboratory Manager. All ELI laboratories have fiscal and QA/QC responsibilities to the corporate office, as well as general operating policies and goals. Quality Assurance Manuals are prepared individually for each laboratory and follow the QA/QC program outlined in the ELI-Helena QA manual.

The ELI-Helena Organizational Chart is also included in Appendix C with curricula vitae of key ELI-Helena laboratory personnel maintained in Appendix D of this manual. Job descriptions are maintained by the Human Resources Department.

Quality Assurance receives direct support from senior management. Laboratory Quality Assurance Officers report directly to the Corporate Quality Assurance Officer as well as the Laboratory Manager. Quality Assurance Officers provide independent oversight of Quality Systems within the overall Energy Laboratories structure. When Quality Assurance Officers fill more than one role within the organization, they operate independently of direct environmental data generation while fulfilling quality assurance responsibilities. Quality Assurance Officers facilitate development of and maintain the Quality Assurance Manual, provide assistance to personnel on quality assurance / quality control issues, maintain a quality assurance training program, and review quality documentation including SOPs.

Management ensures the development and implementation of programs and policies to continuously improve the effectiveness of ELI's QA Program and Management Systems. Management performs an annual review of the laboratory's Quality System (policies, procedures, work instructions) to assure their continuing suitability and effectiveness (See ELI SOP: *Management Reviews*, for detailed procedures). As appropriate, management identifies and implements any necessary changes or improvements. In addition, management performs meetings with supervisory and key staff members throughout the year. Supervisors and QA personnel provide input on their specific areas of responsibility and evaluate the following:

1) Client-Related Items
2) Internal and External Audit Reports
3) Proficiency Testing Results
4) Review of Performance by Department
5) Corrective and Preventive Actions
6) Personnel Training Needs
7) Quality System Policies and Procedures
8) Resources including Personnel, Equipment and Facilities

Laboratory Management Review findings are compiled into a summary report. The report includes deficiencies identified and areas for improvement. The QA department ensures items from the Management Review are tracked, including actions that must be addressed, assignment of parties

responsible for the actions to be taken, and recommendations on improvements to the Quality System. The Technical Director, Laboratory Manager, Quality Assurance Officer or designee, shall assign specific persons to address management review findings and establish deadlines for their completion. The Technical Director, Laboratory Manager, Quality Assurance Officer or designee, reviews and approves all documents issued to personnel in the laboratory as part of the management system. The Technical Director, or designee, has overall responsibility for the technical operations of the laboratory. Any procedural deviations to SOPs that are client or project-specific must receive approval either from the Technical Director, Laboratory Manager, and Quality Assurance Officer. Work is stopped when identification of any of the following is made: unapproved departures from the management system, unauthorized deviations from the procedures for performing tests and/or calibrations, and data quality or data integrity issues. The Technical Director, Laboratory Manager, QA Officer, or designee, is responsible for providing authorization for the work to resume once the identified issue has been addressed.

Personnel Requirements

ELI maintains experienced staff and management. Below is a summary of the primary roles, responsibilities and qualifications for the designated positions. Laboratory experience can be substituted for academic requirements. At ELI's smaller laboratory operations, the technical director may serve multiple roles. Detailed job descriptions are maintained by the Human Resources department. Specific titles of employees are at the discretion of the Laboratory Manager.

Laboratory Manager

The Laboratory Manager is required to have education and experience equivalent to a Bachelor of Science degree in Chemistry or a related science. Five years of relevant laboratory experience is required.

The Laboratory Manager is responsible for all operations, client management, analysis scheduling, and equipment acquisition, as well as compliance with all employment, safety, environmental and NELAP/ISO 17025 regulations. The Laboratory Manager may delegate daily activities of these work aspects to appropriate personnel. The Laboratory Manager reports directly to the Corporate Operations Manager. All Laboratory Managers have both technical and management responsibilities.

Quality Assurance Officer

The Quality Assurance Officer is required to have an education and/or experience equivalent to a Bachelor's of Science degree in Chemistry or a related science. Five years of relevant laboratory experience is preferred.

The Quality Assurance Officer is responsible for quality systems development, implementation, and management. The Quality Assurance Officer is also responsible for maintaining and improving compliance with all applicable state and federal regulations as well as maintaining compliance with NELAP/ISO/IEC 17025 regulations regarding Quality Systems. The Quality Assurance Officer or his/her designee with the help of the Laboratory Manager manages the laboratory's certification programs to meet government regulatory and specific client requirements. The QA program is implemented in cooperation with all levels of management and staff. Quality Assurance Officers report directly to the Corporate Quality Assurance Officer. The Laboratory Manager will direct daily

laboratory-specific QA/QC requirements. The Corporate Quality Assurance Officer reports directly to the ELI President.

Technical Director

The Technical Director is required to have a Bachelor of Science degree in Chemistry or a related science and meet all applicable education requirements listed in the current NELAP standard. Five years of relevant laboratory experience is preferred.

The Technical Director is responsible for ensuring compliance with all laboratory policies and that the analyses conducted under their supervision are compliant with all state, EPA, and NELAC/ISO17025 standards and regulations. The Technical Director reports directly to the Laboratory Manager.

The technical director may serve multiple roles. Laboratory Managers serve as one of the laboratory technical directors.

Laboratory Supervisor

A Laboratory Supervisor is required to have education and experience equivalent to a Bachelor of Science degree in Chemistry or related science. Two years of relevant laboratory experience is required.

ELI's Laboratory Supervisors are responsible for the day-to-day operation of the laboratories: scheduling testing, assigning work, and completing the technical review of laboratory data. Supervisors are responsible for ensuring compliance with all laboratory policies and ensure that the analyses conducted under their supervision are compliant with all state, EPA, and NELAC/ISO17025 standards. They report directly to the Laboratory Manager.

Analysts

Laboratory Analysts are required to have an education equivalent to a Bachelor of Science degree in Chemistry (or related science), or a High School diploma with experience as an analyst in training. New analysts require on-the-job training, under direct supervision of a qualified analyst until authorized by management to perform assigned tasks. The training shall be relevant to the present and anticipated tasks required and the effectiveness of the training must be evaluated (for more information, see ELI SOP, *Personnel Training and Training Records).* After the initial training period, and on a continuing basis thereafter, the analyst must demonstrate acceptable skills through the successful participation in the analysis of applicable performance evaluation and quality control samples.

Analysts perform the following duties: Preparation of samples and reagents, analysis and preliminary data input, as well as various other tasks assigned by the supervisor. Analysts are responsible for complying with all laboratory policies and procedures.

Laboratory Technicians

Laboratory Technicians are required to have a High School Diploma or equivalent. Laboratory Technicians work under the supervision of the primary analyst performing general laboratory tests.

Under the supervision of a primary analyst, Laboratory Technicians perform the following duties: preparation of samples and reagents, analysis, and preliminary data input, as well as various other tasks assigned by the supervisor.
Laboratory Technicians are responsible for complying with all laboratory policies and procedures.

Approved Signatories

Signatures for policies are based on appropriate individuals, roles and responsibilities as determined by the policy being reviewed and approved. A list of significant signatories is included below. Additional signatures may be required for specific procedures.

- Laboratory Manager
- Technical Director
- Quality Assurance Officer
- Corporate Officer- ELI Board of Directors

A master list including signatures and initials for all employees is maintained for reference and signature verification.

CHAPTER 5 – SAMPLING PROCEDURES

Private individuals or companies, who are responsible for using proper collection procedures, collect most of the samples processed in this laboratory. Members of the staff are acquainted with proper sample collection and handling procedures and advise those who need help in this area. Instructions and forms for initiating Chain-of-Custody are available from ELI. Laboratory procedures for logging in samples for analysis and maintaining Chain-of-Custody are described in ELI SOP, *Sample Receipt, Login, and Labeling*.

This laboratory provides proper sample containers and preservatives as specified for the procedure. Certified sample bottles may be ordered upon request. Sample containers, preservatives, coolers for shipping, re-sealable plastic bags for ice containment, trip blanks for monitoring contamination during shipping, temperature blanks for accurately monitoring sample receiving temperatures, Chain-of-Custody forms, Chain-of-Custody seals, sample bottle labels, instructions for sampling, sample labeling, sample preservation, and sample packaging/shipping are provided upon request. Sample container type, sample volume, preservation requirements, and maximum holding times, are detailed for each analyte/method in the Professional Services Guide. Contact an Energy Laboratories project manager for the current pricing.

Energy Laboratories maintains a strict Sample Acceptance Policy. The client is immediately notified (as appropriate) upon sample receipt, or as soon as possible, if there is any doubt concerning the sample's suitability for testing, including but not limited to, when:

- Samples that are out of temperature compliance;
- Samples are received in unacceptable containers;
- Samples have labels or chain-of-custody procedures that are incomplete;
- Samples cannot be analyzed within method recommended holding time; or
- The custody seal has been broken.

*NOTE: Samples that have not been properly preserved are noted on the Sample Work Order Receipt Checklist.

Notification of sample receipt condition is available through the final report, Energy Source, Email, Telephone and/or voice.

Samples not collected or documented properly can be rejected for any regulatory-based analysis with re-sampling recommended. If re-sampling is not possible, or the client cannot be contacted, the sample may be analyzed, and if analyzed, the sample will be clearly qualified in the analytical data package.

The laboratory will preserve samples at the time of sample login if samples are unpreserved and preservation is required by the methodology. Aqueous samples for volatile analysis are checked for preservation at the time of analysis. Samples for microbiological analysis are collected in pre-sterilized 120 mL plastic bottles containing sodium thiosulfate.

Sample preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preserved at collection. Refer to the Professional Services Guide for detailed information on sample preservation requirements per applicable method and regulatory requirements.

The laboratory initiates a sample condition report titled Workorder Receipt Checklist at the time of sample receipt. The sample condition report contains Chain-of-Custody procedures, sample preservation status, carrier used for sample shipment, sample receipt temperature, and general comments concerning sample condition. The sample condition report is provided with the analytical data report package. For more information, see ELI SOP, *Sample Receipt, Login, and Labeling*.

When any sample is shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements as described in the Professional Services Guide, the Office of Hazardous Materials, Material Transportation Bureau, and Department of Transportation have determined the Federal Hazardous Materials Regulations do not apply to the following:

A) Hydrochloric Acid - (HCl) in water solutions of 0.04 % by weight or less (pH of 1.96 or greater).
B) Nitric Acid - (HNO_3) in water solutions of 0.15 % by weight or less (pH of 1.62 or greater).
C) Sulfuric Acid - (H_2SO_4) in water solutions of 0.35% by weight or less (pH of 1.15 or greater).
D) Sodium Hydroxide - (NaOH) in water solutions of 0.080% by weight or less (pH of 12.30 or less).

For regulatory compliance monitoring, it is required that all samples be analyzed within the prescribed holding times. Holding times are the maximum times allowed between sampling and analysis for results to still be considered valid. Samples should be delivered to the laboratory as soon as possible following collection to assure that holding times can be met. Samples are analyzed as soon as possible after sample receipt. When maximum holding times cannot be met, re-sampling is requested. If samples are analyzed out of hold, data is appropriately qualified.

To ensure that drinking water analysis requirements for radiochemistry analyses are met, the requirements for sample handling, preservation, and instrumentation for radiochemical analysis are included in ELI SOP: "*Sample Receipt, Log-In and Labeling*". (For additional information, refer to "Manual for the Certification of Laboratories Analyzing Drinking Water", Table VI-2: Sample Handling, Preservation, and Instrumentation, EPA 5th Edition, January 2005).

CHAPTER 6 – SAMPLE HANDLING

All ELI laboratories utilize a sample tracking policy that includes client-initiated chain of custody. Upon receipt, the security of the samples is maintained by the implementation of the laboratory access and security policies. See ELI SOP, *Facility Description, Access and Security*.

Sample Receipt

All samples arriving at the laboratory are logged in the Laboratory Information Management System (LIMS). Each sample container is given a unique laboratory sample number. The sample receipt checklist evaluates Chain-of-Custody procedures, sample preservation status, carrier used for sample shipment, sample temperature, and provides general comments concerning sample condition. The completed checklist is provided with the analytical report package. Chain-of-Custody forms are checked for pertinent information. If necessary information has been omitted, the collector is notified, if possible, and the missing information is requested.

Samples requiring preservation are checked to determine if the client performed preservation. If requested, ELI staff will preserve or filter samples as appropriate. Samples that degrade quickly or cannot be opened (such as aqueous samples for volatiles) are not preserved at the time of sample login. If samples are improperly preserved, or the maximum holding times are exceeded upon arrival at the laboratory, the client is notified and re-sampling may be recommended.

Samples are stored per method specifications, or as method/parameter storage requirements are updated per later EPA guidance in Federal Regulations posted in 40CFR Part 136 and 40CFR Part 140.

During sample login, all sample information such as sample description, client name and address, analyses requested, special requirements, etc. are entered into the computer database of the Laboratory Information Management System (LIMS). Requested analysis parameters and special requirements are communicated to the analysts via their LIMS work lists. Project-specific requirements are maintained in the LIMS for any samples received from a special project. This process ensures that individual requirements are maintained.

Chain-of-Custody

Evidence level internal chain-of-custody (COC) procedures are available on a project-specific basis. For these procedures, internal COC sample custody is maintained down to the individual analyst level. When transferring the possession of the samples, the transferee must sign and record the date and time on the chain-of-custody record. Every person who takes custody must fill in the appropriate section of the chain-of-custody record. For all sample sets received by ELI, sample identification information on the sample containers is compared to the custody report form. The sample is inspected and information regarding the condition of the sample and seal (if used) is recorded on a report form; the method of shipping is also documented on the report form. A copy of the report form is kept with the sample data file and a copy is sent to the client with the analysis report. Internal chain-of-custody forms, when appropriate, are used to document the progress of the sample through the laboratory. ELI's routine COC policy is maintained at the laboratory level through our laboratory access and security policies. See ELI SOP, *Facility Description, Access, and Security*.

Sample Tracking

Samples are tracked through the analytical process by the LIMS. Completed analyses, which have been approved by the appropriate reviewer as valid data, are reported in the LIMS. When all analyses are complete, the data is reviewed as a whole to ensure results pass data quality checks. The completed report is signed by an approved signatory. The signed report is sent to the client via requested delivery format. Generation of the invoice automatically completes the work order in the LIMS and removes the samples from the status report. For more information, see ELI SOP, *Laboratory Records, Notebooks, and Document Management, Control and Archiving*.

Sample Disposal

It is preferred that remaining hazardous sample material be returned to the originator (client) for disposal. When this is not possible or reasonable, ELI will dispose of remaining hazardous sample materials with a waste disposal surcharge added to the cost of the analysis.

The disposal of laboratory wastes will be performed in accordance with local, state, and federal regulations which apply to such activities. Each method SOP addresses waste minimization and management specific to the method procedure. See ELI SOP, *General Laboratory Waste Disposal,* for more information.

Subcontracting Policy

The ELI Helena laboratory utilizes the expanded ELI branch laboratory capability and expertise to provide comprehensive analytical services. This occurs when the laboratory is requested to perform an analysis outside of the laboratory's capabilities (If sample overload is experienced; if equipment is out of service; for when the laboratory is not accredited for the particular analysis). Upon completion of the analyses, the subcontracted ELI laboratories report the sample results, and their quality control package, to the primary laboratory. The results are reviewed before being reported.

All ELI laboratories are certified to perform drinking water analysis in their state and in neighboring states. Samples are forwarded to our branch laboratories only if the laboratory is certified in the state from which the sample originated per the individual State certification requirements. Individual ELI laboratory Quality Assurance Programs are consistent with the Corporate Quality Assurance Program and are monitored through internal laboratory audits.

To support Energy Laboratories, Inc. Helena analytical services, ELI branch laboratories (which maintain specific instrumentation for specialized analysis) are utilized to provide complete analytical services. Refer to Appendix A for the certificates detailing routine analyses performed by the Helena branch. All ELI laboratory certificates are also available on the Energy Laboratories website at www.energylab.com.

ELI Helena routinely subcontracts the following parameters/methods to ELI laboratories:

Total Organic Halogens (TOX) by SW-846 9020
Low level EDB and DBCP by EPA 504
Carbamates by EPA 531.1
Glyphosate by EPA 547

Diquat by EPA 549.2
Total Organic Carbon (TOC/DOC) by A5310 C or A5310B, and SW-846 9060
Oil & Grease by SW-846 1664A
All Radiochemistry
SVOC by 8270C
Semi-Volatile Organic Compounds by EPA 525
Chlorinated Herbicides by 515.4
PFOS/PFOA by 537(M)

In the event that ELI is dependent on the service of an outside laboratory for analyses not available through our facility or our other branch laboratories, the client is notified on the laboratory analytical report that their samples were subcontracted to a pre-approved outside laboratory. The outside laboratory reports the results to ELI and these results become part of the final report. Any external or internal subcontracted analyses that require accredited analyses will be performed by a laboratory accredited for those parameters in the State from which the sample originated. All final reports indicate where the analyses were performed. Certification files of pre-approved subcontract laboratories are maintained by the ELI QA departments.

CHAPTER 7 – INSTRUMENT OPERATION AND CALIBRATION

Laboratory instruments and equipment are operated and calibrated according to the manufacturer's instructions and according to the requirements of the method being used. Exact calibration procedures are outlined in the appropriate SOP. For most instruments, a calibration curve composed of three to five standards covering the concentration range of the samples is prepared. The acceptance criteria for the calibration curves are listed in the individual methods. Unless otherwise specified in the method, at least one of the standards is at or below the practical quantitation limit (PQL) of the method. Routine PQLs for each method are given in the Professional Services Guide. Calibration standards are routinely compared to second source calibration standards to verify accuracy. These second source standard results must fall within an established range, as described by the SOP, to be considered acceptable. Whenever possible, the laboratory uses calibration standards prepared from certified stock standards. Initial instrument calibration curves are verified and routinely monitored by analyzing a continuing calibration standard every 10 to 20 samples (or within a specified time frequency) and at the end of every analytical sequence, depending on the analysis method and instrumentation. When applicable to the method, high-level samples, which produce an analytical response outside the calibrated range of the instrument, are diluted (or reduced in mass) and re-analyzed until a response within the calibrated range is obtained and/or the result is appropriately qualified.

System cleanliness is verified through the analysis of reagent/instrument blanks prior to analysis, between highly contaminated samples, and at regular intervals during the analysis.

Use of measuring equipment and reagents (glassware, water, chemical reagents, and industrial gases) conform to Good Laboratory Practice guidelines. Good Laboratory Practices (GLPs) are laboratory guidelines which were established by the Food and Drug Administration and published in the Federal Register (21 CFR, part 58). The GLP guidelines were adopted by the Environmental Protection Agency. SOPs are developed in accordance with GLP and NELAP guidelines. Laboratory volumetric glassware conforms to National Institute of Standards and Technology (NIST/SI), American Society for Testing and Materials (ASTM) Class A or B standards. All mechanical pipettes are calibrated at least quarterly. Laboratory balances are serviced by certified technicians annually. Calibration checks of balances are performed each day of use, using ASTM Class 1 or 2 weights. Laboratory thermometers are calibrated annually with a thermometer traceable to the SI through a national metrological institute such as NIST. Laboratory drying ovens, incubators, freezers, refrigerators, and water bath temperatures are monitored and recorded each working day, or at frequencies as described in the specific SOP. Laboratory pure water is generated by commercial water purification systems and is monitored and documented each working day in accordance with specifications needed for applicable methods. The routine analysis of laboratory blanks is used to verify laboratory water quality and the suitability of sampling containers. Chemical reagents and gases meet or exceed purity requirements for their intended uses. Laboratory stock and working standards are derived from ISO/IEC 17025, ISO/IEC 17034 and/or 9001 (or equivalent-certified) commercially available primary standards whenever possible. Standard preparation notebooks document the reagent/standard type, source, purity, content, concentrations, preparation date, and analyst. All calibration standards are documented in each analytical records such that they are uniquely identified and traceable to stock standards and their source.

Standard Operating Procedures (SOPs) detail the sequence of operations involved in instrument start-up, calibration, analysis, shut-down, and routine maintenance. Suggestions for corrective action are included with the SOPs and parameters are identified which dictate certain types of

maintenance. Instrument and method detection limit studies are performed at the method required frequency or whenever there is a significant change in instrumentation. Method Detection Limits are determined according to EPA guidelines found in 40 CFR, part 136, Appendix B (except for the few methods that are not amenable to MDLs). Refer to the Professional Services Guide for practical quantitation limits (method reporting limits). Acceptable instrument response/performance criteria are based upon the manufacturer or the analytical method specifications.

Electronic Instrument logbooks are used to document instrument maintenance and repairs. Instruments that are no longer being utilized are documented in the applicable instrument logbook as “out-of-service” with the date the instrument was taken out of use noted. All out-of-service instruments are labeled with an out-of-service tag that identifies the effective date the instrument was taken out of use.

