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**GEL LABORATORIES, LLC**

**QUALITY ASSURANCE PLAN**

**(GL-QS-B-001 REVISION 21)**

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**SECTION 1  
INTRODUCTION****Section 1 - Introduction**

GEL Laboratories, LLC (GEL) is a privately owned environmental laboratory dedicated to providing personalized client services of the highest quality. Our mission is to be the "Analytical Firm of First Choice."

GEL was established as an analytical testing laboratory in 1981. Now a full service lab, our analytical divisions use state of the art equipment and methods to provide a comprehensive array of organic, inorganic, radiochemical and bioassay analyses and related support services to meet the needs of our clients.

This Quality Assurance Plan provides an overview of our quality assurance program for analytical services. Outlined in this plan are the responsibilities, policies and processes essential to maintaining client satisfaction and our high quality of performance. The Director of Quality Systems is responsible for revising, controlling, and distributing the QAP. It is updated/reviewed at least annually.

Everyone on our staff is expected to understand the policies, objectives and procedures that are described in this plan and to fully appreciate our commitment to quality and their respective roles and responsibilities with regard to quality. We also expect any analytical subcontractors we employ to perform in accordance with the quality assurance requirements delineated in this plan. All GEL employees are required to participate in Annual Quality Systems training.

This Quality Assurance Plan (QAP) has been prepared according to the standards and requirements of the US Environmental Protection Agency (EPA), ANSI/ISO/IEC 17025-2005, and the National Environmental Laboratory Accreditation Program (NELAP) Quality Systems Standards June 2001 effective July 2003.

**1.1 Quality Policy**

GEL's policy is "to provide high quality, personalized analytical services that enable our clients to meet their environmental needs cost effectively."

We define quality as "...consistently meeting the needs and exceeding the expectations of our clients." As such, we consistently strive to:

- meet or exceed client and regulatory requirements
- be technically correct and accurate

- be defensible within contract specifications
- provide services in a cost-effective, timely and efficient manner

At GEL, quality is emphasized at every level—from the Chairman, CEO, CFO and COO to the newest of employees. Management's ongoing commitment to good professional practice and to the quality of our testing services to our customers is demonstrated by their dedication of personnel and resources to develop, implement, assess, and improve our technical and management operations.

The purpose of GEL's quality assurance program is to establish policies, procedures and processes to meet or exceed the expectations of our clients. To achieve this, all personnel that support these services to our clients are introduced to the program and policies during their initial orientation, and annually thereafter during company-wide training sessions.

GEL's management is committed to compliance with and continual improvement of our quality assurance program. The program is designed to comply with the guidelines and specifications outlined in the following:

- NELAC 2003
- ASME/NQA-1
- ANSI/ISO/IEC 17025-2005
- QAPPs, U.S. EPA QA/R5
- Department of Energy Order 414.1b and 414.1c
- Current U.S. EPA CLP statements of work for inorganic and organic analyses
- ANSI N42.23-1996 Measurement and Associated Instrument Quality Assurance for Radioassay Laboratories
- DOE STD 1112-98
- Performance Criteria for Radiobioassay- ANSI N13.30-1996.
- Energy Reorganization Act, 1974, Section 206, 10 CFR, Part 21
- MARLAP
- 10 CFR Part 21- Reporting of Defects and Noncompliance
- 10 CFR Part 50 Appendix B -Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants

- 10 CFR Part 61- Licensing Requirements for Land Disposal of Radioactive Waste
- NRC REG Guide 4.8
- NRC REG Guide 4.15

## 1.2 Quality Goals

GEL's primary goals are to:

- Ensure that all measurement data generated are scientifically and legally defensible, of known and acceptable quality per the data quality objectives (DQOs), and thoroughly documented to provide sound support for environmental decisions
- Ensure compliance with all contractual requirements, environmental standards, and regulations established by local, state and federal authorities.  
Additional goals include:
- A comprehensive quality assurance program to ensure the timely and effective completion of each measurement effort.
- A commitment to excellence and improvement at all levels of the organization.
- Early detection of deficiencies that might adversely affect data quality.
- Adequate document control.
- Effective quality assurance objectives for measurement systems and for quality data in terms of accuracy, precision, completeness, and comparability through the use of proven methods.
- The establishment of procedures that demonstrate that the analytical systems are in a state of statistical control.
- The implementation of corrective actions and improvements to ensure the integrity of data.
- Reduction of data entry errors through comprehensive automated data handling procedures.
- The development and implementation of good laboratory and standard operating procedures (SOPs).
- Ability to customize quality assurance procedures to meet a client's specific requirements for data quality.
- Good control of instruments, services, and chemical procurement.
- A continuously capable laboratory information management system (AlphaLIMS).