Laboratory analysts record and document all instrumental sequences in Laboratory Instrument Logbooks, LIMS system or computer files. Instrument Logbooks and/or dated computer files record instrument performance data, analytical sequences, instrument maintenance, calibration standards data, and any other additional information pertinent to operation of the instrument.

CHAPTER 8 – RECORDS AND REPORTING

Document Management

Energy Laboratories Inc. QA manages three types of documents: 1) controlled, 2) approved, and 3) obsolete.

A CONTROLLED document is one that is uniquely identified, issued, tracked, and kept current as part of the Quality or Management System. Controlled documents may be internal documents or external documents. Controlled documents are considered to be all documents issued to personnel in the laboratory as part of the management system such as accreditation standards, forms, test and/or calibration methods and company policies and procedures. All internal ELI controlled documents are written and reviewed by personnel technically competent to perform the procedure and are approved for use by the Laboratory Manager -or the managers designee(s).

APPROVED document is one that has been reviewed, and approved for use by the Laboratory Manager-or manager's designee(s).

OBSOLETE document is a document that has been superseded by more recent versions or no longer being used. Obsolete documents are retained for legal use or historical knowledge preservation. Old or archived SOPs are available for review using the laboratory's electronic document system. ELI's OBSOLETE document records are maintained for at least ten years.

Documents are reviewed on an annual basis to ensure their contents are suitable and in compliance with the current quality systems requirements, and accurately describe current operations. SOPs include a Record of Revision page, which details revisions. The Quality Assurance Officer maintains a master list of controlled documents (which include title, author, and date of issue).

Procedures for identification, collection, access, filing, storage, and disposal of records are found in ELI SOP,
Laboratory Records, Notebooks, and Document Management, Control and Archiving.

Laboratory Notebooks

Several different types of Laboratory Notebooks are maintained at the ELI Laboratory. These include, but are not limited to, the following:

Method/Parameter Notebooks
Project Notebooks
Instrument/Equipment Use and Maintenance Notebooks
Standard Preparation Logbooks
Balance Calibration Logbooks
Pipet Calibration Logbooks
General Logbooks

The general purpose of maintaining each of these Laboratory Notebooks is to record the details that may be important in repeating a procedure, interpreting data, or documenting certain operations. Entries in the notebook may include data such as standard and sample weights, pH

measurements, instrument operating parameters, preparation of calibration curves, analytical sequences, calculations, recording of instrument operating parameters, sample condition, etc. The analyst's notebook is particularly important in documenting analyses that deviate in any way from routine or standard practices. It can also be an important training record. All pertinent data is to be recorded directly in the notebook. Most notebooks or data records are maintained in electronic format (LIMS, spreadsheets, or databases). Electronic data records are duplicated using hardcopy and/or alternate electronic backup techniques.

It is the responsibility of each analyst to maintain a laboratory notebook according to Good Laboratory Practices (GLP) Guidelines. All physical laboratory notebooks are assigned a unique logbook control number and are assigned to an analyst and/or supervisor. These notebooks remain the responsibility of the ELI staff member to whom they are assigned until they are formally transferred to another staff member, until they are completely filled and returned to the ELI QA Department for archiving, or until the staff member resigns and returns them as a part of the check-out process. ELI staff members, other than the individual to whom the laboratory notebook is issued to, may make entries in the notebook as long as those entries are consistent with the intended use of the notebook and such entries are initialed and dated. Procedures for use and maintenance of laboratory notebooks are detailed in ELI SOP, *Laboratory Notebooks*.

Records

The laboratory maintains records of all chemical analyses, including all quality control records, for a minimum of ten years from the date of last use. In the event that Energy Laboratories, Inc., or any individual laboratory transfers ownership or goes out of business, the records will be transferred to the new owners. If an ELI laboratory is closed, records will be maintained by Energy Laboratories Corporate office in Billings, Montana. Energy Laboratories, Inc. reserves the right to offer the records to the clients in the event of complete closure. Details are described in ELI SOP, *Laboratory Records, Notebooks, and Document Management, Control and Archiving*.
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Data Reduction

Data reduction refers to the process of converting raw data to reportable units. The reporting units used and analytical methods performed are described in the ELI Professional Services Guide.

Wherever possible, the instrument is calibrated to read out directly in the units reported. In this case, the value is recorded directly into a laboratory notebook, logbook, bench sheet, or electronic file and presented for review.

In cases such as titration, gravimetric measurements, or other techniques that require calculation prior to reporting, raw data is recorded in the appropriate laboratory notebook or electronic file, or on the appropriate laboratory form. The calculations specified in the methods are used to determine the reported value. That value is also entered into the laboratory notebook or bench sheet. Most calculations are automated to reduce the chance of arithmetic or transcription errors.

Wherever possible, electronic data results are transmitted throughout the laboratory via the LIMS computer network. This process is intended to minimize manual data transcriptions within the laboratory. Additional advantages include the opportunity for rapid comprehensive data validation by supervisors, and more rapid data reporting.

Validation

Data validation includes the procedures used to ensure that the reported values are consistent with the raw data, calculated values, sample type, sample history, and other analysis parameters requested.

The data recorded is validated with several review steps. The analyst who submits the analytical results checks all the values reported for omissions and accuracy. Elements of this review also evaluate all instrument and method QC results. Automated data management programs are designed with an interactive step allowing data review by the analyst. Results to be reported are approved by the analyst.

The report is reviewed for the suitability of the data according to project and method performance specifications. Analytical results for each requested parameter may be evaluated against other requested parameters, project specifications, other samples within the set, historical files associated with the project/client, and/or any other information provided with the sample.

The reports are generated, proofread, and reviewed by designated reporting staff.

Laboratory managers, project managers, supervisors, QA Officer or their designees, may also examine the data included in the final report.

Internal and external laboratory audits review selected sets of data to ensure that the analytical results are correct and accurate, analytical methods are appropriate, documentation and record keeping procedures are complete, and that there is compliance to the overall objectives of the Quality Assurance Program. Data integrity is monitored on an on-going basis.

All controlled automated programs used to process and report data are initially verified using manually calculated results. Whenever a modification is performed to a program, re-verification of overall software function is performed.

One step of the Quality Control process involves data outlier detection; data that falls outside of established limits. If an outlier is observed, corrective action is taken as appropriate, to investigate and/or correct the cause. Actions to correct these causes may include, but are not limited to, inspection of the instrumentation, checking calibrations, checking sample numbers or dilutions, re-analyzing samples or calibrations.

Reporting

One copy of the report is distributed to the client, via requested delivery format, after the report is validated and signed. A standardized report format is used unless otherwise specified. Client-specified report formats are available upon request. Results can be sent via physical media, email, EDD, website FTP and/or FAX when requested by the client. Energy Laboratories, Inc. offers its clients access to electronic records through our Energy Source Portal.

Various levels of data reporting are available. All analytical results, regardless of the level of reporting used, have record keeping procedures which allow an appropriate "data validation package" to be produced. Note that a comprehensive "data validation package" is most easily generated at the time of sample analysis. Example data packages are available upon request.

Maximum contaminate limits and/or decision rules per applicable regulation may be included on analytical reports per type of regulatory analysis being requested.

Safe Drinking Water Act (SDWA) compliance monitoring samples for microbiological and chemistry samples that exceed the SDWA maximum contaminant level (MCL) may require notification to the appropriate state agencies. Generally, notification to the client, and to the state, of any SDWA MCL exceedance must be within 24 hours of completion of analysis/review, or by noon the next business day. If requested by the client, additional copies of the report will be sent to a specified address or person.

The final copy of a completed report is maintained in an electronic format. An electronic copy of this file is available upon request. Energy Source is a client resource of ELI that provides secure online access for clients to view their data and documents. Clients are able to access their electronic files through ELI's secure website at https://energysource.energylab.com/. For more information, see ELI SOP,
Laboratory Records, Notebooks, and Document Management, Control and Archiving.

In addition to traditional ink signatures, Energy Laboratories has approved the use of electronic signatures within our company-produced PDF documents. These signatures comply with Title 15 of the US Code Section 101 regarding legal requirements of a digital signature.

Electronic signatures verify that the document has not changed after it was produced. Upon opening the document, notifications automatically display to inform the recipient of the validity of the sender's electronic signature and all included certificates. Should any changes be detected, an alert message is automatically displayed, noting that the signatures cannot be validated due to changes made to the document.

CHAPTER 9 – GENERAL LABORATORY PRACTICES

Chemicals and Reagents

When available and appropriate, chemicals used in the laboratory are ACS (American Chemical Society) analytical reagent grade chemicals purchased from reliable suppliers, preferably ISO accredited suppliers, and which meet referenced method specifications. Reagents are prepared, standardized, and made fresh as mandated by the method, their stability, and according to Good Laboratory Practices. Procedures for purchasing of materials may be found in ELI SOP, *Property Procurement, Inventory, and Control*.

Normalized standards are checked regularly against independently prepared reference materials.

All standards and reagents are dated when received, opened, or prepared, and each is labeled with an expiration date when applicable. Standards and reagents are checked for discoloration or signs of degradation and are discarded if these are observed.

Certified primary standards are obtained from ISO accredited commercial sources when available. Standards used for calibration are verified against second source standards. Secondary and working standards are accurately prepared with volumetric flasks, or other calibrated labware, from primary standards and stored in appropriate containers.

ELI has determined twenty years to be a reasonable expiration date for stable salts where the manufacturer does not supply such information. Reagents which are reactive or may be unstable should have an initial expiration date appropriate to the shelf life of the compound, with a suggested maximum of 1 year. Titrants, standards, and other solutions used for analytical purposes are frequently standardized upon preparation with certified or traceable standards. Method SOPs specify if standardization is necessary. The date and analyst's initials must be recorded on the container whenever re-standardized and these records are maintained in a laboratory notebook or in the LIMS.

Individual SOPs may also provide additional details for reagent requirements.

Reagent Interference

To determine the extent of reagent interference, method blanks are analyzed prior to sample analysis whenever appropriate.

If any interference cannot be eliminated, the magnitude of the interference is considered when calculating the concentration of the specific constituent in the sample, but only when permitted within the applicable method.

If reagents, materials, or solvents contain substances that interfere with a particular determination, they are replaced.

Individual method SOPs may also provide additional requirements for handling reagent interferences.

Glassware Preparation

All glassware used for inorganic and radiochemical analysis is washed in warm detergent solution and thoroughly rinsed in tap water. Glassware is then rinsed well three times with laboratory-purified water. This cleaning procedure is sufficient for many analytical needs, but individual SOPs detail additional procedures when necessary. Glassware washing procedures for inorganic analyses are described in ELI SOP, *Inorganic Glassware Washing*.

All glassware used for organic analysis is washed in warm synthetic detergent solution and thoroughly rinsed in tap water. The glassware is then rinsed well with laboratory-purified water, followed by rinses with acetone to remove any residual organics. Prior to use, the glassware is rinsed three times with the organic solvent to be used with the glassware. Glassware washing procedures for cleaning glassware for organic analysis are described in ELI SOP, *Cleaning of Glassware Used in Volatile and Semivolatile Analyte Sample Preparation and Analysis*.

All glassware used for microbiological analysis is washed in warm detergent solution. The detergent must be proven to contain no bacteriostatic or inhibiting substances. The glassware is rinsed thoroughly with laboratory-purified water. Specific details are described in method specific SOPs.

Disposable, glassware/plasticware is preferred for many procedures in the laboratory. The cleanliness and suitability of disposable glassware/plasticware is continuously evaluated for each test with the routine analysis of method blanks.

All volumetric glassware used in precise measurements of volume is Class A or laboratory calibrated.

Laboratory Purified Water

Laboratory-purified water is used in the laboratory for dilution, preparation of reagent solutions and final rinsing of glassware. For organic analysis, organic-free water is prepared and used. Energy Laboratories, Inc. uses water purification systems that are designed to produce deionized water that meets the requirements of the methods. Use and maintenance of laboratory reagent water systems are described in ELI SOP, *Use and Maintenance of Water Purification Systems*.

Water quality is monitored for acceptability in the procedure in which it is used. Specific details are listed in the appropriate SOPs.

Employee Training

All new ELI employees and contract personnel are given an initial general orientation and tour of the laboratory facilities. Personnel are shown the locations of safety equipment such as safety showers, eye wash fountains, fire extinguishers, and first aid supplies. Personal protective equipment such as lab coats, disposable gloves, and safety glasses (if applicable) are issued at this time.

Safety considerations are a vital part of the training process. All hazards associated with the performance of a procedure or with the operation of an instrument are to be understood by the trainee before training can be considered complete. General laboratory safety procedures are a part of the new and current employee training. Specific safety procedures are outlined in SOPs

and in instrument Operator's Manuals. Training in use of protective clothing, eye protection, ventilation, and general safety are provided to each employee. Each employee is required to read and sign the *Laboratory Safety Manual & Chemical Hygiene Plan*.

All new and existing employees must demonstrate capability prior to performing an analytical procedure independently (see Chapter One). Method performance on Quality Control Samples is used to document employee training and work quality. Employees are required to read the Quality Assurance Manual and all appropriate SOPs. Employees are required to sign, for all applicable Manuals and SOPs, a Record of Acknowledgement Form that states they have read, understood, and agree to abide by the Manual/SOP.

Employees also receive training on general laboratory policies including ethics and conflict of interest. All employees are required to read, understand and comply with the Corporate Compliance & Ethics Manual. Data integrity training is provided for all employees initially upon hire and annually thereafter. In addition to the *Corporate Compliance & Ethics Manual*, the ELI Quality Assurance department maintains a *Laboratory Ethics & Data Integrity Manual*, which supplements the corporate manual and provides specific training on data integrity. All employees are required to read, understand and comply with the ELI *Laboratory Ethics & Data Integrity Manual*. An annual Ethics training course is given to all laboratory employees. Attendance is required and is recorded with a signature attendance sheet or other form of documentation that demonstrates all staff members have participated and understands their obligations related to data integrity and ethics policies. For details pertaining to ethics training and additional ethical procedures and policies refer to ELI SOP, *Personnel Training and Training Records*.

ELI encourages attendance at courses, workshops and other forms of continuing education available from on-site seminars, webinars, private institutions, local schools, and State and Federal regulatory agencies. Staff and department meetings are held routinely to communicate company policies and procedures. All training on procedures and policies is documented, per NELAP guidelines, in employee training files. For more information see ELI SOP, *Personnel Training and Training Records*.

Data Integrity

To provide data of the highest quality, Energy Laboratories Inc. activities, policies and procedures are structured and managed to safeguard impartiality. In order to provide for the security and integrity of ELI and client data, the laboratory has multiple controls on the network, LIMS and applications used. These controls limit access to and the ability to change data as well as provide for redundancy in case of loss.

These include but are not limited to:

- Users connecting to ELI computer systems are authenticated through a user name and password combination.
- Passwords are required to be changed on a regular basis.
- Permissions within ELI applications are role based with different roles having various levels of access and control. Users (analysts, supervisors, and managers) are assigned to these roles.
- In the LIMS, analytical data locks after a period of time and cannot be modified without special handling.

- Certain information has been identified for additional tracking and logging. Changes to this information is not only tracked in an audit log but also reported to select personnel.
- Information on ELI servers including the ELI LIMS system is backed up and recoverable.

Standard Operating Procedures

Laboratory operations and procedures are documented in Standard Operating Procedures (SOPs). SOPs provide information regarding the consistent and safe operation of the laboratory. For analytical methods, SOPs provide information on the details of the analysis that may not be specified in the published reference analytical method(s). For routine procedures other than analytical methods, SOPs define the steps required in accomplishing a given task. All SOPs are reviewed and updated periodically to reflect any changes in laboratory operations. Method SOPs follow NELAP requirements. For more information on generation and distribution of SOPs, see ELI SOP, *Preparation, Numbering, Use, and Revision of Standard Operating Procedures*.

Client Confidentiality

Client confidentiality is considered legally enforceable by the laboratory. Each employee has the responsibility to maintain confidentiality in all matters pertaining to our clients, samples submitted, and Energy Laboratories, Inc. Information obtained during employment with this laboratory, regarding the specific business of this laboratory, or its clients shall at no time be revealed to any outside sources without permission from the owner of the data.

Sample submittal, analysis and the report contents are considered confidential information of the client. When requested to provide results (either in person, via telephone or email), the employees shall verify that the requestor is either the person associated with the project, on the COC, or on a list provided by the client who are authorized to receive data. If a person who is not associated with the project personnel (or is not on the approved list), the base client will be contacted to inquire about authorization to release data. These contacts are documented and associated with the work order in the LIMS system to provide archival proof of authorization to release data. If the client does not authorize a release of data, the requestor will be contacted and informed of this decision.

Client confidentially is maintained electronically through the use of password-protected logins on all laboratory computer systems. Additionally, the laboratory maintains network security such as anti-virus programs and firewalls that prevent any unauthorized outside access. All copies of the original report are stored on the laboratory's document archival system, which is also protected from unauthorized use by the network security systems. Raw data, reports, and LIMS records are kept in a secure location of the laboratory or off-site. All client confidential paper waste, including printouts, is shredded.

When the laboratory is required by law or authorized by contractual arrangements to release confidential information, the customer or individual concerns shall, unless prohibited by law, be notified of the information provided. As example, samples provided for Safe Drinking Water Act compliance monitoring, as per individual state regulatory requirements, may also need to be reported to the applicable state agency.

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

CHAPTER 10 – QUALITY CONTROL MONITORING

Routine Monitoring

Temperatures of incubators, water baths, refrigerators, and ovens are checked and recorded according to a prescribed schedule and using an automated continuous monitoring system. In the event that the automated monitoring system is inoperable, the temperatures will be recorded manually on instrument specific forms.

Conductivity of the laboratory-purified water is continuously monitored using an automated monitoring system and as method blanks in routine analytical sequence.

Reagents are dated and initialed at the time of opening. Expiration dates are assigned as a fundamental component of their receipt and/or preparation. Reagents are not used after manufacturer's expiration date is exceeded.

Balances are checked daily, or as required, against ASTM Class 1 or 2 SI traceable weights and are calibrated and serviced by certified technicians annually.

Method and Quality System SOPs are reviewed annually for accuracy.

Laboratory Notebooks are reviewed periodically for correctness and accuracy by supervisors and by internal and external auditing.

Proficiency Testing (PT) Samples are analyzed as required (See Chapter 2 of this QA Manual).

Quality Control Check Samples are analyzed with each analytical batch.

Internal and external audits are performed as specified or requested (See Chapter 2 of this QA Manual for additional discussion).

Additional monitoring requirements may also be specified in individual SOPs.

The Laboratory maintains an active fraud protection program that is implemented through the laboratory ethics policy. Additionally, the potential of fraud is monitored through analyst supervision, management supervision, regular internal audits, PT study participation, and an active quality assurance program.

Instruments/Methods

Calibration is performed as outlined in Chapter 7 of this QA Manual.

Generally, and depending on method requirements, the standard curve is verified with a known second source reference sample. The reference sample results must fall within the appropriate target range for the calibration to be considered acceptable.

In most cases, the calibration stability is checked by analyzing a continuing calibration standard every 10 to 20 samples, depending on the analysis and instrumentation. The verification standard results must fall within an established range as described by the SOP.

All laboratory instruments are subjected to preventive maintenance schedules. Preventive maintenance schedules are specified in instrument maintenance logbooks.

As appropriate, instrument and/or method detection limits are analyzed quarterly and calculated annually, or more frequently if changes in instrument performance are noted or per method requirements. Procedures for the determination of instrument detection and method detection limits are described in ELI SOP, *Determination of Method Detection Limits (MDL) and Quantitation Limits*.

Precision and accuracy requirements for each method are specified in the SOPs. General guidelines are given below.

- Each analytical batch will contain QC samples to measure the accuracy of the method. Each QC sample result is monitored to be within QC specifications of the method. Results of blank spiked sample analysis must be within the established control limits. Quality Control Limits are specified in the SOPs and meet recommended QC limits as described in the referenced method.

- Each analytical batch will contain QC samples to measure the precision of the method. (See Chapter One for discussion on duplicate sample analysis.) Criteria for duplicate sample acceptance are found in the SOP and are generally taken from the referenced method.

- Each analytical batch will contain QC samples to measure the performance of the method on the sample matrix. These are typically identified as a matrix spike analysis and may be performed in duplicate to assess method precision. Typically the sample is fortified with a known amount of target analyte and spike recoveries are calculated. Results outside of method QC guidance are flagged. Quality control limits and appropriate corrective actions steps are specified in the method SOP.

- Several methods are considered to be concurrent methods in that they are either nearly identical or are identical to a method with a different citation. Even if two methodologies are identical in procedure, slight differences in the QC requirements might be the only difference between the two methodologies. These types of methods may also be considered "concurrent" if the procedures are identical and the more stringent of the two method criteria are used. During data reduction and reporting, the referenced method specifications and criteria will always take priority.

As appropriate, the performance trends of QC sample results are evaluated with Quality Control Charts. Suitability of existing QC limits is evaluated and possibly adjusted, but not to exceed method specification.

CHAPTER 11 – CORRECTIVE ACTION

When the quality control checks indicate that an analysis is not within the established control limits, corrective action is needed. This section gives general guidelines for corrective action. Corrective actions for each method or instrument are detailed in individual SOPs. Records are maintained of non-conformances requiring corrective action to show that the root cause(s) was investigated, and includes the results of the investigation. The QA Officer will monitor implementation and documentation of the corrective action to assure that the corrective actions were effective.

Method QC samples that fail to fall within QC control limits may be analyzed again to verify if a problem exists. However, matrix spike or matrix spike duplicate QC samples are not required to be re-analyzed if the performance can be attributed to matrix effects; data results are then reported and properly qualified.

If the repeat analysis is not within control limits, the particular instrument or procedure is checked according to the specific protocols outlined in the method or according to the instrument manufacturer's guidelines. Results within acceptable control limits must be reestablished before the instrument can continue analysis. Analysis of all samples that were analyzed while the procedure was out of control must be repeated. In the case of radiochemical analysis, the term "analyze again" means to recount the final sample on the same (or different) detector.

If the analyst is unable to achieve acceptable results after following the corrective action guidelines detailed in the SOP, a supervisor and/or Technical Director is consulted. If necessary, the appropriate service personnel are contacted if the problem is determined to be due to instrument error, and cannot be resolved. It is also possible that the result is due to statistical variation of the results based on the tolerable error rate that has been determined for the analysis (usually 0.05). In certain cases, where control limits are exceeded, it is possible that problems cannot be corrected to satisfy QC criteria. This could be due to problems such as matrix interference, instrument problems, lack of sufficient sample, missed holding times, high blank contamination, etc. If all possible solutions available to correct the problem are examined and the sample results are still considered valid, qualifying comments are attached to the sample report describing the non-compliance and probable cause.

In the case of a single radiochemistry detector being returned to service, this refers only to the samples counted on that detector. For example, an individual gas proportional counter instrument may have up to 16 detectors; if only one does not pass the QC check the others are still valid and sample analyses performed on the others do not need to be repeated.

In the event that a QC audit or other informational review shows an analysis report to be incorrect, incomplete, or adversely compromised, a revised report and explanation is submitted to the client within ten business days unless otherwise communicated to the client with another time period. The report will clearly be identified as a revised report. As appropriate, an explanation submitted to the client should give a detailed review of the problem and document any unapproved deviations from the regulations, standard operating procedures, or project- specific scope of work that may have caused it. The explanation to the client may include, but not be limited to, the following components:

1) What actions have been taken regarding the affected data set(s),
2) Identification of the cause, and
3) Corrective action(s) taken to prevent future occurrence.

In the event that a QC check fails, the analyst will follow the procedures outlined in the QA/QC summary of the SOP.

Quality Control Checks for each method or instrument may vary. Energy Laboratories Inc. follows the QC checks set by each governing method. Due to the wide variations between methods, specifics are listed within each SOP for the given method. Please reference the SOP for specific QC checks for the given method. The QC checks may include: ICV, MB, CCV, CCB, LCS, LCSD, LOD, MS, MSD or others specific to that method.

A summary of Quality Assurance/Quality Control specifications and QC corrective actions for representative methods is outlined in Appendix B. Any deviation from the SOP/method shall be documented in laboratory records.

Procedure for Dealing with Complaints

DEFINITIONS

Complaint: For the purposes of this procedure, a complaint is an expression of dissatisfaction from a client, a user of our data, or employee. The complaint might cover issues about the quality of our data, sample turnaround time, method used, pricing, or other expectations for which a response is expected.

Client: The client is a person or company that ordered and paid for the services.

Procedure: The staff person receiving the complaint exercises judgment in deciding the severity and disposition of every complaint. The judgment must be used to decide whom, if anyone, is alerted to the complaint and what actions are appropriate. The complaint issued should be handled with a high degree of discretion and tact by the supervisor or manager involved. The individual handling the complaint is instructed to follow ELI's guidelines provided in this section on how to handle the complaint. This involves listening to the client and getting adequate information so the complaint can be investigated and resolved. The appropriate laboratory staff is notified and a solution to the problem, as well as a timeline for action, is given. Records are maintained regarding the complaint and of the investigation and corrective action(s) being taken.

After the complaint is investigated or resolved, as necessary, the client is made aware of the results and determination is made as to what further actions are needed. Complaints and investigations may result in the need to submit a revised report or invoice. Complaints that are straightforward and can be resolved using the resources available to the person handling the complaint should be resolved there. These include such things as minor revisions of reports or invoices. If other decisions need to be made, the appropriate person should be contacted.

It may be appropriate to initiate or prepare a corrective action report. This report should be completed with the intention of informing the affected staff about the problem so that all relevant staff can use it as a learning opportunity, change our procedures and improve our service. A procedure to document corrective action reports is documented in ELI SOP, *Nonconformance Procedures and Corrective/Preventive Action Reports.*

If an employee sees an issue, they are encouraged to report concerns regarding Quality Systems, unethical behavior, and/or financial mismanagement. This issue should initially be brought to the attention of their supervisor. The supervisor will take appropriate action to resolve the concern. If

the employee is uncomfortable with approaching their supervisor or feels that the issue was not properly dealt with, they may approach higher levels of management with their issue.

Energy Laboratories, Inc. has also implemented a program to facilitate confidential reporting to upper management. This tool allows employees, customers, vendors, auditors and other interested parties to report situations or behaviors that they consider to be unethical, immoral, or improper. It also allows the reporting of suggestions or comments. The program has been implemented at ELI so that anyone reporting a situation can be assured that there will not be retaliation for reporting. It is meant to encourage parties to communicate with upper management when there appears to be no alternative for resolving the types of issues already described. Access to the program is available on the ELI internal website. Complaints, suggestions or comments from clients, vendors, auditors and other interested parties can be submitted directly to project or laboratory management who will initiate a resolution.

Penalty for Improper, Unethical or Illegal Actions

Energy Laboratories, Inc. employees are expected to work in an ethical, proper, and legal manner. They are expected to perform laboratory analyses according to the cited method(s) and in conjunction with the SOP and the Quality Assurance Plan. Employees are expected and required to report any violations of this policy. All employees are mandated to participate in an ethics-training program as part of their orientation upon hire.

Improper, unethical, or illegal actions by an employee will be addressed on a case-by-case basis as determined by the seriousness of the offense. Corrective actions may include disciplinary action up to and including discharge and legal liabilities.

CHAPTER 12 – MANAGEMENT OF CHANGE

Management of change is the process used to review and manage proposed changes to materials, technology, equipment, procedures, personnel and facility operations. These changes may be permanent or temporary depending on circumstances. Change is managed, communicated, and documented as appropriate to the level of change, by the Laboratory Manager and the Supervisors of each department. Significant revisions to controlled documents may require employees to sign a record of acknowledgement.

- New Equipment Validation – Documented in the Instrument Maintenance Module. Supporting studies are documented in the LIMS.
- Implementation of new test methods and method updates – Documented in the method SOP and the Instrument Maintenance Module. Supporting studies are documented in the LIMS.
- The QA Manual and SOPs – Documented in the Record of Revision and stored in the Document Control Software.
- Work order changes are documented in the work order report and stored in the LIMS or Document Control Software.
- LIMS changes are documented in a version control repository.
- Personnel changes are- documented in employee training records or personnel records.

CHAPTER 13 – MAJOR EQUIPMENT AND METHODS

A summarized listing of major instrumentation utilized in the laboratory is included in Appendix E. See attached State of Montana certificate in Appendix A for a complete list of accredited methods and analytes that ELI performs to support SDWA regulated methods. Refer to ELI's Professional Services Guidebook, located on the ELI website at www.energylab.com, for a list of comprehensive services including methods and analyte parameters performed by Energy Laboratories, Inc.

CHAPTER 14 – PREVENTIVE MAINTENANCE

Preventive maintenance is performed on laboratory equipment according to the manufacturer's guidelines and our operational experience. Repairs and maintenance are accomplished in-house by experienced laboratory personnel whenever possible. Other than consumable equipment items, an inventory of spare parts is not maintained. Spare parts are available from outside vendors on an as needed basis. (To ensure method capability, some methods have more than one instrument available). An example of maintenance performed follows:

Instrument	**Maintenance**	**Frequency – Note that Daily is based on use.**
Balances	Check with appropriate Class weights	Daily
	Perform Internal Calibration	As needed-when daily check does not meet acceptance criteria
	Independent Service	Annually
Pipettes	Check volume	Quarterly/Daily
Thermometers	Calibration Verification	Annually
Ion Chromatograph	Replace Bed supports	Weekly
	Replace Guard Column	As Needed
	Replace Analytical Column	As Needed
	Calibrate	After maintenance or as needed
	Clean Stator Plate	Annually
	Replace tubing	As needed
	Calibrate Conductivity Cell	Every 6 months
	Backup Data	Monthly
ICP-Atomic Emission	Check Pump Tubing	Daily
	Check Coolant Levels	Monthly
	Lubricate Autosampler	As needed
	Air Filter	Quarterly
	Optics Servicing	As needed
ICP-Mass Spectrometry	Check Pump Tubing	Daily
	Check Coolant Levels	Monthly
	Check Electron Multiplier	Daily
	Lubricate Autosampler	As needed
	Air Filter	Quarterly
Gas Chromatograph	Replace Septum	As needed
	Check Injection Liner	Daily
	Clean Detector	As needed
	Change Gas Cylinders	At 200 psi
	Change Column	As needed
Auto Analyzers		
	Check For Leaks	Daily
	Replace Tubing	When wear is visible
	Lubricate Pumps	Annually
	Lubricate Sampler	Annually
Man-tech Auto-titrator	Visually inspect all probes/ stirrer/ thermometer and fill probes	Daily/As needed
	Flush pH probe/ Fluoride probe	Every 15 days
	Calibrate sample dosing pump	Quarterly
	Replace Tubing	Annually/ As needed
	Clean out titration vessel and rinse station	Quarterly/ As needed
	Clean buret	Quarterly
	Calibrate buret	Monthly

Instrument	**Maintenance**	**Frequency – Note that Daily is based on use.**
	Replace pH/ Fluoride probe	As needed
	Change Lip seals gland washers on dosing pump	As needed
Metrohm-automated ph, conductivity, auto-titrator	Visually inspect all probes/ stirrer/ thermometer and fill probes	Daily/As needed
	Flush pH probe/ change storage solution	Monthly/ As needed
	Replace Tubing	As needed
	Calibrate buret	Monthly
	Replace pH probe	As needed
Mass Spectrometers	Monitor Vacuum Pressures	Daily
	Monitor Background Levels	Daily
	Monitor Electron Multiplier	Daily
	Change Pump Oil	As Needed
Microbiology	Monitor Room Temperature	Twice daily
	Monitor Incubator Temperature	Twice daily
	Autoclave Maintenance	Annually
	Monitor Water Bath Temperature	Twice daily
Reagent Water Systems	Change/Check Cartridges	Quarterly, or as needed
Compressed Gases	Change Gas Cylinders	At 200 psi, monitor daily
Liquid Chromatograph	Flush System	Daily
	Change Filters	As needed
	Replace Seals	As needed
Continuous Temperature Monitoring System	Check Temperatures	Daily, calibrated annually

CHAPTER 15 - REFERENCES

ANSI N42.23-1996, American National Standard Measurement and Associated Instrument Quality Assurance for Radioassay Laboratories.

ASTM Annual Book of Standards, Part 31 (water), American Society for Testing and Materials.

ASTM D 7282-06 Standard Practices for Set-up, Calibration, and Quality Control of Instruments Used for Radioactive Measurements.

Handbook for Analytical Quality Control in Water and Wastewater Laboratories, Environmental Protection Agency. EPA 600/4-79-019

ELI Professional Services Guide, Current Revision, Energy Laboratories, Inc.

Manual for the Certification of Laboratories Analyzing Drinking Water, 5th Ed., EPA 815-R-05-004, 2005.

Manual for the Certification of Laboratories Analyzing Drinking Water, Supplement to 5th Ed., EPA 815-F-08-006, June 2008.

Methods for Chemical Analysis of Water and Wastes Environmental Protection Agency, 600/4-79-020.

Methods for the Determination of Metals in Environmental Samples – Supplement I, EPA/600/R-94-111, May 1994.

Methods for the Determination of Inorganic Substances in Environmental Samples, EPA/600/R-93-100, August 1993.

Methods for the Determination of Organic Compounds in Drinking Water, EPA/600/4-88/039, December 1998.

Methods for the Determination of Organic Compounds in Drinking Water – Supplement I, EPA/600/4-90/020, July 1990.

Methods for the Determination of Organic Compounds in Drinking Water – Supplement II, EPA/600/R-92/129, August 1992.

NELAC Chapter 5: Quality System Standard, 2003, 2009, or 2016 most current version approved by Florida and Texas NELAC Accreditation program.

NELAP, National Environmental Laboratory Accreditation Program. The NELAC Institute (TNI) http://www.nelac-institute.org/newnelap.php

Standard Methods for the Examination of Water and Wastewater; 20th, 21st and -22nd Editions, APHA.

Technical Notes on Drinking Water Methods, EPA/600/R-94/173, October 1994.

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW846), Environmental Protection Agency. https://www.epa.gov/hw-sw846

Management and Technical Requirements for Laboratories Performing Environmental Analysis, TNI Standard, Volume 1 (EL-V1-2009), The NELAC Institute.

Management and Technical Requirements for Laboratories Performing Environmental Analysis, TNI Standard, Volume 1 EL-V1-2016 Rev2.1, ELV1M4-2017-Rev2.2, The NELAC Institute.

DOD Quality System Manual (QSM) for Environmental Laboratories, Version 5.2, U.S. Department of Defense, December 2018.

General requirements for the competence of testing and calibration laboratories, ISO/IEC 17025, Second edition, 2005; Third edition 2017-11

Risk Management – Guidelines, ISO 31000, 2nd Edition 2018-02

CHAPTER 16 – GLOSSARY OF TERMS

Acceptance Criteria - Specified limits placed on characteristics of an item, process, or service defined in requirement documents.

Accreditation - The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy - The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.

Analyst - The designated individual who performs the "hands-on" analytical methods and associated techniques, and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analyte - A substance, organism, physical parameter, property, or chemical constituent(s) for which an environmental sample is being analyzed.

Analyst - The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Sample - Any solution or media introduced into an instrument on which an analysis is performed, excluding QC samples such as: instrument calibration, initial calibration verification, initial calibration blank, continuing calibration verification, and continuing calibration blank.

Assessment - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation).

Audit - A systematic and independent examination of facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

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

A preparation batch is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the abovementioned criteria and with a laboratory specified time frame.

An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples.

Blank (BLK) - A sample of clean matrix that accompanies the samples through different aspects of sampling and/or sample preparation. It is used to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value. There are various types of blanks: equipment blank, field blank, instrument blank, method blank, and reagent blank.

> **Method Blank** - A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Blank Spike - See Laboratory Fortified Blank.

Blind QC Check Samples - Samples whose analyte concentrations are not known to the analyst. That the sample is a QC check sample may or may not be known to the analyst.

Calibration - A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards.

> 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).
>
> 2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Check Standard - See Check Standard.

Calibration Curve - The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.

Calibration Standard - A substance or reference material used for calibration.

Chain of Custody Form - Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. See also Legal Chain of Custody Protocols.

Check Standard - A material of known composition that is analyzed concurrently with test samples to evaluate a measurement process.

Clean Water Act - Public Law PL 92-500. Found at 40 CFR 100-140 and 400-470. The act regulates the discharge of pollutants into surface waters.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) - The enabling legislation (42 USC 9601 - 9675 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 USC 9601 et seq.), to eliminate the health and environmental threats posed by hazardous waste sites.

Confirmation - Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: Second column confirmation, Alternate wavelength, Derivatization, Mass spectral interpretation, Alternative detectors, or Additional cleanup procedures.

Constant Weight - The repeated process of drying, cooling, desiccating, and weighing a sample until readings are ≤4% of the previous weight or does not vary more than ≤0.5mg.

Continuing Calibration Blank (CCB) – A sample of laboratory purified water or matrix similar to calibration standards, in which no analytes of interest are present at concentrations that impact results, measured periodically throughout an analytical run. Evaluates baseline drift, contamination in the analytical system, and analyte carryover.

Continuing Calibration Verification (CCV) - A mid-range calibration standard measured periodically throughout an analytical run that evaluates instrument drift throughout analytical run.

Control Limits - A range within which specified measurement results must fall to be compliant.

Control Standard - See Check Standard.

Corrective Action (CA) - An action taken to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence.

Data Integrity - The condition that exists when data are sound, correct, and complete, and accurately reflect activities and requirements.

Data Reduction - The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more useful form.

Data Quality Objectives (DQO) - An integrated set of specifications that define data quality requirements and the intended use of the data.

Decision Rule – Rule that describes how measurement uncertainty is accounted for when stating conformity with a specific requirement.

Demonstration of Capability - A procedure to establish the ability of the analyst to perform analyses with acceptable accuracy and precision.

Detectability – For radiochemical analysis, detectability as a Lower Limit Detection (LLD) or Minimum Detection Concentration (MDC), is assessed based on the requirements of 40 CFR 141.25(c) and is a sample-specific determination. The equation is specific for each method and noted in the method SOP.

Detection Limit - See Practical Quantitation Limit and Method Detection Limit. Reporting of detection in radiochemistry is based on specific formulas identified in individual procedures. Single

activity point standards are used for efficiency calibration. When required, multiple energy emitters are used for energy calibration.

Document Control - The act of ensuring that documents and revisions 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.

Duplicate (DUP) - A second aliquot of a sample that is treated the same as the original sample to determine the precision of the method.

Duplicate Sample - See Duplicate.

Field of Accreditation - Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Finding - An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement.

Fortified Sample - See Matrix Spike.

Holding Times (Maximum Allowable Holding Times) - The maximum time that can elapse between two (2) specified activities. Sample holding time is based on Date/Time of Collection and Date/Time of the beginning of sample analysis. Time is based on hour/minute by default or by the accreditation requirements for a project. The maximum time is the longest time period that samples may be held prior to analysis and still be considered valid or not compromised.

In-depth Data Monitoring - When used in the context of data integrity activities, a review and evaluation of documentation related to all aspects of the data generation process that includes items such as preparation, equipment, software, calculations, and quality controls. Such monitoring shall determine if the laboratory uses appropriate data handling, data use and data reduction activities to support the laboratory's data integrity policies and procedures.

Internal Standard - A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.

Impartiality - The presence of objectivity which is managed by procedures and processes to avoid conflict of interest, freedom from bias, lack of prejudice, neutrality, fairness, open-mindedness, even handedness, detachment and balance so as not to adversely influence subsequent activities of the laboratory.

Initial Calibration Verification (ICV) - A sample of known concentration, from a source other than that of the calibration standards, analyzed following calibration to demonstrate validity of the calibration and standards used.

Instrument Blank - See Calibration Blank.

Internal Standard – A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, Initial calibration verification (ICV) or QC check sample) - A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Laboratory Control Sample Duplicate (LCSD) - A second laboratory control sample of known concentration and similar matrix as samples. Evaluates overall method accuracy/bias and precision for the batch.

Laboratory Fortified Blank (LFB) – A sample of laboratory purified water or matrix similar to the calibration standards to which a known amount of target analyte(s) is added. Evaluates spiking technique and when prepared from a source independent of the calibration standards can also be used to measure method performance.

Laboratory Inter-comparison Sample - A sample, typically a performance evaluation sample of same or similar composition, analyzed by two or more laboratories in accordance with predetermined conditions. Acceptance criteria are often based statistically on the analysis results.

Laboratory Intra-comparison Sample - A sample, of same or similar composition, analyzed within the same laboratory with predetermined conditions. Sample may be used for evaluation of new instruments or methodology.

Legal Chain of Custody Protocols - Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain of Custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.

Limit of Detection (LOD) - For chemical analysis, the LOD is an estimate of the minimum amount of a substance that an analytical process can reliably detect with 99% confidence. At the LOD the false negative rate (type II error) is 1%. An LOD is analyte and matrix specific and may be laboratory-dependent. Generally, the LOD is assigned as 1-3X of the MDL. See LOD Verification.

Limit of Detection Verification - This is an analysis of a sample spiked with a concentration near the calculated MDL. The spike concentration should be at a level of 1-4 times the calculated MDL for multiple analyte tests and 2-3 times the calculated MDL for single analyte tests. Lower spike concentration may be used if LOD verification criteria are met.

Limit of Quantitation (LOQ) – For chemical analysis, the LOQ is the smallest concentration that produces a quantitative result with known and recorded precision and bias. The LOQ must be equal to or greater than the LOD, and the LOQ shall be set at or above the concentration of the lowest initial calibration standard and within the calibration range. The LOQ is comparable to the PQL (Practical Quantitation Limit) or RL (Reporting Limit) as defined by the laboratory. The lowest LOQ available is the lowest limit of quantitation (LLOQ).