- Validated and documented computer hardware and software.

## 1.3 Key Quality Elements

A sound quality assurance program is essential to our ability to provide data and services that consistently meet our high standards of integrity. The key features of our program are:

- An independent quality assurance (QA) validation and Quality Systems Department.
- A formal quality policy and QAP.
- Management Review
- Stated data quality objectives.
- A comprehensive employee training program.
- Ethics policy and education program.
- Internal audits and self-evaluations.
- A closed-loop corrective action program.
- State-of-the-art facilities and instruments.
- Adherence to standard operating procedures.
- EPA/NIST traceable reference materials.
- Electronically based document control.
- Chain of custody and electronic sample tracking.
- Inter-laboratory comparison programs.
- Formal laboratory accreditations.
- The evaluation of subcontractor laboratories.
- Statistical controls for analytical precision and accuracy.
- Replicate, method blank, matrix spike, tracer yield, internal standards, and surrogate measurements.
- The preventive maintenance of instrumentation and equipment.
- Independently prepared blind standard reference materials.
- Multi-level review processes.
- Focus on client satisfaction.
- Electronic tracking of client commitments, nonconformances and corrective actions.
- Trend analysis of nonconforming items.

## 1.4 Management Reviews

The effectiveness of the Quality System is reviewed at least annually by Senior Management. These reviews address issues that impact quality, and the results of the reviews are used to develop and implement improvements to the system. Records of the review meetings are maintained as quality documents.

**1.5 Disposition of Client Records**

In the event that the laboratory should change ownership, the responsibility for the maintenance and disposition of client records shall transfer to the new owners. In the unlikely event that the laboratory ceases to conduct business, clients shall be notified and asked to provide instructions as to how their records should be returned or disposed. If a client does not provide instructions, those records will be maintained and disposed in a manner consistent with regulations and good laboratory practices for quality records.

**1.6 Supporting Documents**

Our laboratory operations and the quality of our analytical data comply with the specifications described in the documents listed in Appendix A.

**1.7 Definitions**

Applicable definitions are listed in Appendix B.

## SECTION 2

### ORGANIZATION, MANAGEMENT, AND PERSONNEL

#### Section 2 - Organization, Management, and Personnel

The chart found in Appendix C depicts our corporate organization, chain of command and flow of responsibility. The illustration in this appendix is designed to ensure the overall quality and cost efficiency of our company's analytical products and services.

Our structure is based on customer-focused divisions that follow a project from the point of initial contact to the final invoicing of work. These divisions include expertise in project management, sample receipt and custody, sample preparation and analysis, data review and data packaging. An independent Quality Systems Management Department monitors the adherence of these divisions to the Quality Assurance Program.

The general responsibilities associated with the following position levels are discussed in this section:

- Chairman
- Chief Executive Officer (CEO) and President
- Chief Financial Officer (CFO)
- Chief Operating Officer (COO)
- Quality Systems Director
- Laboratory Directors
- Project Managers
- Group Leaders
- Laboratory and Technical Staff
- Information Systems Manager
- Environmental Manager

An overview of GEL's employee training protocol is also provided at Section 2.11.

#### 2.1 Chairman, CEO/President, Chief Financial Officer and Chief Operating Officer

Operational responsibility rests with GEL's three owners and COO. Kathleen H. Stelling, James M. Stelling, and Douglas E. Earnst are GEL's owners and serve respectively as Chairman, CEO/President, and CFO. Carey J. Bocklet occupies the position of COO. As the highest level executives, their philosophical approach to quality, technology and customer service keeps GEL unique.

The Stellings, Mr. Earnst and Ms. Bocklet comprise our Executive Committee. They are also part of a Leadership Team that works to create a workplace environment that attracts and retains highly qualified professionals.

As Chairman, Ms. Stelling oversees the Executive Committee and leads management in implementing total quality initiatives that ensure quality services that meet stringent criteria of excellence. She has responsibility for public relations efforts and community affairs. Ms. Stelling holds a Bachelor of Arts in Education from the University of South Carolina.