LIMS - Laboratory Information Management System.

Matrix – The substrate of a test sample.

Matrix Duplicate - A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision. (Also see MSD)

Matrix Spike (spiked sample or fortified sample) - A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. Generally, for valid recovery calculations the parameter spike level should be greater than 1-4X of the sample parameter level.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate) - A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Maximum Contaminant Level (MCL) – Regulatory action level for a contaminant of concern.

Measurement System - A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).

Method - A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Method Detection Limit (MDL) - A measure of the limit of detection for an analytical method determined according to the procedure given in 40 CFR Part 136 Appendix B. The MDL is the minimum concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from a zero or blank concentration. At the MDL the false positive rate (Type I error) is 1%.

Method Validation - The confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled (NELAC 2003) (MARLAP 2004 for radiochemical methods).

Metrological Traceability – Property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty.

NELAC - National Environmental Laboratory Accreditation Conference.

NELAP - National Environmental Laboratory Accreditation Program (Now TNI).

National Institute of Standards and Technology (NIST) - A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (NMI). SI is the international metrological traceability term which NIST includes.

NPDES - National Pollutant Discharge Elimination System- A discharge permit system authorized under the Clean Water Act.

Performance Evaluation (PE) Sample - A sample with a composition unknown to the analyst that is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance limits.

Physical Parameter - A measurement of a physical characteristic or property of a sample as distinguished from the concentrations of chemical or biological components.

Practical Quantitation Limit (PQL) – See LOQ definition.

Precision - The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. Preservation - Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis.

Preservation - Refrigeration and/or reagents added at the time of sample collection to maintain the chemical and/or biological integrity of the sample.

Preventative Action – A pro-active process to identify opportunities for improvement rather than a reaction to the identification of problems or complaints.

Proficiency Testing - A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.

Proficiency Testing Program - The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.

Proficiency Testing (PT) Sample - A sample with a composition unknown to the analyst/laboratory which is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.

Protocol - A detailed, written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed.

Quality Assurance (QA) - An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

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Quality Assurance Project Plan (QAPP) - A formal document describing the detailed quality control procedures pertaining to a specific project. For environmental clean-up projects, this is typically produced by an engineering firm with references to include a laboratory's Quality Assurance Manual.

Quality Control (QC) - The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that

measurement systems are maintained within prescribed limits, providing protection against “out of control” conditions and ensuring that the results are of acceptable quality.

Quality Control Sample - A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control.

Quality Manual - A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System - A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities.

Quality System Matrix - These matrix definitions are to be used for purposes of batch and QC requirements:

> **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device.
> **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, ground water effluents, and TCLP or other extracts.
> **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
> **Chemical Waste**: A product or by-product of an industrial process that results in a matrix not previously defined.
> **Drinking Water**: Any aqueous sample that has been designated a potable or potential potable water source.
> **Non-Aqueous Liquid**: Any organic liquid with <15% settleable solids.
> **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.
> **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Raw Data - The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records.

Reference Material - Material or substance, one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Method - A reference method is a published method issued by an organization generally recognized as competent to do so. (When the ISO language refers to a “standard

method", that term is equivalent to "reference method"). When a laboratory is required to analyze an analyte by a specified method due to a regulatory requirement, the analyte/method combination is recognized as a reference method. If there is not a regulatory requirement for the analyte/method combination, the analyte/method combination is recognized as a reference method if it can be analyzed by another reference method of the same matrix and technology.

Reference Standard - Standard used for the calibration of working measurement standards in a given organization or at a given location.

Replicate - See Duplicate.

Reporting Limit (RL) – The lowest level of concentration reported for an analyte.

Resource Conservation and Recovery Act (RCRA) - The enabling legislation under 42 USC 321 et seq. (1976) that gives EPA the authority to control hazardous waste.

Safe Drinking Water Act (SDWA) - The enabling legislation, 42 USC 300f et seq. (1974), which requires the USEPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations.

Sampling - Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Sample (SAMP) - A portion of material to be analyzed.

Selectivity - The ability to analyze, distinguish, and determine a specific analyte from another component that may be a potential interferent or that may behave similarly to the target analyte within the measurement system.

Sensitivity – The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g. concentrations) of a variable of interest.
Spiked Sample – See Matrix Spike.

Standardization - See Calibration.

Standard Operating Procedures (SOPs) - A written document that details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.

Technology - A specific arrangement of analytical instruments, detection systems, and/or preparation techniques

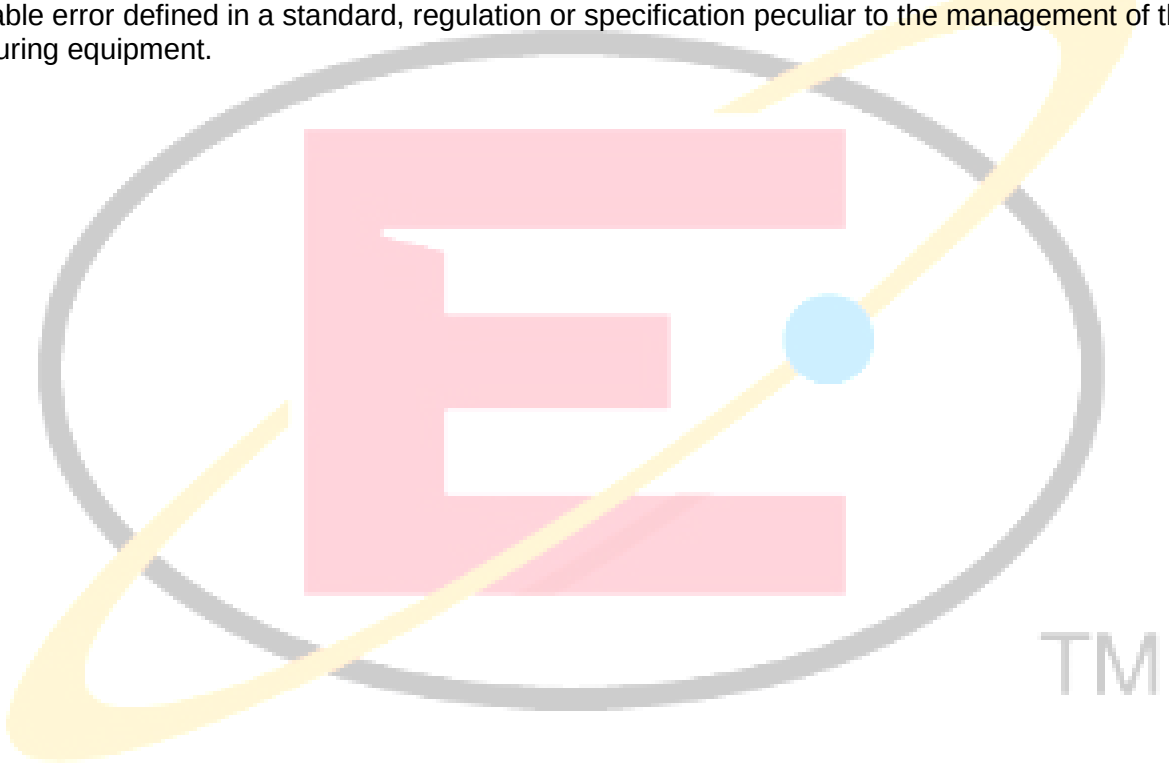
TNI – The NELAC Institute

Traceability - The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.

Trip Blank - One type of Field Blank. An aliquot of analyte-free water or solvent transported to the field in a sealed container and returned to the laboratory with the sample containers.

Validation – The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

Verification - Confirmation by examination and objective evidence that specified requirements have been met. In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.



Acronyms and Abbreviations

AA	-	Accrediting Authority
AB	-	Accrediting Body
ANSI	-	American National Standards Institute
AOAC	-	The Scientific Association Dedicated to Analytical Excellence
APHA	-	American Public Health Association
ASQC	-	American Society for Quality Control
ASTM	-	American Society for Testing and Materials
Bq	-	Becquerel
BLK	-	Blank
Bg	-	Background
°C	-	Degrees Celsius
Cal	-	Calibration
CAS	-	Chemical Abstract Service
CCB	-	Continuing Calibration Blank
CCV	-	Continuing Calibration Verification
COC	-	Chain of Custody
DOC	-	Demonstration of Capability
DO	-	Dissolved Oxygen
DQO	-	Data Quality Objectives
DMRQA	-	NPDES Discharge Monitoring Report Quality Assurance
DUP	-	Duplicate
ELI	-	Energy Laboratories, Inc.
EPA	-	Environmental Protection Agency
FDA	-	Food and Drug Administration
g/L	-	Grams per Liter
GC	-	Gas Chromatography
GC-MS	-	Gas Chromatography-Mass Spectrometry
ICP-AES	-	Inductively Coupled Plasma Atomic Emission Spectrophotometry
ICP-MS	-	Inductively Coupled Plasma-Mass Spectrometry
ICV	-	Initial Calibration Verification
ISO	-	International Organization for Standardization
LCS	-	Laboratory Control Sample
LFB	-	Laboratory Fortified Blank
LIMS	-	Laboratory Information Management System
LLD	-	Low Limit Detection
LOD	-	Limit of Detection
LOQ	-	Limit of Quantitation
MDC	-	Minimum Detection Concentration
MDL	-	Method Detection Limit
MBLK	-	Method Blank
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NEHA	-	National Environmental Health Association
NELAC	-	National Environmental Laboratory Accreditation Conference
NELAP	-	National Environmental Laboratory Accreditation Program
NIOSH	-	National Institute for Occupational Safety and Health
NIST	-	National Institute of Standards and Technology
NPDES	-	National Pollutant Discharge Elimination System
OSHA	-	Occupational Safety and Health Administration
pCi/L	-	Picocuries per Liter
PT	-	Proficiency Testing
QA/QC	-	Quality Assurance / Quality Control
QS	-	Quality Systems

QAM	-	Quality Assurance Manual
QAPP	-	Quality Assurance Project Plan
RDL	-	Required Detection Level
RCRA	-	Resource Conservation and Recovery Act
RL	-	Reporting Limit
RPD	-	Relative Percent Difference
RSD	-	Relative Standard Deviation
SI	-	International System of Units
SOP	-	Standard Operating Procedure
SPK	-	Spike
Std	-	Standard
SVOC	-	Semi-Volatile Organic Compound
TNI	-	The NELAC Institute
ug/L	-	Micrograms Per Liter
UV/VIS	-	Ultraviolet/Visible Spectroscopy
VOC	-	Volatile Organic Compound
WET	-	Whole Effluent Toxicity

APPENDIX A

Laboratory Certifications

DEPARTMENT OF
PUBLIC HEALTH AND HUMAN SERVICES
STATE OF MONTANA

ENVIRONMENTAL LABORATORY

CERTIFIED DRINKING WATER PARAMETERS

ENERGY LABORATORY, INC.
3161 East Lyndale
Helena, MT 59604
CERT0079
Chemistry Expiration 01/01/2021
Microbiology Expiration 01/01/2021

MICROBIOLOGY PARAMETERS

PARAMETER	METHOD
Total Coliforms	SM 9223 B
E. coli	SM 9223 B

ENUMERATION	METHOD
Total Coliforms	SM 9223 B
E. coli	SM 9223 B

INORGANIC PARAMETERS

PARAMETER	METHOD 1	METHOD 2
Aluminum	EPA 200.7	EPA 200.8
Arsenic	EPA 200.8	
Antimony	EPA 200.8	
Barium	EPA 200.7	EPA 200.8
Beryllium	EPA 200.7	EPA 200.8
Cadmium	EPA 200.7	EPA 200.8
Chromium	EPA 200.7	EPA 200.8
Copper	EPA 200.7	EPA 200.8
Nickel	EPA 200.7	EPA 200.8
Lead	EPA 200.8	
Selenium	EPA 200.8	
Thallium	EPA 200.8	
Uranium	EPA 200.8	
Mercury	EPA 200.8	EPA 245.1
Iron	EPA 200.7	EPA 200.8
Manganese	EPA 200.7	EPA 200.8
Silver	EPA 200.7	EPA 200.8
Zinc	EPA 200.7	EPA 200.8
Fluoride	SM 4500-F-C	EPA 300.0
Nitrate	EPA 353.2	EPA 300.0
Nitrite	EPA 353.2	EPA 300.0
Total Dissolved Solids	SM 2540 C	
Turbidity	SM2130B	
Conductivity	SM 2510 B	
Ortho-Phosphate	EPA 365.1	EPA 300.0
pH	SM4500-HB	
Sulfate	EPA 300.0	EPA 300.0
Alkalinity	SM 2320 B	
Chlorate	EPA 300.0	

Chlorate	EPA 300.1	
Chlorite	EPA 300.0	EPA 300.1
Chloride	EPA 300.0	
Bromide	EPA 300.0	
Bromate	EPA 300.0	EPA 300.1

VOLATILE ORGANIC COMPOUNDS

PARAMETER	METHOD
Bromodicloromethane	EPA 524.2
Bromoform	EPA 524.2
Chlorodibromethane	EPA 524.2
Chloroform	EPA 524.2
Total Trihalomethanes	EPA 524.2
1,1,1-Trichloroethane	EPA 524.2
1,1,2-Trichloroethane	EPA 524.2
1,1-Dichloroethylene	EPA 524.2
1,2 Dichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2-Dichloroethane	EPA 524.2
1,2-Dichloropropane	EPA 524.2
1,4-Dichlorobenzene	EPA 524.2
Benzene	EPA 524.2
Carbon Tetrachloride	EPA 524.2
Chlorobenzene	EPA 524.2
cis-1,2-Dichloroethylene	EPA 524.2
Dichloromethane	EPA 524.2
Ethylbenzene	EPA 524.2
Styrene	EPA 524.2
Tetrachloroethylene	EPA 524.2
Toluene	EPA 524.2
trans-1,2-Dichloroethylene	EPA 524.2
Trichloroethylene	EPA 524.2
Vinyl Chloride	EPA 524.2
Xylenes	EPA 524.2
1,1,1,2-Tetrachloroethane	EPA 524.2
1,1,2,2-Tetrachloroethane	EPA 524.2
1,1-Dichloroethane	EPA 524.2
1,1-Dichloropropane	EPA 524.2
1,1-Dichloropropene	EPA 524.2
1,2-Dibromoethane	EPA 524.2
1,2-Dibromo-3-Chloropropane	EPA 524.2
1,2,3-Trichlorobenzene	EPA 524.2
1,2,3-Trichloropane	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2
1,3-Dichloropropane	EPA 524.2
2,2-Dichlorobenzene	EPA 524.2
2,2-Dichloropropane	EPA 524.2
Bromobenzene	EPA 524.2
Bromochloromethane	EPA 524.2
Bromomethane	EPA 524.2
Chloroethane	EPA 524.2
Chloromethane	EPA 524.2
Cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2

Dichlorodifluoromethane	EPA 524.2
Fluorotrichloromethane	EPA 524.2
Hexachlorobutadiene	EPA 524.2
Isopropylbenzene	EPA 524.2
Methyl tert Butyl ether (MTBE)	EPA 524.2
Naphthalene	EPA 524.2
n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2
o-Chlorotoluene	EPA 524.2
p-Chlorotoluene	EPA 524.2
p-Isopropyltoluene	EPA 524.2
sec-Butylbenzene	EPA 524.2
tert-Butylbenzene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2

Montana Department of Public Health and Human Services

Recognizes that

Energy Laboratories - Helena
Helena MT

has completed the requirements for Montana certification and is licensed to analyze Montana's Public Drinking Water Supplies. See attached listing.

Montana Certification Number:	CERT0079

	Chemistry	Microbiology
Expiration Date:	01/01/2021	01/01/2021

Russell Lee

Laboratory Certification Officer
DPHHS Environmental Laboratory

Effective Date: 01/01/2020

APPENDIX B
Quality Assurance / Quality Control Specifications

METHOD QA/QC PARAMETERS
MERCURY ANALYSIS BY COLD VAPOR AA
EPA METHODS 245.1(Rev 3.0, May 1994)/7470A

Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry EPA Method 245.1/ 7470A

QA/QC Parameters

QA Indicator	Frequency	Acceptance Criteria	Corrective Action	Comments
Sample Preparation	All samples digested	Meet method QC Criteria for the matrix	1)Re-analyze the sample 2)Re-digest the sample/batch	
Instrument Calibration	Daily, after maintenance or as needed.	$R^2 \geq 0.995$	1) Recalibrate 2) Prepare fresh standards and recalibrate 3) Assess possible causes for failing calibration and adjust method if necessary.	At least 4-point calibration including blank. Calibration standards are not required to be digested by 245.1.
Initial Calibration Verification (ICV)	Immediately following calibration	R% = 90-110	1) Prepare fresh ICV, Reanalyze 2) Prepare fresh standards/ICV, 3) Recalibrate and reanalyze.	Evaluates accuracy/bias in calibration standards. Must be a second source standard. Functions as QCS per 245.1
Method Blank (MBLK)	1/preparation batch	Larger of ±1 * lowest reporting limit or 2.2 X MDL (245.1) < RL (7470)	11) Re-analyze MBLK 2) Re-digest samples from batch which fail acceptance criteria or flag and report data. 3) Test-re-prep all reagents for contamination.	Evaluates overall method including possible contamination in reagents and glassware utilized in preparatory batch. Functions as LRB per 245.1
Continuing Calibration Verification 1 (CCV1)	Initial CCV, immediately ran after ICV, once per calibration.	%R= 95-105% (245.1) % R=90-110% (7470)	1.) Reanalyze CCV1 2.) Recalibrate	Establishes the ability to generate precision and recovery. Named IPR in Cetac software.
Continuing Calibration Verification (CCV)	Analyzed after every 10 analytical samples and at end of run.	R%= 90-110%	1) Reanalyze CCV 2) Recalibrate and rerun all samples since last passing CCV.	Evaluates instrument drift throughout analytical sequence. Functions as IPC per 245.1
Continuing Calibration Blank (CCB)	Run every 10 analytical samples, run immediately after CCV.	Larger of ±1 * RL or 2.2 X MDL (245.1) < RL (7470)	1) Check for high concentration sample 2) Rinse and Reanalyze CCB 3) Reanalyze samples since last passing CCB	Evaluates baseline drift, contamination in the analytical system, and analyte carryover.

Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry EPA Method 245.1/ 7470A **QA/QC Parameters**				
QA Indicator	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Comments**
Laboratory Control Sample (LCS)	1/preparation batch	90-110% (245.1-LL) 85-115% (245.1) 80-120% (7470)	1) Re-pour or re-inject. 2) Re-digest/re-prepare all QC and samples since last valid CCV 3) Recalibrate.	Evaluates overall method accuracy/bias for the Preparatory Batch. Must be second source. If prepared the same as MS/MSD will evaluate the spiking technique.
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	Minimum 1/10 samples (245.1) 1/20 samples (7470)	%R=70-130% RPD <30% (245.1) %R=75-125% RPD <20% (7470)	LCS/LFB/ICV must be passing. 1) If matrix interference suspected report as found, or 2) Re-analyze and re-spike if no matrix interference suspected, or 3) Use "A" qualifier for sample amount > 4X spike level.	Evaluates effect of matrix on method performance Functions as LFM per 245.1
Sample Dilution (SD)	Every spiked parent sample (7470)	<10% RPD	1) Remake and rerun. 2) Evaluate concentration level. 3) Report qualified data.	Evaluates for an interference with spiked samples.
MDL	**Initial MDL:** <u>Samples:</u> Analyze at least 7 MDL samples over at least 3 calendar days. <u>Study:</u> Initial study required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing MDL:** <u>Samples:</u> Analyze at least 2 ongoing MDL spikes for each quarter samples are analyzed. <u>Study:</u> Annually, recalculate MDL spike and MDL blank from overall historical data.	MDL Samples: All results are quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). MDL Studies: MDL = whichever is higher of MDL spike or MDL blank. < PQL	1) If the result for any individual analyte from the MDL spiked samples does not meet the method qualitative criteria or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. 2) Repeat initial MDL spike and MDL blank study or adjust reporting limit to > 2X of calculated MDL.	Per CFR Part 136 The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.

Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry EPA Method 245.1/ 7470A **QA/QC Parameters**				
QA Indicator	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Comments**
LOD Verification	Annually, immediately following MDL Study.	Positive Result above signal-to-noise	1) Examine method or preparatory steps, 2) Verify MDL study, 3) Repeat analysis.	Spike at 1-3X calculated MDL for single analyte test.
LOQ Verification	**Initial LOQ:** Samples: Analyze at least 7 LOQ samples over at least 3 calendar days. Verification: Initial verification required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing LOQ:** Samples: Analyze at least 1 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, verify that acceptance criteria is met.	LOQ Sample: Quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). % Rec = Statistical or set LOQ Verification: > Calculated MDL	1) Correct method or instrument performance and repeat the verification. 2) Evaluate and correct established statistical acceptance criteria. 3) Adjust reporting limit.	**If MDL samples meet the LOQ acceptance criteria, the MDL samples can be used as LOQ Samples.**
Linear Dynamic Range (LDR)	Annually, or whenever method changes might affect sensitivity	Calculated standard values within 10% of expected.	1) Repeat 2) Correct problem 3) Adjust upper calibration limit	Used to determine upper linear range for instrument.
Control Charting	Annual statistical review of method.	Data statistically within control limits.	1) Trend Analysis/ Method Review 2) Correct method/instrument problem 3) Replace analyst.	For statistical process control.

Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry EPA Method 245.1/ 7470A **QA/QC Parameters**				
QA Indicator	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Comments**
Demonstration of Capability (DOC)	Initially for each new analyst, annually thereafter	4 passing LCS (or other second source QC), passing PT study results, or qualifying statement from supervisor. Method requirements for initial DOCs and ongoing DOCs must be met.	1) Provide additional training 2) Replace analyst.	Demonstrates proficiency to perform the method and obtain acceptable results for each analyst.
External PE Samples	Semiannual WS and/or WP sample	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies)	1) Complete corrective action report 2) Repeat with make-up study (for failure of 2 out of 3)	External review of analytical method accuracy. Commonly RTC studies.
Batch Definition	20 analytical samples.	Pass method QC criteria specified above	Re-analyze batch or qualify results.	A group of samples and associated QC.

METHOD QA/QC PARAMETERS
ANALYSIS OF SAMPLES FOR MERCURY IN SOLID OR SEMISOLID WASTE
EPA METHOD 7471B

QA Indicator	Frequency	Acceptance Criteria	Corrective Action	Comments
Instrument Calibration	Daily or as needed. Multi-point calibration and blank.	$R^2 \geq 0.995$	1) Recalibrate 2) Prepare fresh standards and recalibrate 3) Assess possible causes for failing calibration and adjust method if necessary.	Calibration of instrument. Calibration validity tested by ICV and MBLK
Initial Calibration Verification (ICV)	Following calibration. Second source standard	R% = 90-110	1) Prepare fresh ICV, reanalyze 2) Prepare fresh standards/ICV, recalibrate and reanalyze.	Evaluates accuracy/bias in calibration standards
Method Blank (MBLK)	1/preparation batch	< Reporting limit	1) Prepare fresh blank, reanalyze 2) Recalibrate and reanalyze	Evaluates Instrument calibration, reagent contamination, and instrument carryover
Continuing Calibration Verification (CCV)	Analyzed immediately after calibration and after every 10 samples.	R%= 90-110%	1) Reanalyze CCV 2) Recalibrate and rerun all samples since last passing CCV.	Evaluates instrument calibration drift
Continuing Calibration Blank (CCB)	Run every 10 samples, run immediately after,CCV.	< Reporting limit	1) Check for high concentration sample 2) Rinse and Reanalyze CCB 3) Reanalyze samples since last passing CCB	Measure analyte carryover in instrument and also evaluates possible contamination in reagents and glassware
Laboratory Control Sample (LCS)	1/preparation batch	R%=71-126.4% (manufacturer specified limits)	1) Repeat analysis 2) Re-extract and re-analyze all samples associated with LCS	Evaluates overall method accuracy/bias for the preparatory batch
Laboratory Fortified Blank (LFB)	1/preparation batch	R%=80-120%	1) Repeat analysis 2) Re-extract and re-analyze all samples associated w/LFB	Evaluates analyte spike recovery in a clean matrix
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	Minimum 1/10 samples	R%=80-120% <20% RPD	1) Rerun spike 2) Evaluate lab fortified blank performance	Evaluates effect of matrix on method performance. If the spike is not in compliance, it may be attributed to matrix interference.
Sample Dilution (SD)	Every spiked parent sample	<10% RPD	1) Remake and rerun.	Evaluates for an interference with spiked samples.
LOD Verification	Annually per method requirement or whenever method changes might affect sensitivity	Positive Result	1) Examine method or preparatory steps, 2) Verify MDL study, 3) Repeat analysis.	Spike at 1-3X calculated MDL for single analyte test.
Control Charting and Proof of Competency	Annual statistical review of method. QC data for each analyst or as needed: MDL, PE samples.	Data statistically within control limits.	1) Correct method/instrument problem. 2) QA Audit method 3) Replace analyst	For statistical process control.
External PE Samples	Semiannual WP sample	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies)	1) Complete corrective action report 2) Repeat with another make-up study (for failure of 2 out of 3)	External review of analytical method accuracy. Commonly RTC studies.

MDL Studies Per CFR Part 136	Initial study required for new method and whenever method changes might reasonably be expected to affect sensitivity. Quarterly generate 2 ongoing MDL spikes for every quarter samples are analyzed. Recalculate MDL spike and MDL blank annually. MDL=highest value from MDL spike or MDL Blank.	MDL<PQL	1) If result for any analyte from the MDL spiked samples does not meet the method qualitative criteria, or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. 2) Perform instrument maintenance or new initial calibration.	The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.

METHOD QA/QC PARAMETERS

DETERMINATION OF METALS AND TRACE ELEMENTS IN WATER AND WASTES BY INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY (ICP) EPA METHOD 200.7/6010B

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Sample Preparation	Waters: Dissolved metals analyze direct.; Acid soluble metals analyze direct Drinking Waters: Check turbidity – turbidity <1 analyze direct; turbidity >1 digest per 200.2 method Total and Total Recoverable waters: 200.2 digestion 6010 Total and Total Recoverable waters: 3010A digestion Soils: Mine Soil: Specified Extraction Waste Soils: 3050B Digestion	Meet method QC criteria for the matrix.	1) Re-analyze sample. 2) Re-prepare sample/batch.	If a dissolved sample contains sediment or the turbidity is >1 NTU the client may choose to have the sample prepared by 200.2 , re-filter an unpreserved sample portion in the lab or analyze as received
Instrument Calibration (IC)	Daily, after maintenance or when needed due to peak shifts or QC failures.	If used, multipoint calibration must have correlation coefficient =0.995 or better.	1) Recalibrate.	Calibration validity tested by ICV, ICB. 1-point calibration and a blank.
Initial Calibration Verification (ICV)	Daily. Immediately follows calibration.	6010B R% =90-110 200.7 R%=95-105	1) Recalibrate and rerun. 2) Prepare fresh standards and/or ICV.	Evaluates accuracy of calibration standards. Must be prepared from second source standard.
Initial Calibration Blank (ICB)	Daily. Analyze at beginning of run.	< Reporting Limit	1) Re-pour blanks, recalibrate, and rerun. 2) Prepare fresh blank.	Evaluates instrument calibration, reagent contamination, and instrument carryover.
Low Level Calibration Verification (LLRV)	Analyzed at beginning of run.	R% = 50-150 (200.7) R% = 80-120 for Be & Cd (200.7) R% = 80-120 for 6010	1) Limits are advisory	Verifies instrument ability to detect/quantitate analytes near the reporting limit. Internal QC tracking purposes. Count as sample for CCVs.

Interference Check Sample "A" (ICSA)	Analyzed at beginning of run.	R% = 80-120 for interferents ± 2* reporting limit for analytes	1) Evaluate sample data. Results near reporting limit suspect if failing. 2) Rerun samples as needed.	Evaluates spectral interference correction factors. Count as sample for CCVs.
Interference Check Sample "AB" (ICSAB)	Analyzed at beginning of run.	R% = 80-120 for all elements	1) Re-determine IECs if failures persist. 2) Rerun samples as needed.	Evaluates spectral interference correction factors. Count as sample for CCVs.
Continuing Calibration Verification (CCV)	Analyzed at beginning of run, every 10 samples and at end of run.	200.7: R%=95-105 Immediately after Initial Calibration 90-110 for on-going and ending 6010B: R% = 90-110	1) Recalibrate and rerun samples since last valid CCV. 2) Check for sample matrix problem.	Evaluates instrument drift throughout analytical sequence. Same source standard.
Continuing Calibration Blank (CCB)	Analyzed at the same frequency as the CCV, typically analyzed after every CCV.	< Reporting Limit	1) Check for high concentration sample carryover 2) Re-analyze CCB. 3) Re-analyze samples as needed.	Evaluates baseline drift, contamination in the analytical system, and analyte carryover.
Analytical Spike Sample (MS2/MSD2) (Direct water samples and samples prepared in the soil dept.)	200.7: Minimum 1/10 samples 6010B: Minimum 1/20 samples	200.7: R% = 70-130 6010B: R% = 75-125 % RPD ≤ 20%	1) Evaluate LFB performance. 2) Report spike as analyzed if LFB is acceptable. 3) Reprep and reanalyze samples. 4) Use "A" qualifier for sample amount > 4X spike level.	Evaluates effect of matrix on method performance. MSD also evaluates method precision.
Serial Dilution Sample (SD or dil)	When new matrix is encountered, 1 per batch, or 1 per 20 samples	RPD = 10% for analytes greater than 50 * PQL	1) Rerun samples. 2) Run samples on dilution.	Used for screening analyses evaluating new matrices. N Qualifier indicates analyte concentration not sufficiently high to calculate a RPD for the serial dilution test.
Method Blank (MBLK)	Direct: 1/ analytical run Digested: 1 /batch	< Reporting Limit	1) Re-analyze MBLK. 2) Re-digest samples from batch which fail acceptance criteria or flag and report data.	Evaluates possible contamination in reagents and glassware.
Laboratory Fortified Blank (LFB)	Direct:1/analytical run or Digested1 /batch for 3050 samples and soil department extracts	Direct R%=85-115 3050 R%=80-120 Soils R%=80-120	1) Re-analyze. 2) Re-digest sample batch or flag data.	Evaluates preparation method accuracy. If prepared the same as MS/MSD will evaluate the spiking technique.

Laboratory Control Sample (LCS)	1/ batch	Waters: 85-115% Solid/soils: Within established acceptance ranges.	1) Re-analyze LCS. 2) Re-digest sample batch or flag data.	Evaluates overall method accuracy/bias for the Preparatory Batch. Must be second source.
Pre-digestion Spike Sample (MS3/MSD3) (200.2 and 3010 preps)	Minimum 1/10	R% = 200.7: 70 - 130 6010B: 75 - 125 % RPD ≤ 20%	1) See LCS performance. 2) Report spike as analyzed if LCS is acceptable. 3) Reprep and reanalyze. 4) Use "A" qualifier for sample amount > 4X spike level.	Evaluates effect of matrix on method performance. MSD also evaluates method precision.
Post Digestion Spike (PDS/PDSD)	1/20 samples for 6010B or 1/batch	R%= 6010B: 75-125	LFB/LCS must be passing 1) If matrix interference suspected report as found, 2) Re-analyze and re-spike if no matrix interference suspectedor 3) Use "A" qualifier for sample amount > 4X spike level.	Evaluates effect of matrix on method performance. Use the same solution and concentration as LFB/LCS.
Internal Standards (IS)	All samples & QC	70-130% Advisory Limits Only	1) Evaluate data for sample matrix affects	Quantitation using Internal Standards improves method accuracy. IS recoveries can be affected by sample matrix.
IDL Studies	Annually	Prior Studies	1) Repeat if obvious problem occurs.	Evaluates overall instrument detection limits in clean sample matrix.

MDL	**Initial MDL:** Samples: Analyze at least 7 MDL samples over at least 3 calendar days. Study: Initial study required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing MDL:** Samples: Analyze at least 2 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, recalculate MDL spike and MDL blank from overall historical data.	MDL Samples: All results are quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). MDL Studies: MDL = whichever is higher of MDL spike or MDL blank. < PQL	1) If the result for any individual analyte from the MDL spiked samples does not meet the method qualitative criteria or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. 2) Repeat initial MDL spike and MDL blank study or adjust reporting limit to > 2X of calculated MDL.	Per CFR Part 136 The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.
LOD Verification	Whenever a new MDL study is performed.	Positive Result Above signal–to-noise	***1) Examine method or preparatory steps,*** ***2) Verify MDL study,*** ***3) Repeat analysis.***	Spike at 1-4X MDL for multiple analyte tests. Required for each analyte/ method to verify calculated MDL.
LOQ Verification	**Initial LOQ:** Samples: Analyze at least 7 LOQ samples over at least 3 calendar days. Verification: Initial verification required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing LOQ:** Samples: Analyze at least 1 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, verify that acceptance criteria is met.	LOQ Sample: Quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). % Rec = Statistical or set LOQ Verification: > Calculated MDL	1) Correct method or instrument performance and repeat the verification. 2) Evaluate and correct established statistical acceptance criteria. 3) Adjust reporting limit.	**If MDL samples meet the LOQ acceptance criteria, the MDL samples can be used as LOQ Samples.**
Inter-Element Correction Factor Studies	Annually, or whenever instrument changes might affect inter-element effects. Verified every 6 months.	Comparison to historical data.	1) Repeat. 2) Correct problem.	Correction factors to account for spectral overlap between differing elements.
Upper Linear Range Studies	Annually, or whenever method changes might affect sensitivity.	Comparison to historical data.	1) Repeat. 2) Correct problem. 3) Adjust upper calibration limit.	Used to determine upper linear range for instrument.

External PE Samples	WS and WP and internal blind samples	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies)	1) Complete corrective action report 2) Repeat with another make-up study (for failure of 2 out of 3)	External review of analytical method accuracy.
Batch	Direct: Each daily analytical sequence. Prepped Samples :Each batch of samples/matrix or when there is a change of reagents, whichever is more frequent.	Must pass all method QC criteria	1) Reanalyze batch or qualify results	A group of samples and associated QC
Control Charting	Annual statistical review of method.	Data statistically within control limits.	1) Trend Analysis/ Method Review 2) Correct method/instrument problem. 3) Replace analyst.	For statistical process control.
Demonstration of Capability (DOC)	Initially for each new analyst, annually thereafter	4 passing LCS (or other second source QC), passing PT study results, or qualifying statement from supervisor. Method requirements for initial DOCs and ongoing DOCs must be met .	1) Provide additional training 2) Replace analyst.	Demonstrates proficiency to perform the method and obtain acceptable results for each analyst.

QAQC PARAMETERS
METHOD SW-846 6010D:

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Batch Definition	Each daily analytical sequence for direct samples. Prepped samples: Each batch of 20 samples/matrix, or when there is a change of reagents, whichever is more frequent.	Must pass all method QC criteria.	Reanalyze batch, re-prepare samples, or qualify results.	A group of samples and associated QC.
Sample Preparation	Dissolved Waters: Analyze direct. Total Waters: 3010 Digestion. TCLP extracts: 3010 Digestion. Soils: 3050 Digestion.	Meet method QC criteria for the matrix.	1) Reanalyze sample. 2) Re-prepare sample/batch.	
Instrument Calibration (IC)	Daily, or when needed. Minimum 1-point calibration and blank.	If used, multipoint calibration must have correlation coefficient r ≥ 0.995	See QC Samples.	Calibration of Instrument. Calibration validity tested by ICV, ICB.
Initial Calibration Verification (ICV)	Immediately follows calibration. Second source standard used.	%R =90-110	1) Determine cause. 2) Recalibrate and rerun. 3) Prepare fresh standards and/or ICV.	Evaluates accuracy of calibration standards.
Initial Calibration Blank verification sample (ICB)	Analyzed at beginning of run.	±0.5 * LLOQ	1) Re-pour blanks, recalibrate, and rerun. 2) Prepare fresh blank.	Evaluates instrument calibration, reagent contamination, and instrument carryover.
Low Level Read-back Verification (LLRV)	Analyzed at beginning of run.	%R = 80-120	1) Determine cause. 2) Recalibrate and rerun affected samples. 3) Prepare fresh standards and/or LLRV.	Verifies Instrument ability to quantitate analytes near the reporting limit.
Interference Check Sample "A" (ICSA)	Analyzed at beginning of run.	Within ± LLOQ of true for analytes except for Al, Ca, Fe, Mg.	1) Raise reporting limit (LLOQ) for failing elements as needed. 2) Rerun samples as needed.	Evaluates spectral interference correction factors.
Upper Linear Range Standard	Daily. Only one higher standard is necessary and may be analyzed anywhere within the run.	%R = 90-110	1) Repeat. 2) Correct problem. 3) Adjust upper calibration limit to the highest calibration standard.	Used to determine upper linear range for instrument.
Continuing Calibration Verification (CCV)	Analyzed at beginning of run, every 10 samples and at end of run. Same source standard.	%R = 90-110	1) Recalibrate and rerun samples since last valid CCV. 2) Check for sample matrix problem.	Evaluates Instrument calibration drift.

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Continuing Calibration Blank (CCB)	Analyzed after every CCV.	1) ± 1*LLOQ or lowest reporting limit.	1) Check for high concentration sample carryover. 2) Reanalyze CCB. 3) Reanalyze samples as needed.	Measures instrument drift and/or analyte carryover.
Method Blank (MBLK) /Laboratory Reagent Blank (LRB)	1 per analytical run for direct samples, or 1 per digestion batch.	MB ±0.5*LLOQ or < 10% lowest sample	1) Reanalyze LRB/MBLK. 2) Redigest samples from batch which fail acceptance criteria or flag and report data.	Evaluates possible contamination in reagents and glassware.
Laboratory Fortified Blank (LFB) /Laboratory Control Sample (LCS)	1 per analytical run for direct samples, or 1 per digestion batch.	%R = 80-120	1) Reanalyze LFB/LCS. 2) Redigest sample batch or flag data.	Evaluates preparation method accuracy.
Standard Reference Material (Soil / Oil) (SRM)	Prepared and analyzed 1 per prep batch for applicable matrices.	Within SRM-established acceptance ranges.	1) Reanalyze SRM. 2) Redigest affected samples. 3) Evaluate prep method.	Evaluates preparation method accuracy. May be used as LCS for applicable matrices and prep methods.
Matrix Spike Sample (MS)	Minimum 1/20 samples or 1 per digestion batch.	%R = 75-125	1) Evaluate LCS/LFB performance. 2) Report spike as analyzed if LCS/LFB is acceptable.	Evaluates effect of matrix on method performance. Results not evaluated when sample analyte concentration > 4X spike level.
Matrix Spike Duplicate (MSD), or Analytical Duplicate Sample	Minimum 1/20 samples or 1 per digestion batch. May run Duplicate instead.	%R = 75-125 Larger of 3 * LLOQ or 20% RPD	1) See LCS/LFB performance. 2) Report spike as analyzed if LCS/LFB is acceptable.	Measures method precision/sample homogeneity.
Duplicate Sample (DUP)	May be run instead of MSD.	Larger of 3 * LLOQ or 20% RPD	1) Rerun samples 2) Report data with qualifier.	Measures method precision/sample homogeneity.
Serial Dilution Sample (DIL or SD)	1 per batch or 1 per 20 samples	%R = 80-120 for analytes greater than 25 * LLOQ	1) Report results as "estimated" 2) Rerun samples. 3) Run samples on dilution.	Used for evaluating matrix when MS fails.
Post Digestion Spike (PDS)	1 per batch or 1 per 20 samples	%R = 75-125	1) Report results as "estimated" 2) Rerun samples. 3) Run samples on dilution.	Used for evaluating matrix when MS fails. Results not evaluated when sample analyte concentration > 4X spike level.
Internal Standards (IS), when used.	All sample & QC in sequence.	50-150% Recovery Advisory Limits	1) Evaluate data for sample matrix affects	Quantitation using Internal Standards improves method accuracy. IS recoveries can be affected by sample matrix.

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
LLOQ Study	Performed initially to verify LLOQ for each instrument and preparation method. Prepare and analyze 7 replicate samples. Quarterly after initial study	Average %R =65-135 RSD ≤ 20%	1) Repeat if obvious problem occurs. 2) Adjust reporting limit to passing LLOQ.	Evaluates overall method detection limits in clean sample matrix. Actual samples may have higher MDL.
LLOQ Verification	Quarterly, after initial study.	%R 65-135	1) Re-prepare and rerun. 2) Adjust reporting limit and repeat LLOQ Study to confirm.	Can be control charted to verify ongoing LLOQ.
LOD Verification	Annually for each instrument and preparation method to verify detection limit.	Positive result above signal-to-noise.	1) Examine method or preparatory steps. 3) Repeat analysis.	Spike at 1-4 X reported detection limit.
Inter-Element Correction Factor Studies	Every 6 months.	Comparison to historical data.	1) Repeat. 2) Correct problem.	Correction factors to account for spectral overlap between differing elements.
External PE Samples	WS and WP, LPTP (soil) and internal blind samples	EPA/PE Provider-defined control limits.	1) Repeat. 2) Correct problem.	External review of analytical method accuracy.