As CEO and President, Mr. Stelling has overall operational responsibility for GEL. He operates the laboratory according to corporate policies and applicable licenses and regulations.

Mr. Stelling also has primary responsibility for the development and administration of our analytical testing and environmental consulting services. He holds a Bachelor of Science in Commerce from the University of Virginia.

Douglas E. Earnst is GEL's Chief Financial Officer and oversees our financial management. He is responsible for contracts administration, invoicing, purchasing, payroll, accounts payable and receivable, inventory control, property control, and financial forecasting. Mr. Earnst holds a Bachelor of Science in Business Administration from the Citadel.

The Chief Operating Officer is Carey J. Bocklet. Ms. Bocklet is responsible for the daily operations of the laboratories and client services. Ms. Bocklet holds a Bachelor of Science in Chemical Engineering, and a Masters of Science in Business Administration, both from Clemson University.

Together, the Chairman, CEO/President, CFO and COO form GEL's Executive Committee. Their responsibilities include the following:

- Ensuring that the individuals who staff our technical and quality positions have the necessary education, training and experience to competently perform their jobs.



- Ensuring that all staff members receive ancillary training, as needed, to enhance performance in assigned positions.
- Budgeting, staffing, managing and equipping the laboratory to meet current and future analytical program requirements.
- Overseeing the implementation and overall effectiveness of our Quality Assurance Plan, health and safety initiatives, and environmental programs.
- Managing production and cost control activities.
- Ensuring development of capabilities in response to new or revised regulations, instrumentation and procedures, and quality assurance initiatives.

## 2.2 Technical Laboratory Co-Directors

To enhance our responsiveness to clients through dedicated expertise and teamwork, our laboratory is divided into two major divisions, Chemistry and Radiochemistry, each with its own Technical Laboratory Director.

The Technical Directors report to the Executive Committee and are ultimately responsible for the technical content and quality of work performed within each division. They are also responsible for strategic planning, profitability and growth, personnel management and business development. Other responsibilities include:

- Monitoring and meeting profitability and growth objectives of the division.
- Establishing and implementing short and long range objectives and policies that support GEL's goals.
- Defining the minimum level of qualification, experience, and skills necessary for positions in their divisions.
- Establishing and implementing policies and procedures that support our quality standards.
- Ensuring that technical laboratory staff demonstrates initial and continuing proficiency in the activities for which they are responsible.
- Documenting all analytical and operational activities of the laboratory.
- Supervising all personnel employed in the division.
- Ensuring that all sample acceptance criteria is verified and that samples are logged into the

sample tracking system, properly labeled and stored.

- Documenting the quality of all data reported by the division.
- Developing internal mechanisms and measurements to improve efficiency.
- Overseeing activities designed to ensure compliance with laboratory health and safety requirements.
- Allocating the resources necessary to support an effective and ongoing quality assurance program.
- Representing the company to the public and to clients.
- Ensuring the appropriate delegation of authorities during periods of absence.
- Ensuring compliance to the ISO 17025:2005 Standard.

Due to high volume and variety of analytical tests performed in the Chemistry Laboratory, the Technical Director for the Chemistry Laboratory has the daily assistance of a Production Manager.

## 2.3 Quality Systems Director

Our Quality Systems Director (QSD) reports directly to the CEO. The QSD manages the design, implementation and maintenance of our quality systems in a timely, accurate, and consistent manner.

In addition to having responsibility for the initiation and recommendation of corrective and preventative actions, the QSD is responsible for:

- Establishing, documenting and maintaining comprehensive and effective quality systems.
- Developing and evaluating quality assurance policies and procedures pertinent to our laboratory functions, and communicating these with the division directors and managers.
- Ensuring that the operations of the lab are in conformance with the Quality Assurance Plan and meet the quality requirements specific to each analytical method.
- Ensuring that laboratory activities are in compliance with local, state and federal environmental laws and regulations.
- Reviewing project-specific quality assurance plans.