QA/QC METHOD PARAMETERS
METHOD SW-846 6020B:

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Batch Definition	Each daily analytical sequence for direct samples. Prepped samples: Each batch of 20 samples/matrix, or when there is a change of reagents, whichever is more frequent.	Must pass all method QC criteria.	Reanalyze batch, re-prepare samples, or qualify results.	A group of samples and associated QC.
Sample Preparation	Dissolved Waters: Analyze direct. Total Waters: 3010 Digestion. TCLP extracts: 3010 Digestion. Soils: 3050 Digestion.	Meet method QC criteria for the matrix.	1) Reanalyze sample. 2) Re-prepare sample/batch.	
Instrument Calibration (IC)	Daily, or when needed. Minimum 1-point calibration and blank.	If used, multipoint calibration must have correlation coefficient r ≥ 0.995	See QC Samples.	Calibration of Instrument. Calibration validity tested by ICV, ICB.
Initial Calibration Verification (ICV)	Immediately follows calibration. Second source standard used.	%R =90-110	1) Determine cause. 2) Recalibrate and rerun. 3) Prepare fresh standards and/or ICV.	Evaluates accuracy of calibration standards.
Initial Calibration Blank verification sample (ICB)	Analyzed at beginning of run.	±0.5 * LLOQ	1) Re-pour blanks, recalibrate, and rerun. 2) Prepare fresh blank.	Evaluates instrument calibration, reagent contamination, and instrument carryover.
Low Level Read-back Verification (LLRV)	Analyzed at beginning of run.	%R = 80-120	1) Determine cause. 2) Recalibrate and rerun affected samples. 3) Prepare fresh standards and/or LLRV.	Verifies Instrument ability to quantitate analytes near the reporting limit.
Interference Check Sample “A” (ICSA)	Analyzed at beginning of runand every 12 hours.	Within ± 2 * LLOQ of true for analytes except for matrix elements present.	1) Raise reporting limit (LLOQ) for failing elements as needed. 2) Rerun samples as needed.	Evaluates matrix effects and elemental equations.
Upper Linear Range Standard	Daily. Only one higher standard is necessary and may be analyzed anywhere within the run.	%R = 90-110	1) Repeat. 2) Correct problem. 3) Adjust upper calibration limit to the highest calibration standard.	Used to determine upper linear range for instrument.
Continuing Calibration Verification (CCV)	Analyzed at beginning of run, every 10 samples and at end of run. Same source standard.	%R = 90-110	1) Recalibrate and rerun samples since last valid CCV. 2) Check for sample matrix problem.	Evaluates Instrument calibration drift.

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Continuing Calibration Blank (CCB)	Analyzed after every CCV.	1) ± 1*LLOQ or lowest reporting limit.	1) Check for high concentration sample carryover. 2) Reanalyze CCB. 3) Reanalyze samples as needed.	Measures instrument drift and/or analyte carryover.
Method Blank (MBLK) /Laboratory Reagent Blank (LRB)	1 per analytical run for direct samples, or 1 per digestion batch.	MB ±0.5*LLOQ or < 10% lowest sample	1) Reanalyze LRB/MBLK. 2) Redigest samples from batch which fail acceptance criteria or flag and report data.	Evaluates possible contamination in reagents and glassware.
Laboratory Fortified Blank (LFB) /Laboratory Control Sample (LCS)	1 per analytical run for direct samples, or 1 per digestion batch.	%R = 80-120	1) Reanalyze LFB/LCS 2) Redigest sample batch or flag data.	Evaluates preparation method accuracy.
Standard Reference Material (Soil / Oil) (SRM)	Prepared and analyzed 1 per prep batch for applicable matrices.	Within SRM-established acceptance ranges.	1) Reanalyze SRM. 2) Redigest affected samples. 3) Evaluate prep method.	Evaluates preparation method accuracy. May be used as LCS for applicable matrices and prep methods.
Matrix Spike Sample (MS)	Minimum 1/20 samples or 1 per digestion batch.	%R = 75-125	1) Evaluate LCS/LFB performance. 2) Report spike as analyzed if LCS/LFB is acceptable.	Evaluates effect of matrix on method performance. Results not evaluated when sample analyte concentration > 4X spike level.
Matrix Spike Duplicate (MSD), or Analytical Duplicate Sample	Minimum 1/20 samples or 1 per digestion batch. May run Duplicate instead.	%R = 75-125 Larger of 3 * LLOQ or 20% RPD	1) See LCS/LFB performance. 2) Report spike as analyzed if LCS/LFB is acceptable.	Measures method precision/sample homogeneity.
Duplicate Sample (DUP)	May be run instead of MSD.	Larger of 3 * LLOQ or 20% RPD	1) Rerun samples 2) Report data with qualifier.	Measures method precision/sample homogeneity.
Serial Dilution Sample (DIL or SD)	1 per batch or 1 per 20 samples	%R = 80-120 for analytes greater than 25 * LLOQ	1) Report results as "estimated" 2) Rerun samples. 3) Run samples on dilution.	Used for evaluating matrix when MS fails.
Post Digestion Spike (PDS)	1 per batch or 1 per 20 samples.	%R = 75-125	1) Report results as "estimated" 2) Rerun samples. 3) Run samples on dilution.	Used for evaluating matrix when MS fails. Results not evaluated when sample analyte concentration > 4X spike level.

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Internal Standards (IS).	All sample & QC in sequence.	30-125% Recovery	1) Evaluate data for sample matrix affects	Quantitation using Internal Standards improves method accuracy. IS recoveries can be affected by sample matrix.
LLOQ Study	Performed initially to verify LLOQ for each instrument and preparation method. Prepare and analyze 7 replicate samples. Quarterly after initial study	Average %R =65-135 RSD ≤ 20%	1) Repeat if obvious problem occurs. 2) Adjust reporting limit to passing LLOQ.	Evaluates overall method detection limits in clean sample matrix. Actual samples may have higher MDL.
LLOQ Verification	Quarterly, after initial study.	%R 65-135	1) Re-prepare and rerun. 2) Adjust reporting limit and repeat LLOQ Study to confirm.	Can be control charted to verify ongoing LLOQ.
LOD Verification	Annually for each instrument and preparation method to verify detection limit.	Positive result above signal-to-noise.	1) Examine method or preparatory steps. 3) Repeat analysis.	Spike at 1-4 X reported detection limit.
External PE Samples	WS and WP, LPTP (soil) and internal blind samples	EPA/PE Provider-defined control limits.	1) Repeat. 2) Correct problem.	External review of analytical method accuracy.

Attachment 17.5
QA/QC Method Parameters
INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP/MS)
EPA METHOD 200.8

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Sample Preparation	**Dissolved Waters**: analyze direct **Drinking Waters**: Turbidity <1 analyze direct Turbidity >1 digest using 200.2 **Total/Total Recoverable** samples: digest using 200.2 **Acid Soluble:** analyze direct; avoid inverting. **Sediments:** analyze by 200.2-S **Total $HClO_4$/HF Soils:** analyze by total digestion **ASA13-3.** After prep, dilute samples accordingly.	Meet method QC criteria for the matrix.	1) Re-analyze sample. 2) Re-prepare sample/batch	
Instrument Calibration	Daily, after maintenance or when needed due to QC failures. Minimum of 3-point calibration and blank.	Calibration correlation coefficient must be =0.995 or better	1) Check calibration graphs. 2) Prepare new standards. 3) Recalibrate.	Establishes calibration curve over a range of concentrations to quantify analytes of interest.
Initial Calibration Verification/Quality Control Sample (ICV)	Immediately follows calibration.	R% =90-110	1) Recalibrate and rerun. 2) Prepare fresh standards and/or ICV. 3) Instrument Maintenance	Evaluates calibration accuracy and method performance. Must be prepared from second source standard.
Interference Check Sample "A" (ICSA)	Analyzed at beginning of run and every 12 hours.	R% = 70-130 for Interferents & IS recoveries must be 80-120.	1) Evaluate process of interference correction. 2) Rerun. 3) Evaluate sample data to determine if results may be suspect.	Evaluates matrix effects and interference correction processes.
Interference Check Sample "AB" (ICSAB)	Analyzed at beginning of run and every 12 hours during run	R% = 70-130 for interferents and analytes; IS recoveries must be 80-120%.	1) Evaluate process of interference correction. 2) Rerun. 3) Evaluate sample data to determine if results may be suspect.	Evaluates matrix effects and interference correction processes.
Continuing Calibration Verification (CCV)	After each calibration, every 10 analytical samples and at end of run.	R% = 90-110	1) Check for sample matrix problem. 2) Recalibrate and rerun samples since last valid CCV.	Evaluates instrument drift throughout analytical sequence.
Continuing Calibration Blank (CCB)	Run after every CCV.	≤ 2.2 X MDL or less than 10% of the analyte level determined for a sample	1) Check for high concentration sample. 2) Reanalyze CCB. 3) Reanalyze affected samples.	Evaluates baseline drift, contamination in the analytical system, and analyte carryover.
Laboratory Reagent Blank (LRB)	1/analytical run for direct samples	≤ 2.2 X MDL or less than 10% of the analyte level determined for a sample	1) Re-pour blanks 2) Recalibrate and rerun. 2) Prepare fresh blank	Evaluates instrument calibration, reagent contamination, and instrument carryover.

Attachment 17.5
QA/QC Method Parameters
INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP/MS)
EPA METHOD 200.8

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Laboratory Fortified Blank (LFB)	Direct: 1 per analytical run Digested: 1 per batch	R% = 85-115	1) Check LRB performance 2) Re-analyze LFB 3) Recalibrate	Evaluates method preparation accuracy. If prepared the same as MS/MSD will evaluate the spiking technique.
Analytical Matrix Spike Sample (MS) (Post-extraction spike for digested soils)	Minimum 1/10 direct samples or 1/10 soil digest samples	R% = 70-130	LFB/ICV must be passing 1) If matrix interference suspected report as found, or 2) Re-analyze and re-spike if no matrix interference suspected, or 3) Use "A" qualifier for sample amount > 4X spike level.	Evaluates effect of matrix on method performance.
Analytical Spike Duplicate (MSD)	Minimum 1/10 samples for each direct analysis	20% RPD R% = 70-130	LFB/ICV must be passing 1) If matrix interference suspected report as found, or 2) Re-analyze and re-spike if no matrix interference suspected, or 3) Use "A" qualifier for sample amount > 4X spike level.	Measures method precision/sample homogeneity.
Method Blank (MB)	1/preparation batch	≤ 2.2 X MDL or less than 10% of the analyte level determined for a sample	1) Re-analyze MBLK. 2) Re-digest samples from batch which fail acceptance criteria or flag and report data.	Evaluate possible preparation method contamination.
Laboratory Control Sample	1/ preparation batch	R% = 85-115 or within established manufacturer acceptance ranges.	1) Re-analyze 2) Re-prep sample batch and re-analyze 3) Correct prep methodology to ensure passing LCS.	Evaluates overall method accuracy/bias for the Preparatory Batch. Must be second source.
Digestion Matrix Spike (MS3)	1/10 water/sediment samples	R% = 70- 130	LCS/LFB/ICV must be passing 1) If matrix interference suspected report as found, or 2) Re-analyze and re-spike if no matrix interference suspected, or 3) Use "A" qualifier for sample amount > 4X spike level.	Evaluates effect of matrix on method performance.
Digestion Matrix Spike Duplicate (MSD3)	1/10 water/sediment samples	20% RPD R% = 70-130	LCS/LFB/ICV must be passing 1) If matrix interference suspected report as found, or 2) Re-analyze and re-spike if no matrix interference suspected, or 3) Use "A" qualifier for sample amount > 4X spike level.	Measures method precision/sample homogeneity.

Attachment 17.5
QA/QC Method Parameters
INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP/MS)
EPA METHOD 200.8

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Extraction Duplicate Sample	1/10 soil extract samples	20% RPD or ±2*PQL	1) Check RPD of all analytes. 2) Rerun sample pair, evaluate for sample homegeneity 3) Re-extract. 4) Report with qualifiers	Measures method precision/sample homogeneity.
Internal Standards (IS)	All samples and QC	60-125% Recovery; ICSA/ICSAB 80-120%	Reanalyze samples on dilution, as needed.	Corrects data for sample matrix effects. Quantitation using IS is required for ICP-MS.
MDL	**Initial MDL:** Samples: Analyze at least 7 MDL samples over at least 3 calendar days. Study: Initial study required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing MDL:** Samples: Analyze at least 2 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, recalculate MDL spike and MDL blank from overall historical data.	MDL Samples: All results are quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). MDL Studies: MDL = whichever is higher of MDL spike or MDL blank. < PQL	1) If the result for any individual analyte from the MDL spiked samples does not meet the method qualitative criteria or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. 2) Repeat initial MDL spike and MDL blank study or adjust reporting limit to > 2X of calculated MDL.	Per CFR Part 136 The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.
LOD Verification (Required for each analyte/method to verify calculated MDL).	Following MDL to confirm calculated MDL value.	Positive result (above background)	1) Examine method or preparatory steps, 2) Verify MDL study, 3) Repeat analysis. 4) Consult QA.	Spike at 1-4X MDL for multiple analyte tests.
LOQ Verification	**Initial LOQ:** Samples: Analyze at least 7 LOQ samples over at least 3 calendar days. Verification: Initial verification required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing LOQ:**	LOQ Sample: Quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). % Rec = Statistical or set LOQ Verification:	1) Correct method or instrument performance and repeat the verification. 2) Evaluate and correct established statistical acceptance criteria. 3) Adjust reporting limit.	**If MDL samples meet the LOQ acceptance criteria, the MDL samples can be used as LOQ Samples.**

Attachment 17.5
QA/QC Method Parameters
INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP/MS)
EPA METHOD 200.8

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
	Samples: Analyze at least 1 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, verify that acceptance criteria is met.	> Calculated MDL		
Linear Range Studies	Annually, or whenever method changes might affect sensitivity	Comparison to historical data.	1) Repeat. 2) Correct problem. 3) Adjust upper calibration limit.	Used to determine upper linear range for instrument.
External PE Samples	Semi-annual WS and WP	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies)	1) Complete corrective action report 2) Repeat with another make-up study (for failure of 2 out of 3)	External review of analytical method accuracy.
Control Charting	Statistical review of method performance.	Data statistically within control limits.	1) Trend Analysis/Method Review. 2) Correct method/instrument problem. 3) Replace Analyst.	For statistical process control.
Demonstration of Capability (DOC)	Initially for each new analyst, annually thereafter	4 passing LCS (or other second source QC), passing PT study results, or qualifying statement from supervisor. Method requirements for initial DOCs and ongoing DOCs must be met.	1) Provide additional training 2) Replace analyst.	Demonstrates proficiency to perform the method and obtain acceptable results for each analyst.
Batch Definition	Direct samples: Each daily analytical sequence. Prepped samples: Each batch of 20 samples/matrix or when there is a change of reagents, whichever is more frequent.	Must pass all method QC criteria	Re-analyze batch or qualify results.	A group of samples and associated QC.

ATTACHMENT 17.2
METHOD QA/QC Parameters
Volatile Petroleum Hydrocarbons (VPH) per Massachusetts Method

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Surrogate Recovery	All samples and QC	%Rec = 70-130%	1. Re-analyze sample 2. Re-extract sample 3. Prepare new standard 4. Look for sample matrix interference	VPH surrogates monitor method performance for each individual sample. Trifluorotoluene is used
Instrument Calibration (ICAL)	A 5 Point calibration precedes analyses. Use average response factors. Certain compounds are selected for FID calibration and other compounds are used for PID calibration.	1. Low cal standard must be ≤ RL 2. %RSD ≤ 25% for each target analyte	1. Correct problem. 2. Prepare new standards. 3. Recalibrate.	Establishes calibration curve over a range of analyte concentrations to quantify analytes of interest. Calibration of instrument and check of response linearity. Analysis cannot proceed until a valid calibration is produced. RE (Residual Error) = Calculated as % Recovery in Omega
Initial Calibration Verification (ICV)	Follows valid initial calibration	%Rec = 80-120%	1. Correct problem. 2. Re-calibrate and rerun ICV.	Evaluates calibration accuracy and method performance. Must be prepared from second source standard.
Continuing Calibration Verification (CCV)	Every 24 hours and at the end of every analytical sequence	%Rec = 75-125% for CCV preceding sample analyses	1. Correct problem. 2. Re-analyze CCV. 3. Recalibrate and re-analyze all samples since last valid calibration check.	Evaluates instrument drift throughout analytical sequence. Typically uses midpoint calibration standard or ICV.
Method Blank	Before samples, and at least one MB every 24 hours. Soils-1/prep batch	½ of PQL for target analytes	1. Repeat analyses once. 2. Correct problem. 3. Re-extract and re-analyze all samples associated with failing method blank.	Evaluates overall method including possible contamination in reagents and glassware utilized in preparatory batch. Soil method blanks use clean sand.
Matrix Spike and Matrix Spike duplicate (MS/MSD)	Each batch of 20 samples/matrix or when there is a change of reagents, whichever is more frequent.	%Rec = 70-130% %RPD ≤ 20%	1. Repeat analyses. 2. Re-extract and re-analyze MS/MSD (if sufficient sample).	Evaluates effect of matrix on method performance. Must use a second source standard MSD also evaluates method precision.
Lab Control Sample (LCS)	Minimum 1/20 samples	%Rec = 70-130%	1. Repeat analyses. 2. Prepare new standards. 3. Recalibrate. 4. Re-extract and re-analyze all samples associated with failing LCS (laboratory fortified blank).	Evaluates overall method precision and accuracy. Method specifies 70-130. Must use second source standard Soils are prepared using a blank sand matrix.

ATTACHMENT 17.2
METHOD QA/QC Parameters
Volatile Petroleum Hydrocarbons (VPH) per Massachusetts Method

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Analyte Confirmation in samples	1. As suspected by analyst after thorough examination of data. 2. If detection is > ½ MCL 3. As requested by client	QC pertaining to confirmation method.	None	Past sample history can be used to verify MTBE / Naphthalene detects.
MDL	**Initial MDL:** Samples: Analyze at least 7 MDL samples over at least 3 calendar days. Study: Initial study required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing MDL:** Samples: Analyze at least 2 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, recalculate MDL spike and MDL blank from overall historical data.	MDL Samples: All results are quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). MDL Studies: MDL = whichever is higher of MDL spike or MDL blank. < PQL	1) If the result for any individual analyte from the MDL spiked samples does not meet the method qualitative criteria or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. 2) Repeat initial MDL spike and MDL blank study or adjust reporting limit to > 2X of calculated MDL.	Per CFR Part 136 The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.
LOD Verification	Annually based on MDL	Positive Result, (Above background)	1) Examine method or preparatory steps. 2) Verify MDL study. 3) Repeat analysis. 4) Consult QA.	Spike at 1-4X calculated MDL. Required to verify calculated MDL.
LOQ Verification	**Initial LOQ:** Samples: Analyze at least 7 LOQ samples over at least 3 calendar days. Verification: Initial verification required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing LOQ:** Samples: Analyze at least 1 ongoing MDL spikes for each quarter samples are analyzed. Study:	LOQ Sample: Quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). % Rec = Statistical or set LOQ Verification: > Calculated MDL	1) Correct method or instrument performance and repeat the verification. 2) Evaluate and correct established statistical acceptance criteria. 3) Adjust reporting limit.	**If MDL samples meet the LOQ acceptance criteria, the MDL samples can be used as LOQ Samples.**

ATTACHMENT 17.2
METHOD QA/QC Parameters
Volatile Petroleum Hydrocarbons (VPH) per Massachusetts Method

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
	Annually, verify that acceptance criteria is met.			
Retention Time Windows	Update as needed when maintenance is performed, new column installed, or flows are adjusted	Peaks must fall within RT windows.	1. Identify problem 2. Confirm RTs are stable	Calculate according to method
External PE Samples	Semi-annually, LPTP/UST study samples.	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies)	1. Complete corrective action report. 2. Repeat with another make-up study (for failure of 2 out of 3).	External review of analytical method accuracy.
Control Charting and Proof of Competency	Annual, statistical review of method.	Data statistically within control limits.	1. Trend Analysis/ Method Review. 2. Correct method/instrument problem. 3. Replace analyst.	For statistical process control.
Preparatory Batch	Soils: 20 samples or less over a maxiumum of 7 days. Waters: Samples ran within a 24-hour period not to exceed 20	Must pass all method QC criteria.	1. Re-analyze batch or qualify results 2. Re-extract soil batch	Each batch must contain the same reagents throughout.