- Ensuring that quality control limits are established and followed for critical points in all measurement processes.
- Initiating internal performance evaluation studies using commercially purchased certified, high-purity standard reference materials.
- Performing independent quality reviews of randomly selected data reports.
- Conducting periodic audits to ensure method compliance.
- Conducting or arranging periodic technical system evaluations of facilities, instruments and operations.
- Overseeing and monitoring the progress of nonconformances and corrective actions.
- Communicating system deficiencies, recommending corrective action to improve the system, and defining the validity of data generated during out of control situations.
- Preparing and updating quality assurance documents and reports to management.
- Coordinating inter-laboratory reviews and comparison studies.
- Overseeing Stop Work Orders in out of control situations.
- Administering accreditation and licensing.
- Administering our document control system.
- Providing guidance and training to laboratory staff as requested.
- Evaluating subcontractors and vendors that provide analytical and calibration services.
- Designating quality systems authorities in times of absence to one or more appropriately knowledgeable individuals.
- Overseeing notification if required for compliance with Energy Reorganization Act, 1974, 10 CFR, Part 21, should data recall be necessary.

## 2.4 Quality Systems Review

The effectiveness of the Quality System is reviewed on a regular basis during meetings of the Leadership Team, which may be as often as weekly, but not less than quarterly. These meetings address issues that impact quality and the subsequent discussions are used to design and implement improvements to the system. At least annually, a management assessment of GEL's Quality

System is conducted and reported. The QSD maintains records of these assessments.

## 2.5 Manager of Client and Support Services

Project Managers (PMs) serve as primary liaisons to our clients. PMs, under the guidance of the Manager of Client and Support Services, manage the company's interaction with clients. They are the client's first point of contact and have responsibility for client satisfaction and for communicating project specifications and changes to the appropriate laboratory areas.

Additional responsibilities include:

- Retaining clients and soliciting new work.
- Managing multiple sample delivery orders and preparing quotes.
- Working with clients to define analytical methodologies, quality assurance requirements, reports, deliverables, and pricing.
- Overseeing sample management and informing laboratory staff of the anticipated arrival of samples for analysis.
- Conducting a review of client documents (i.e. quotes, invoices, routine and specialized reports).
- Working with the accounting team on invoicing and collection issues.
- Working with the Laboratory Directors and Production Manager to project workloads and determine schedules.

## 2.6 Production Manager and Group Leaders

Group Leaders are a critical link between project management, lab personnel and support staff. They report to the Technical Directors and have the following responsibilities:

- Planning and coordinating the operations of their groups to meet client expectations.
- Scheduling sample preparation and analyses according to holding times, quality criteria, and client due dates.
- Ensuring a multi-level review of 100% of data generated by their groups.
- Coordinating nonconformances and corrective actions in conjunction with the Quality Systems Management team.
- Serving as technical resources to their groups, including data review.

- Managing special projects, reviewing new work proposals, and overseeing the successful implementation of new methods.
- Monitoring and controlling expenses incurred within their groups such as overtime and consumables.
- Providing performance and career development feedback to their group members.

## 2.7 Laboratory and Technical Staff - General Requirements

At GEL, every effort is made to ensure that the laboratory is sufficiently staffed with personnel who have the training, education and skills to perform their assigned jobs competently.

Depending upon the specific position, laboratory personnel are responsible for:

- Complying with quality assurance and quality control requirements that pertain to their group and/or technical function.
- Demonstrating a specific knowledge of their particular function and a general knowledge of laboratory operations.
- Understanding analytical test methods and standard operating procedures that are applicable to their job function.
- Documenting their activities and sample interactions in accordance with analytical methods and standard operating procedures.
- Implementing the quality assurance program as it pertains to their respective job functions.
- Identifying potential sources of error and reporting any observed substandard conditions or practices.
- Identifying and correcting any problems affecting the quality of analytical data.

## 2.8 Information Systems Manager

The Information Systems Manager reports directly to the COO. The responsibilities of this position include management of the Computer Services Team and AlphaLIMS, our laboratory information management system.

The combined responsibilities of the Information Systems Team, performing under the leadership of the Information Systems Manager, include the:

- Development and maintenance of all software and hardware.
- Translation and interpretation of routines for special projects.
- Interpretation of general data and quality control routines
- Optimization of processes through better software and hardware utilization.
- Customization, testing and modification of data base applications.
- Maintenance and modification of our computer modeling, bar coding, CAD, statistical process control, project management, and data packaging systems.
- Development and maintenance of client and internal electronic data deliverables.
- Validation and documentation of software used in processing analytical data.

## 2.9 Environmental Manager

The Environmental Manager oversees our physical facility, laboratory and radiation safety programs, and instrumentation. This position reports to the COO, and manages and supervises the functions and staff assigned to these areas.

Responsibilities of the Environmental Manager include:

- Planning, evaluating and making recommendations for facility maintenance, additions and renovations.
- Overseeing building renovations and new construction activities.
- Implementation of the Chemical Hygiene and Radiation Safety programs.
- Installing, maintaining, repairing and modifying analytical instrumentation.
- Providing technical expertise and training in instrumentation operation, calibration and maintenance.
- Monitoring and ensuring regulatory compliance for waste management operations and off-site disposal.

**2.10 Radiation Safety Officer**

The Radiation Safety Officer (RSO) reports to the Environmental Manager. The RSO is responsible for the administration and execution of GEL's Radiation Protection Program. This person provides technical guidance and leadership for all issues concerning radiation health and safety as well as direct operations to ensure compliance with South Carolina Department of Health and Environmental Control (SCDHEC) regulations for radioactive materials.

Responsibilities of the RSO include:

- Establishing and enforcing policies consistent with the principles and practices designated to maintain all exposure to ionizing radiation "As Low As Reasonably Achievable" (A LARA)
- Supervising Radiation Protection Specialists in the execution of radiological surveys and maintenance of the Radioactive Material License inventory
- Executing the Personal Dosimetry, Air Effluent Monitoring, and Sealed Radioactive Source Leak test Programs
- Developing procedures and protocols to establish and maintain compliance
- Providing training for staff in proper radiation protection practices

**2.11 Director of Human Resources**

The Director of Human Resources reports directly to the CEO. The DHR manages the design, implementation, and ongoing development of our Human Resources. Responsibilities of the DHR include:

- Administration, orientation and indoctrination of all new employees
- Administration and compliance with Federal, State, and Local employment regulations
- Sourcing candidates for all functional positions to maintain and strengthen the technical services provided by GEL
- Management of occupational health and safety as it relates to Federal, State, and OSHA regulations

**2.12 Employee Training**

To ensure that our clients receive the highest quality services possible, we train our employees in the general policies and practices of the company, as well as the specific operating procedures relative to their positions. We conduct and document this training according to GL-HR-E-002 for Employee Training and GL-HR-E-003 for Maintaining Training Documentation.

New employees participate in a company orientation shortly after they are hired. During orientation they receive information on quality systems, ethics/data integrity, laboratory safety, and employment practices. Each new employee is also provided a manual that reiterates our policies on equal opportunity, benefits, leave, conflicts of interest, employee performance and disciplinary action. Employees can access standard operating procedures, the Quality Assurance Plan, Safety, Health and Chemical Hygiene Plan, and the Laboratory Waste Management Plan on GEL's Intranet.

Other training provided on an ongoing basis may include:

- Demonstration of initial proficiency in analytical methods and training to SOPs conducted by a trainer who has been documented as qualified and proficient in the process for which training is being provided.
- Demonstration of continued analyst proficiency is updated annually, usually during the first quarter of each year. Proficiency is demonstrated using the same processes as those used for initial Demonstration of Capability. (See section 8.3.1)
- Company-wide, onsite training.
- Courses or workshops on specific equipment and analytical techniques.
- University courses.
- Professional and trade association conferences, seminars, and courses.

Documentation of employee training is the joint responsibility of the employee and the applicable Group Leader. If an SOP is revised during the course of the year, training to the revised SOP must be documented.

**2.13 Ethics and Data Integrity**

As our corporate vision statement explains, "We are a company that values: Excellence as a way of life, Quality Service, A Can-Do attitude, and a fundamental

commitment to Ethical Standards." Employees attend Ethics education programs that focus on the high standards of data integrity and ethical behavior mandated by our company and expected by our clients.

The annual ethics training includes:

- Specific examples of unethical behaviors for the industry and for the laboratory
- Explanation of Internal Auditing for unethical behaviors and practices
- GEL use of electronic audit functions using instrument and AlphaLIMS software
- Explanation of GEL's Ombudsman policy for reporting inappropriate activities
- Examples of consequences of inappropriate or unethical behaviors/practices

All employees sign an Ethics and Data Integrity Agreement that reflects their commitment to always perform their duties with these high standards. (See Appendix F)

## 2.14 Confidentiality

The laboratory maintains the confidentiality and proprietary rights of information including the type of work performed and results of analysis. Laboratory personnel and staff are informed of this policy and sign a confidentiality agreement.