ATTACHMENT 17.2 METHOD QA/QC PARAMETERS Extractable Petroleum Hydrocarbons (EPH) per Massachusetts Method 2004 Revision				
QA SAMPLE/ INDICATOR	**FREQUENCY**	**ACCEPTANCE CRITERIA**	**CORRECTIVE ACTION**	**COMMENTS**
Initial Calibration (ICAL)	Annually or after significant instrument maintenance. 5 point initial calibration each for aliphatics and aromatics, (external standardization option of method chosen) Aliphatic Standard Solution Aromatic Standard Solution Range: 1.5, 5,50,200,500,and 1000 ug/mL. To precede sample analyses.	25% RSD MnRF 25%RSD each component. RE = Generally same as CCV requirements. Lowest point may be set statistically.	1. Repeat once 2. Correct problem 3. Prepare new standards 4. Recalibrate	Used to Calibrate instrument, evaluates chromatographic separation effectiveness, and instrument response linearity. RE (Residual Error) = Calculated as % Recovery in Omega .
Initial Calibration Verification (ICV)	The first LCS analyzed following calibration must pass its acceptance criteria.	LCS: TEH %Recovery: 60-140% Fractions: % Recovery of target analytes: 40-140% (30-140% for nonane) Surrogate: 40-140% OR ICV: 80-120% Recovery for each component	1. Repeat once 2. Prepare fresh standards and reanalyze. 3. Recalibrate and re-analyze all affected samples.	Evaluates accuracy of calibration standards. ICV is required if a separate source standard is NOT used for the LCS. LCS utilized in method is second source and used as the ICV.
Continuing Calibration Verification (CCV)	Analyzed at the beginning of every analysis sequence, every 12 hours, and at the end of every analysis sequence	75% - 125% Recovery for each component, excluding n-nonane. N-nonane : 70%-130% recovery Final CCV: four compounds may have percent differences greater than 25% but less than 40%	1. Repeat once 2. Correct problem 3. Re-calibrate and re-analyze all samples since last valid CCV	Verifies instrument calibration and evaluates instrument drift throughout analytical sequence. Mid-level standard
Chromatography Resolution	1) Each ICAL or CCV-Resolution is verified 2) Retention Time Windows – Use RRT and analyst discretion for instrument stability.	Chromatographic resolution: Monitored against historical performance levels. 50% separation of phenanthrene and anthracene.	1. Repeat once 2. Adjust column conditions 3. Perform instrument maintenance 4. Replace GC column	Verifies that gas chromatographic system is operating properly. Resolution criteria for two selected PAH pairs are not met as per method specifications.
System Solvent Blank	As indicated, such as after a heavily contaminated extract. A method blank analysis can be substituted for an instrument blank.	< Lowest reporting limit	1. Repeat analyses once 2. Perform Instrument maintenance 3. Re-analyze all associated samples in sequence where contamination level may affect result.	Measures and evaluates possible contamination in gas chromatographic analysis system.

Method Blank	One per analytical batch	< Lowest reporting limit Surrogate: 40-140%	1. Re-analyze sample on instrument 2. Re-extract and re-analyze all samples associated with the corresponding analytical batch. 3. Qualify sample data	Evaluates overall method including possible contamination in reagents and glassware utilized in preparatory batch.
Laboratory Control Standard (LCS)	One per analytical batch	TEH %Recovery: 60-140% Fractions: % Recovery of target analytes: 40-140% (30-140% for nonane) Surrogate: 40-140%	1. Re-analyze sample on instrument 2. Prepare new standards 3. Recalibrate 4. Re-extract and re-analyze all samples associated the corresponding analytical batch.	Evaluates overall method accuracy/bias for the Preparatory Batch. Must be second source. If prepared the same as MS/MSD will evaluate the spiking technique.
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	One per analytical batch	Corrected TEH %Recovery: 40-140% Fractions: % Recovery of target analytes: 40-140% (30-140% for nonane) Surrogate: 40-140% %RPD = 50% (advisory)	1. If matrix interference suspected, report as found 2. Re-analyze on instrument 3. Re-extract and reanalyze MS/MSD, (if sufficient sample) or select another sample to MS.	Evaluates effect of individual matrix on method performance and method precision. Poor MS/MSD QC performance does not necessarily reject extraction batch group. Control limits are advisory due to sample matrix effects.
Extraction Surrogates	Added to all samples and QC prior to extraction . Ortho-Terphenyl (PAH fraction) and 1-Chloro-octadecane (Aliphatic fraction).	%Recovery: 40-140% Control limits are advisory due to possible sample matrix effects.	1. Re-analyze sample on instrument 2. Evaluate for matrix effects 3. Re-extract samples if method batch performance is suspected.	Evaluates extraction performance on each individual sample analyzed. Water samples containing sediment may have reduced analyte and surrogate extraction efficiency. Extraction performance alone can be evaluated from an EPH screening result.
Fractionation Surrogates	Surrogates added to sample extract prior to fractionation. 2-Bromonapthalene and 2-Fluorobiphenyl.	%Recovery: 40-140% in Aromatic fraction. Control limits are advisory due to possible sample matrix effects.	1. Re-analyze sample on instrument 2. Evaluate for matrix effects 3. Re-fractionate samples if method batch performance is suspected.	Evaluates the effectiveness of the aliphatic/aromatic separation step. Proportional level of presence of either surrogate in the aliphatic fraction suggests incomplete separation of the more volatile PAH's from the aliphatic fraction.
Fractionation Check	Per each Lot # of Silica gel	Effective separation of target analytes into appropriate fraction. %Recovery: 40-140% except the more volatile target analytes with >20% recovery.	1. Repeat once 2. Correct problem (adjust elution volumes) 3. Prepare new standards 4. Recalibrate	Uses aliphatic and aromatic hydrocarbon standards in hexane. The more volatile aromatic and aliphatic compounds may have lower recoveries than method specified limits.
PAH Target Analyte Confirmations	: Water and Soil: PAH analyses performed by 8270 per MTDEQ guidance.	Meets 8270 analyses criteria	1. Repeat analyses to meet all 8270 method QC criteria	Confirms and accurately quantitates PAH levels in aromatic extract. 8270 method is considered less sensitive to false positives than the EPH method.

MDL	**Initial MDL:** Samples: Analyze at least 7 MDL samples over at least 3 calendar days. Study: Initial study required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing MDL:** Samples: Analyze at least 2 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, recalculate MDL spike and MDL blank from overall historical data.	MDL Samples: All results are quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). MDL Studies: MDL = whichever is higher of MDL spike or MDL blank. < PQL	1) If the result for any individual analyte from the MDL spiked samples does not meet the method qualitative criteria or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. 2) Repeat initial MDL spike and MDL blank study or adjust reporting limit to > 2X of calculated MDL.	Per CFR Part 136 The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.
LOD Verification	Annually, following the MDL study. LOD is spiked at 1-4X the MDL.	Positive result, above background	1. Examine method or preparatory steps 2. Verify MDL study 3. Repeat analysis 4. Consult QA	Verifies the calculated MDL for each matrix.
LOQ Verification	**Initial LOQ:** Samples: Analyze at least 7 LOQ samples over at least 3 calendar days. Verification: Initial verification required for new method and whenever method changes might reasonably be expected to affect sensitivity. **Ongoing LOQ:** Samples: Analyze at least 1 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, verify that acceptance criteria is met.	LOQ Sample: Quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). % Rec = Statistical or set LOQ Verification: > Calculated MDL	1) Correct method or instrument performance and repeat the verification. 2) Evaluate and correct established statistical acceptance criteria. 3) Adjust reporting limit.	**If MDL samples meet the LOQ acceptance criteria, the MDL samples can be used as LOQ Samples.**
External PE Samples	Semi-Annually	PT sample defined acceptance limits (must pass 2 out of last 3 PT studies)	1. Complete corrective action report 2. Repeat with another make-up study (for failure of 2 out of 3)	External review of analytical method accuracy.
Control Charting	Annual statistical review of method.	Data statistically within control limits.	1) Trend Analysis/ Method Review 2) Correct method/instrument problem. 3) Replace analyst.	For statistical process control.

Demonstration of Capability (DOC)	Initially for each new analyst, annually thereafter	4 passing LCS (or other second source QC), passing PT study results, or qualifying statement from supervisor. Method requirements for initial DOCs and ongoing DOCs must be met.	1) Provide additional training 2) Replace analyst.	Demonstrates proficiency to perform the method and obtain acceptable results for each analyst.
Batch Definition	Each batch of 20 samples/matrix extracted within a 7-day time frame or when there is a change of reagents, whichever is more frequent	Must pass all method QC criteria	Re-analyze batch or qualify results	A group of samples and associated QC

ATTACHMENT 17.2 METHOD QA/QC PARAMETERS VOLATILE ORGANICS BY PURGE AND TRAP GC/MS EPA Method SW-846 8260B for SOIL & WATER				
QA SAMPLE/ INDICATOR	**FREQUENCY**	**ACCEPTANCE CRITERIA**	**CORRECTIVE ACTION**	**COMMENTS**
Sample Preparation	Methods: Soils: Extracted by 5030B then analyzed by Purge & Trap Waters: 5030B Purge & Trap Surrogates added to all samples	Meet method QC criteria for the matrix.	1. Re-analyze sample.	Waters are introduced into the GC/MS using Purge & Trap. Soils are extracted into methanol and the methanol extract is added to water and analyzed by Purge and Trap/GC/MS.
Initial Calibration	9-point initial calibration Range: 0.25, 0.5, 1, 2,5,10, 15, 20, 40 ug/L After maintenance or when needed due to peak shifts or QC failures.	If %RSD<15 use avg RF, alternatively use calibration curve. CCC= Continuing Calibration Check Compounds. Calibration curve (first or higher order), all analytes %RSD<30 then R2 >0.99, RF for SPCCs: >0.3000 for Chlorobenzene and 1,1,2,2-Tetrachloroethane; >0.1 for Chloromethane and 1,1-dichloroethane, and Bromoform. Evaluated against statistically set criteria with default limits being the CCV criteria excepting the lowest point (s) which should have a 50% - 150% recovery.	1. Perform instrument maintenance. 2. Recalibrate. 3. Prepare new Standards.	Establishes calibration curve over a range of analyte concentrations to quantify analytes of interest. Minimum number of Calibration points: Ave RF = 4 Linear = 5 Quadratic = 6 Cubic = 7 Polynomial = 3 + #equation factors (min 7) Relative error (RE) when calculated as a percent recovery of the standard against the curve
Tuning	BFB Initially and every 12 hours thereafter.	Meet method-tuning criteria.	1. Adjust instrument. 2. Recheck tune. 3. Until successful.	Evaluate mass sensitivity, mass resolution, isotope ratio, and baseline threshold.
Continuing Calibration Verification CCV	Mid-level standard analyzed every 12 hours	RF Drift ±20% of Initial Calibration for CCCs, RF Drift ±30% for all other compounds. RF for SPCCs must be > 0.3000 for Chlorobenzene and 1,1,2,2-Tetrachloroethane; and must be > 0.1000 for Chloromethane, 1,1-dichloroethane, and Bromoform. EICP Area of the Internal Standards must be 50-150% of the Initial Calibration and the retention time	1. Remake and rerun. 2. Re run instrument tune 3. Re-calibrate and re-analyze all samples since last valid calibration check.	Evaluates instrument drift throughout analytical sequence. Midpoint calibration standard.

ATTACHMENT 17.2
METHOD QA/QC PARAMETERS
VOLATILE ORGANICS BY PURGE AND TRAP GC/MS
EPA Method SW-846 8260B for SOIL & WATER

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
		must not shift more than 30 seconds.		
Method Blank (MBLK)	1/batch	<½ PQL	1. Repeat analyses once. 2. Correct problem. 3. Re-extract and re-analyze all samples associated with failing method blank.	Evaluates overall method including possible contamination in reagents and glassware utilized in preparatory batch.
Lab Control Sample (LCS)	1/batch	Statistical Control Limits	1. Repeat analyses. 2. Prepare new standards. 3. Recalibrate. 4. Re-extract and re-analyze all samples associated with failing LCS.	Evaluates overall method precision and accuracy. Must be second source. If prepared the same as MS/MSD will evaluate the spiking technique.
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	Each batch of 20 samples/matrix or when there is a change of reagents, whichever is more frequent.	Statistical Control Limits	1. Repeat analyses. 2. Re-extract and re-analyze MS, (if sufficient sample). 3. Evaluate LCS performance.	Evaluates effect of matrix on method performance.
Internal Standards (Samples and QC)	Added to all samples and QC.	Samples: Area% 50-150% of IC RT = ±30 sec of IC.	1. Repeat analyses. 2. Re-prepare samples. 3. Analyze different sample. 4. Re-analyze set of samples.	Measures instrument stability and sensitivity. Monitor total areas in each analyses Bromochloromethane-d2 Fluorobenzene Chlorobenzene-d5 1,2-Dichlorobenzene-d5
Surrogates	All samples and QC.	Statistical Control Limits	1. Repeat analyses 2. Recalibrate with fresh fortification standard. 3. Re-extract samples. 4. Recalibrate.	Evaluates method performance on each individual sample analyzed. 1,2-Dichloroethane-d4 Dibromofluoromethane Toluene-d8 p-Bromofluorobenzene
Mass Spectra	Review all target analytes in standards, and also target	Spectra must be consistent with library database.	1.Verify calibration spectra and retention times.	Used to qualitatively identify target compound hits in

ATTACHMENT 17.2
METHOD QA/QC PARAMETERS
VOLATILE ORGANICS BY PURGE AND TRAP GC/MS
EPA Method SW-846 8260B for SOIL & WATER

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
	compounds found in samples.		2. Repeat analyses.	samples.
MDL Studies	Initial MDL: Samples: Analyze at least 7 MDL samples over at least 3 calendar days. Study: Initial study required for new method and whenever method changes might reasonably be expected to affect sensitivity. Ongoing MDL: Samples: Analyze at least 2 ongoing MDL spikes for each quarter samples are analyzed. Study: Annually, recalculate MDL spike and MDL blank from overall historical data.	MDL Samples: All results are quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). MDL Studies: MDL = whichever is higher of MDL spike or MDL blank. < PQL	1) If the result for any individual analyte from the MDL spiked samples does not meet the method qualitative criteria or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. 2) Repeat initial MDL spike and MDL blank study or adjust reporting limit to > 2X of calculated MDL.	Per CFR Part 136 The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.
LOD Verification	Annually based on MDL study frequency.	Positive Result, Must meet method criteria for identification. (Above background)	1. Examine method or preparatory steps, 2. Verify MDL study, 3. Repeat analysis 4. Consult QA	Spike at 1-4X calculated MDL.
LOQ Verification	Initial LOQ: Samples: Analyze at least 7 LOQ samples over at least 3 calendar days. Verification: Initial verification required for new method and whenever method changes might reasonably be expected to affect sensitivity. Ongoing LOQ: Samples: Analyze at least 1 ongoing MDL spikes for	LOQ Sample: Quantitative (above zero and meet the qualitative identification criteria of the method; e.g., recognizable spectra, signal to noise requirements, and presence of qualifier ions). % Rec = Statistical or set LOQ Verification: > Calculated MDL	1) Correct method or instrument performance and repeat the verification. 2) Evaluate and correct established statistical acceptance criteria. 3) Adjust reporting limit.	Used to verify ongoing instrument quantitative accuracy at the LOQ. Can be control charted to verify and determine statistical LOQ limits If MDL samples meet the LOQ acceptance criteria, the MDL samples can be used as LOQ Samples.

ATTACHMENT 17.2 METHOD QA/QC PARAMETERS VOLATILE ORGANICS BY PURGE AND TRAP GC/MS EPA Method SW-846 8260B for SOIL & WATER				
QA SAMPLE/ INDICATOR	**FREQUENCY**	**ACCEPTANCE CRITERIA**	**CORRECTIVE ACTION**	**COMMENTS**
	each quarter samples are analyzed. Study: Annually, verify that acceptance criteria is met.			
External PE Samples	Semi-annually, WP study samples.	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies)	1. Complete corrective action report. 2. Repeat with another make-up study (for failure of 2 out of 3).	External review of analytical method accuracy.
Control Charting	Annual, statistical review of method.	Data statistically within control limits.	1. Trend Analysis/ Method Review. 2. Correct method/instrument problem. 3. Replace analyst.	For statistical process control.
Demonstration of Capability (DOC)	Initially for each new analyst, annually thereafter	4 passing LCS (or other second source QC), passing PT study results, or qualifying statement from supervisor. Method requirements for initial DOCs and ongoing DOCs must be met.	1. Provide additional training 2. Replace analyst.	Demonstrates proficiency to perform the method and obtain acceptable results for each analyst.
Batch Definition	Water: 20 samples from the daily analytical sequence. Soils 20 samples/matrix extracted over 7 days or when there is a change of reagents, whichever is more frequent.	Must pass all method QC criteria as specified above	Re-analyze batch or qualify results	A group of samples and associated QC

Method QA/QC Parameters
SEMIVOLATILE ANALYSES BY GC/MS
By SW-846 Method 8270C, 8270D and EPA 625 and 625.1

QA SAMPLE/ INDICATOR	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	COMMENTS
Sample Preparation Extraction	SW-846 Methods: Soils: 3550B or 3545 Waters: 3510C or3520C Wastes: 3550B, 3545, 3580 Surrogates added to all samples.	Meet Method QC criteria for the matrix	1) Re-analyze sample or re-extract sample. If re-extraction outside of holding time, report both sets of data.	Minimum sample volume required per sample. Soils: 30 grams Water: 1 Liter
Instrument Calibration (IC)	7-point calibration Range: 10, 20,50,75,100,120, 150ug/mL Bottom point or two may be dropped for reactive compounds as long as five consecutive points are used at a minimum	See Note #1 at bottom Relative error (RE) when calculated as a percent recovery of the standard against the curve is recommended to be evaluated against statistically set criteria with default limits being the CCV criteria excepting the lowest point (s) which should have a 50% - 150% recovery.	1) Perform instrument maintenance. 2) Recalibrate. 3) Prepare new Standards.	Establishes calibration curve over a range of analyte concentrations to quantify analytes of interest.
Instrument Blank	Following instrument calibration or beginning of each analytical sequence. May be substituted with batch method blank.	Clean baseline. No target analytes.	1) Rerun. 2) Perform instrument maintenance.	Evaluates instrument performance chromatographic baseline.
Tuning	DFTPP Initially and every 12 hours thereafter	Meet method-tuning criteria (Attachment 17.4)	1) Adjust instrument. 2) Recheck tune. 3) Until successful.	Evaluates mass sensitivity, mass resolution, isotope ration, and baseline threshold.
Initial Calibration Verification (ICV)	Immediately following calibration.	RF for SPCC>0.050 %R of CCCs must be ±20% difference from IC. 625 and 8270D Method: %R for all compounds is ±20%.	1) Repour and rerun. 2) Prepare fresh calibration standards and/or ICV. 3) Recalibrate and rerun.	Evaluates calibration accuracy and method performance. Must be prepared from second source standard.
Method Blank (MBLK)	Immediately follows ICV. Each batch of 20 samples/matrix or when there is a change of reagents, whichever is more frequent.	< ½ PQL excepting phthalates <PQL for SIM	1) Prepare fresh blank 2) Re-extract and re-analyze all samples associated with failing method blank.	Evaluates calibration accuracy, reagent/ glassware contamination, and instrument carryover.
Continuing Calibration Verification (CCV)	Mid-level standard analyzed every 12 hours to update internal standard response factors (RF).	RF for SPCC>0.050 %R of CCCs must be ±20% difference from IC. 625 Method: %R for all compounds is ±20%.	1) Remake and rerun. 2) Rerun instrument tune. 3) Recalibrate and rerun samples since last valid CCV	Evaluates instrument drift throughout analytical sequence. Typically uses midpoint calibration standard or ICV.
GC Performance Analyte Degradation	Each tuning; Evaluate TIC areas of DDT breakdown products and chromatographic profile.	< 20% breakdown	1) Instrument maintenance. 2) Re-check tune.	Evaluates chromatographic system for reactivity.

Minimum Response Factor	Check bottom ICAL point RF against values in Attachment 17.9	See Attachment 17.9	No action necessary. This is considered advisory criteria only.	The RFs are provided as guidance only and are not intended to be a requirement per 8270E.
Matrix Spike (MS/MSD)	Each batch of 20 samples/matrix or when there is a change of reagents, whichever is more frequent. For 8270-a representative list. For 625- all target analytes	See LCS limits. Statistical control limits. RPD: 40%	LCS must be passing 1) If matrix interference suspected report as found, or 2) Re-extract and re-analyze MS if no matrix interference suspected (if sufficient sample) 3) Evaluate LCS performance (See Note #3 at bottom)	Evaluates effect of matrix on method performance. MSD also evaluates method precision.
Duplicate Sample (DUP)	If used in place of a MSD, 1/20 samples	5, 10, 20% RPD or 2X PQL depending on method	1) Rerun sample pair, evaluate for sample homogeneity or 2) Report with qualifiers	Evaluates method precision. MSD duplicate analyses preferred on some methods.
Laboratory Control Sample (LCS)	Minimum 1/20 samples/matrix and each batch of samples, whichever is more frequent.	Reference Material specified limits or laboratory statistical limits. 625 method: Limits don't exceed method criteria. DoD samples have LCS limits in Attachment 17.14	1) Prepare new Standards. 2) Re-calibrate. 3) Re-extract and re-analyze all samples associated with failing LCS.	Evaluates spiking technique and when prepared from a source independent of the calibration standards can also measure method performance.
Internal Standards	Monitor total areas in each analyses Acenapthene-d10 Phenanthrene-d10 Chrysene-d12 1,4-Dichlorobenzene-d4 Napthalene-d8 And Perylene-d12	Samples: Area %50-150% of IC. RT = ±30 sec of IC.	1) Repeat analyses 2) Re-prepare samples. 3) Analyze different sample. 4) Re-extract and re-analyze set of samples.	Measures instrument stability and sensitivity.
Mass Spectra	Review all target analytes in standards and reported analytes in samples.	Spectra must be consistent with library database.	1) Verify calibration spectra and retention times. 2). Repeat analyses.	Used to qualitatively identify target compound hits in samples.
Surrogates	Present in all extracted samples (Including QC).	Reference Material specified limits or laboratory statistical limits. 625 Method: Limits don't exceed method criteria.	1) Repeat analyses. 2) Recalibrate with fresh fortification standard. 3) Re-extract samples.	Evaluates method performance on each individual sample analyzed.
MDL Studies Per CFR Part 136	Bi-annually or annually per method requirement or whenever method changes might affect sensitivity	Spike at ~PQL, PQL = 10 ug/L or 0.33 ug/g with exceptions (See Note #4 at bottom).	1) If the result for any individual analyte from the MDL spiked samples does not meet the method qualitative criteria or does not provide a numerical result greater than zero, repeat the spiked samples at a higher concentration. 2) Repeat initial MDL spike or adjust reporting limit to > 2X of calculated MDL.	Evaluates overall method detection limits in clean sample matrix. The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results Actual samples may have higher MDL.

LLOQ Study	Performed initially to verify LLOQ for each instrument and preparation method. Prepare and analyze 7 replicate samples. MDL study may be used if criteria met.	Within established in-house limits or advisory limits of +/-20% of the LCS limits (i.e. low limit -20% upper limit +20%).	1) Repeat if obvious problem occurs. 2) LLOQ Recovery should be reasonable relative to default advisory limits. Results should be within statistically based limits when available.	Evaluates overall method precision and accuracy at the lowest reporting limit. Actual samples may have higher RL.
LLOQ Verification	Annually, after initial study.	Within established in-house limits or advisory limits of +/-20% of the LCS limits (i.e. low limit -20% upper limit +20%).	1) Repeat if obvious problem occurs. 2) LLOQ Recovery should be reasonable relative to default advisory limits. Results should be within statistically based limits when available.	Used to verify ongoing instrument quantitative accuracy at the LLOQ. Can be control charted to verify and determine statistical LOQ limits.
LOD Verification	Bi-annually or annually per method MDL requirement following each MDL Study	Positive Result, S/N greater than 3 (above typical Method Blank performance)	1) Examine method or preparatory steps, 2) Verify MDL study, 3) Repeat analysis. 4) Consult QA	Spike at 1-4X MDL for multiple analyte tests.
External PE Samples	WP and LPTP PT studies. Biannual WS and/or WP and internal blind and double blind samples.	PT sample defined acceptance limits (Must pass 2 out of last 3 PT studies).	1) Complete corrective action report 2) Repeat with another make-up study (for failure of 2 out of 3).	External review of analytical method accuracy.
Control Charting and Proof of Competency	Annual statistical review of method.	Data statistically within control limits. Evaluate statistical limits reasonableness.	1) Trend Analysis/ Method Review. 2) Correct method/instrument problem. 3) Replace analyst.	For statistical process control.
Batch Definition	Prepped Samples = Each batch of 20 samples/matrix or when there is a change of reagents, whichever is more frequent.. 24 Hours	Must pass all method QC criteria.	Re-analyze batch or qualify results	A group of samples and associated QC

Note #1 %RSD for CCC (Table 4 SOP ELI 50-009) <30. RF for SPCC's (N-nitroso-di-n-propyl amine, hexachlorocyclopentadiene, 2,4 Dinitrophenol, and 4-Nitrophenol) > 0.050. If % RSD for a compound is < 15, linearity is assumed and average RF is used (<20% for 8270D). If % RSD > 15 (and less than 30 for CCC), use a calibration curve with correlation coefficient >= 0.990. Lower calibration levels are not used for certain compounds. PQLs are adjusted as appropriate.

Note #2 RF for SPCC>0.050, RF of CCC's must be <20% difference from IC. RF of all other compounds must be <30% difference from IC.

Note #3 If any analyte in the MS/MSD fails, QC limits for failed compounds must be within acceptable recovery limits for the blank spike laboratory control sample.

Note #4 PQL for Benzidine, 3,3' Dichlorobenzidine, and pyridine = 20ug/L. 4-Nitrophenol, Pentachlorophenol, 2,4-Dinitrophenol, 4,6-Dinitro-2-methylphenol = 50 ug/L.

APPENDIX C

Organizational Charts

Energy Laboratories

Helena | 11/12/2020

BOARD OF DIRECTORS
Officers
President- Hager, Jon
Vice President- Rohrer, Cindy
Sec/Treas- Dangerfiled, Tracy
VP Operatons – Bradley, Lisa
Director – Brown, William

Lab Manager
Hager, Jon
Assistant Lab Manager
Carlson, Amanda

Safety Officer
Dull, Stephanie

Quality Assurance Officer
Carlson, Amanda

Inorganics Supervisor
Wunderlich, Scott

- Analyst
  Reed, Josh
- Analyst
  Hodgson, Elizabeth
- Analyst
  Tooke, Rebecca
- Lab Tech
  Dailey, Orrin

Soils Supervisor
Pester, Skyler

- Sample Prep
  Hornby, Shane
- Sample Prep
  Johnson, Stephen
- Sample Prep
  Reimund, Keith

Organics Supervisor

- Analyst
  Buchanan, Tammy
- Analyst
  Martin, Kathryn
- Analyst
  DeVault, Kristine
- Analyst
  Sappington, Gage

Metals Supervisor

- Analyst
  Dull, Stephanie
- Analyst
  Kono, Dustin
- Analyst
  Jacobson, Ian
- Analyst
  Wintrode, Jason

Office Manager
Johnson, Wanda

- Project Management
  Smith, Jessica
- Log In/Prep
  Kent, Kevin
- Log-in
  Jones, Gabriel

APPENDIX D

Curricula Vitae of Key Laboratory Personnel

Contents

William T. Brown

Board of Directors

Responsible for corporate direction and operations of Energy Laboratories, Inc.

Experience: Thirty plus years of experience in environmental laboratory operations including lab manager, supervisor of organic analysis and senior organic chemist. Experienced in Gas Chromatography, Gas Chromatography/Mass Spectrometry (GC/MS), sample preparation and extraction, ion chromatography and chromatography data systems.

Education
Bachelor of Science in Fish and Wildlife, Montana State University, Bozeman, Montana, 1977

Professional Experience
1986 to present, President - Energy Laboratories, Inc

1981 - 1987, Manager - Energy Laboratories, Inc., Branch Laboratory, Gillette, Wyoming. Responsible for routine analysis and quality control of water, natural gas, and petroleum products. Involved in field on site sampling and testing, meter calibrations, and supervision of branch laboratory staff.

1979 - 1981, Laboratory Technician - Energy Laboratories, Inc., Billings, Montana. Responsible for the natural gas and petroleum products department of the lab including field natural gas testing. Also involved with various work in water and soil analysis including formal training in ion chromatography.

1977 - 1979, Fisheries Biologist - Water and Forests Department of the Government of Niger, Africa. While in the Peace Corps, responsible for developing fisheries management programs in a specific region including monitoring water quality by on-site testing.

LISA A BRADLEY PH.D.

Vice President Corporate Laboratory Operations

Responsible for development and oversight of technical operations for Energy Laboratories, Inc.

Experience: Interim laboratory manager, supervisor of inorganic analysis, supervisor of elemental analysis, senior elemental analyst, research assistant, laboratory environmental technician.
Experienced in atomic absorption spectroscopy (AA), inductively coupled plasma optical emission (ICPOES), and mass spectrometry (ICP-MS).

Education
Ph.D., Analytical Chemistry, Indiana University - Bloomington, Indiana, 1996
Bachelor of Science, Chemistry, Montana State University, Bozeman, Montana, 1990

Professional Experience

2007-Present, Vice President/Director of Corporate Technical Operations- Energy Laboratories, Inc., Billings, MT.

2005-2008, Supervisor, Inorganics Dept.- Energy Laboratories, Inc., Billings, MT: Responsible for supervision and management of inorganics laboratory.

2000-2005-Supervisor, Metals Dept- Energy Laboratories, Inc., Billings, MT: Supervised metals department; performed chemical analyses using laboratory instrumentation.

1996- 2000, Analytical Chemist - Energy Laboratories, Inc., Billings, Montana: Performed atomic absorption spectroscopy (AA), inductively coupled plasma optical emission (ICP-OES), and mass spectrometry (ICP-MS) analyses.

October 1990-1995, Research Assistant/Department of Chemistry - Indiana University, Bloomington, Indiana.

August, 1990-December, 1992, Associate Instructor of Chemistry - Indiana University, Bloomington, Indiana.

1989, Laboratory Technician - Intermountain Laboratory, Bozeman, Montana.

1986-1990, Undergraduate Research Assistant - Montana State University, Bozeman, Montana

TRACY A. DANGERFIELD, CPA, MBA

Treasurer and Chief Financial Officer

Experienced in business leadership, management and strategic development. Extensive background in accounting, finance and organizational development.

Education

Master of Business Administration, University of Montana, Missoula, MT 2013
Certified Public Accountant, 1992
Bachelor of Science, Business Administration, Minor in Accounting, Eastern Montana College, Billings, MT 1989

Professional Experience

1989-Present, Chief Financial Officer-Energy Laboratories, Inc., Billings, Montana.
Responsible for initiating, developing, and directing administrative operations including finance, human resources, taxation and marketing. Involved with growing Energy Laboratories, Inc. (ELI) from 20 employees to over 225, quadrupling revenues, and expanding to six locations throughout the Rocky Mountain Region. Steered the implementation of an Employee Stock Ownership Plan, transacted the ensuing 30% purchase of ELI, and continues to serve as Plan Trustee.

1985 -1989 Office Management-Energy Laboratories, Inc., Billings, Montana.
Responsible for daily office operations and management of staff.

JONATHAN D. HAGER

President / Laboratory Manager Helena

Academic Training

Bachelor of Arts in Biology, Chemistry Minor, Carroll College, Helena, MT, May 2003

GC/MS Training Seminar, Restek 8 hour seminar, Sept 2005.

Interaction Management, 40 hr class, Billings, MT, 2008.

Professional Experience

May, 2001-Present: Laboratory Manager -Energy Laboratories, Inc., Helena, Montana.

Responsible for ensuring work is performed with ethics, quality and safety as a primary concern. Encourages a quality-oriented and cooperative atmosphere that promotes collaboration and company-wide success.

Coordinates laboratory analysis with client contracts. Responsible for direction, training, and supervision of the analytical laboratory staff. Involved in new procedural and equipment development, quality assurance program, client relations, and report preparation.

Experienced in the analysis of soils and water in a variety of applications.

Technical Training:

GC/MS Training Seminar, Restek 8 hour seminar, Sept 2005.
Interaction Management, 40 hr class, Billings, MT, 2008.
Leadership Helena, Helena Chamber of Commerce, 2018

Professional Organizations

American Chemical Society
Treasure State Resource Industry Association
Alaska Miners Association
Soil Society of America

AMANDA B. CARLSON

Corporate Quality Assurance Officer/Assistant Laboratory Manager

Academic Experience

Bachelor of Arts in Chemistry, Carroll College, Helena, MT, May 2004

Professional Experience

June 2019-Present Corporate Quality Assurance Officer.

Jan 2013-Present Assistant Laboratory Manager-Helena, Montana

January 2008-Present-Quality Assurance Manager Helena, Montana

Ensures the laboratory maintains client satisfaction by meeting quality requirements. Maintains training records for all employees and provide ongoing training of QAQC topics to all employees. Maintains a general knowledge of methods performed in the laboratory and the appropriate method corrective actions.

Assists in the supervision of the daily operations of the laboratory while promoting collaboration and communication between analysts. Supervise Inorganics Department.

Certified analyst for total coliform and E.Coli in both public and private water samples.

Coordinate client relations from bottle preparation and sample receipt through reporting and invoicing, and data review of technical reports issued to clients.

May 2004-2008 Inorganics and Organics Analyst-Energy Laboratories, Inc. Helena Montana.

Professional Organizations

American Water Works Association
American Chemical Society

Technical Training

GC/MS Training Seminar, Restek 8 hour seminar, Sept 2005.
Interaction Management, 40 hr class, Billings, MT, 2008.
Contaminant Vapor Migration and Intrusion, 13 hr class, Helena, MT, Feb 2013.
Small Laboratory TNI Standard Implementation, 21 hour course, 2017
Basic Assessor Training-TNI Standard 2016, 3 day course, 2019

WANDA J JOHNSON

Office Manager/Project Management

Adept at client relations, sample receipt and login, and data processing, including reporting of clients' data.

Education and Academic Training

HS Graduate, General Studies—Business Courses

Interaction Management, 40 hr class, Billings, MT, 2009.

Professional Experience

2002 - Present, Project Manager/Office Manager, Energy Laboratories, Inc., Helena, MT

Project Manager-Responsible for overseeing client needs. Providing assistance with understanding clients permits/planners on what is needed for their systems. Provide Quotes/Assistance with bottle orders. General overall assistance.

Reporting—Generates and mails client reports and invoices. Prepares, proofs, and mails public water system CCR reports each spring.

Client Relations—Creates new client accounts and updates Helena database with any changes to existing accounts from any of the branch labs.

Electronic Data Delivery—Creates and e-mails CSV, Excel, PDF, or EDD files for clients who request those formats.

Helena Accounting—Collects up-front client payment when applicable, and ensures delivery of all payments and invoices to the Energy Labs SBT accounting system at our corporate office.

1993-1999, Heritage Home Health, Helena, MT
Responsible for payroll and accounts receivable for 5 branch offices. Managed employee and contract personnel files to federal and state guidelines requirements. Reviewed medical records for appropriate coding to meet Medicare/Medicaid and insurance requirements.

1990-1993, Independent Home Health, Helena, MT
Responsible for payroll and accounts receivable for 5 branch offices. Managed employee and contact personnel files to federal and state guidelines requirements. Reviewed medical records for appropriate coding to meet Medicare/Medicaid and insurance requirements.

STEPHANIE L. DULL

Safety Officer/ Chemist

Experienced in the administration of safety programs and analysis of environmental samples.
Proficient at running many inorganic analyses and assuring timely turnaround of samples.

Education:

Bachelor of Arts in Biology, Minor in Chemistry, Carroll College, Helena, MT, May 2003

Master of Science of Forensic Science - Advanced Investigation, University of New Haven, West Haven, CT, August 2004

HAZWOPER Certified, 40 hour

Experience:

March 2005 – Present, Safety Officer/Chemist, Energy Laboratories, Inc., Helena, MT

Skilled in many inorganic analyses including alkalinity, chlorides, conductivity, pH, sulfate, TDS, and TSS and Nutrient Analysis.

Experienced in ICP analysis for metals in both water and soil matrices.

Implementation and maintenance of safety program in the Helena lab under the guidance of the Corporate Safety Officer.

Microbiology Analyst-Certified analyst for total coliform and E.Coli in both public and private water samples.

SKYLER PESTER

Soil Laboratory Supervisor

Proficient at performing various soil analyses and analysis of major cations.

Education

Bachelor of Arts in Chemistry – Carroll College Helena MT (2008)
Minor in Biology
Minor in Business Administration

Interaction Management (8 Hours)

Professional Experience

April 2008-Present Energy Laboratories-Helena

2008-2010 – Analyzed Nutrients including phosphate, nitrite, nitrate, ammonia, total Kjeldahl nitrogen, and chemical oxygen demand: utilizing flow injection colorimetry and spectrophotometric analysis.

2010-2011 – Analyzed heavy metals including mercury, arsenic, selenium, and chlorophyll; utilizing cold vapor atomic absorption, hydride generation fluorescence detection, UV-Vis Spectroscopy and high pressure liquid chromatography.

2011-2013 – Analyzed S, D, and P- Block metals, utilizing Inductively Coupled Plasma – Optical Emission Spectroscopy

2011-Present – Soil Department Supervisor, responsible for managing department, coordinating work flow, client interaction, and data review to ensure data quality and integrity.

Certifications

Advanced Wilderness First Aid
CPR/AED
SAR Tech III
Swiftwater Rescue Tech I
Dive Rescue Tech I
Ice Rescue Tech
Hovercraft Pilot.

SCOTT R. WUNDERLICH

Inorganics Supervisor

Supervises the operation of daily inorganics testing of soil and water matrices.

Education

Bachelor of Science in Environmental Studies with an emphasis on Sustainable Resource Management and Wetlands Management, University of Montana-Western, Dillon, MT. May, 2012

Experience

November 2013-Present: Energy Laboratories-Helena

June 2018-Present: Inorganics Supervisor- Responsible for managing same day inorganics and nutrients analyses.

May 2016-Present: Backup Safety Officer- Assist the Safety Officer with the implementation and maintenance of the safety program in Helena.

May 2014-June 2018: Inorganics Analyst- Responsible for analyzing inorganics, including: anions, solids, pH, conductivity, alkalinity, and BODs.

November 2013-May 2014: Login Prep Technician- Responsible for receiving, triaging, prepping, logging in, and packaging samples.

Technical Training

IC Essentials Training Program for Metrohm, February, 2017

OSHA: General Industry (10-Hour)

Certifications

Certified in First Aid/CPR

APPENDIX E

Equipment and Methods List

Equipment	Quantity	Methods
Gas Chromatograph-FID with auto sampler	2	DRO, MA-EPH, SW8015
Gas Chromatograph-PID/FID with purge and trap and auto sampler	2	GRO, MA-VPH E602, SW8021, SW8015
Gas Chromatograph-Mass Spectrometer with purge and trap and auto sampler	2	E524.2, SW 8260B
Inductively Coupled Argon Plasma Spectrophotometer	1	E200.7,SW 6010
ICP-MS Collision Cell	2	E200.8, SW6010.20
Leco Sulfur Analyzer	1	ASA29-3, E3.2.3
Lachat Flow Analyzer	2	E350.1, E353.2, ASA38-3, ASA10-3, E365.1
Environmental Express Digestion Block	1	E351.2
Incubator	2	SM9223, E1603, SM9222
TDS/TSS Oven	3	SM2540 C, E160.2
UV-Visual Spectrophotometer	1	E410.4, SM3500-Cr B
Ion Chromatography System	2	E300.0,E 300.1
CVAA PSA with Autosampler	1	SM3114
CeTac with Autosampler	2	SW7470, SW7471, E245.1,
Autotitrator	2	SM2320B, , USDA23c
pH/Conductivity/DO/ISE meters and probes	Multiple	SM2510B, SM4500-H B, SM4500-O G, SM4500-F C
Hach 2100N Turbidimeter	1	E180.1
HPLC	2	E1632, SM10200 H
Quanti-Tray Sealer	1	SM9223 B
Digestion Blocks	4	SW3050B, SW3010,E 200.2
SampleTek Extractor	1	various
Automated Biochemical Oxygen Demand (BOD) Analyzer	1	SM5210B
3-bar, 15 bar	1	

ATTACHMENT 1

Record of Revision Form

RECORD OF REVISION
Helena, Montana
Quality Assurance Manual

Date of Revision	Revision Number	Performed By	Action (Detailed modifications)
2/7/14	1.4.13	Janel Weidemoyer	QA Manual Reviewed-not updated
1/7/15	January 5, 2015	Amanda Blackburn	Used Energy Laboratories Billings current updated to QAM (reviewed by Andy Valkenburg, Bill Brown, Lisa Bradley, Tracy Dangerfield, Cindy Rohrer and Greg Waring). Significant revisions from previous Helena QAM.
5/18/15	May, 5, 2015	Amanda Blackburn	Removed references to ELI SOP Lab Policies and Roles and Responsibilities. Changed references from Branch Manager to Laboratory Manager and QA Manager to QA officer. Added Chapter 12, Management of Change.
7/26/16	June 22, 2016	Amanda Carlson	Updated references to the ELI Fee Schedule to Technical and Professional Services Guidebook. Updated equipment list, updated Amanda Blackburn to Amanda Carlson in CV. Updated QAQC parameters for 6010D, 6020B, 200.7 and 200.8.
11/14/17	November 14, 2017	Amanda Carlson	Updated references to ELI Professional Services Guidebook. Updated equipment list. Updated QAQC elements sheets with most current sheet from method SOPs. Updated CVs.
1/17/19	January 17, 2019	Amanda Carlson	Used the most recent revision from ELI-B, which incorporates changes from the Billings laboratory and Casper laboratory. Updated language to include additional requirements for management review, discussion on confidentiality and improved syntax. Definitions updated and several added. Updated CVs- Remove Dustin Kono, added Scott Wunderlich. Updated QAQC elements table with the newest versions available from most recent SOP updates. Updated Equipment List.
11/9/2020	November 9, 2020	Amanda Carlson	Updated CV to reflect changes in corporate structure and Helena Branch. Updated QAQC parameter tables to most current version.