A confidentiality statement accompanies the electronic transfer of data from GEL via telefacsimile (fax) or electronic mail systems (email). Government affiliated auditing agencies have access to pertinent laboratory records. However, contract, third party, and client auditors have access only to those records that may be applicable to their inspection and shall not be granted access to client records that may be considered in conflict with their interests, unless prior authorization has been given by the submitting client. Confidential information may be purged of references to client identity, project and/or sample identity by the laboratory so that records may be provided to other entities (e.g. auditors) for review.



## SECTION 3 QUALITY SYSTEMS

### Section 3 - Quality Systems

Our Quality Systems include all quality assurance (QA) policies and quality control procedures (QC) necessary to plan, implement, and assess the work we perform. GEL's QA Program establishes a quality management system (QMS) that governs all of the activities of our organization.

GEL's quality management system is designed to conform to the requirements specified in the standards referenced in Appendix A. Essential elements of our quality management system are described in this section.

#### 3.1 Quality Systems Team

The quality systems team is responsible for managing GEL's QA Program. This team functions independently of the systems it monitors and is comprised of the Quality Systems Director, Lead Auditor, QA Officers and/or Specialists.

Following is a summary of the responsibilities of each position.

##### 3.1.1 Quality Systems Director

- Reports to the CEO
- Demonstrates strict adherence to and support of the company ethics policy.
- Serves as management's representative for quality
- Responsible for the implementation and maintenance of the QMS
- Supervises the Quality Systems Team and their functions
- Initiates and recommends preventive action and solutions to quality problems
- Implements appropriate action to control quality problems until solutions are implemented and verified to be effective
- Verifies that effective solutions are implemented
- Demonstrates knowledge of the Quality System as defined by NELAC, ANSI/ISO/IEC 17025, DOEAP, and DOELAP.

##### 3.1.2 Quality Systems Lead Auditor

- Reports to the Quality Systems Director
- Demonstrates strict adherence to and support of the company ethics policy.
- Demonstrates knowledge of the Quality System defined under NELAC, DOEAP, and DOELAP and other quality standards such as ANSI/ISO/IEC 17025-2005.
- Plans, schedules and participates in GEL's client audits, internal audits and subcontractor audits
- Conducts conformance audits as necessary to verify implementation and closure of audit action items
- Serves as liaison to client and third party auditors
- Coordinates laboratory responses to audit reports and prepares final response
- Monitors progress of corrective actions
- Prepares and monitors progress of internal and subcontractor audit reports

##### 3.1.3 Quality Assurance Officers

- Report to the Quality Systems Director
- Demonstrate strict adherence to and support of the company ethics policy.
- Demonstrate the ability to evaluate data objectively without outside influence
- Have documented training and/or experience in QA/QC procedures and knowledge of the Quality system as defined under NELAC and ISO 17025
- Have knowledge of analytical methods
- Assist in the conduct of internal and supplier audits and requests for pricing reviews
- Administer corrective actions and nonconformances
- Monitor and respond to client -identified nonconformances and technical inquiries
- Implement and maintain statistical process control (SPC) system
- Ensure the monitoring of balances, weights, and temperature regulation of ovens, waterbaths, and refrigerators
- Coordinate the monitoring of DI water system and volatile organics storage coolers

- Maintain Method Detection Limit studies
- Write or review Quality documents and standard operating procedures under the direction of the QS Director
- Provide training in quality systems and good laboratory practices.
- Manage Laboratory Certification processes
- Coordinate the receipt and disposition of external and internal performance evaluation samples.

**NOTE:** Once PE samples have been prepared in accordance with the instructions provided by the PE vendor, they are managed and analyzed in the same manner as environmental samples from clients. The analytical and reporting processes for PE samples are not specially handled.

#### 3.1.4 *Quality Systems Specialists*

- Reports to the Quality Systems Director
- Demonstrates strict adherence to and support of the company ethics policy.
- Assist the team as directed with respect to Records Management, Document Control, Laboratory Certification, temperature and weight calibrations, logbook review, training documentation and nonconformances, etc.

### 3.2 **Quality Documents**

Our Quality Systems policies and procedures are documented in the QA Plan (GL-QS-B-001) and other supporting documents. GEL's management approves all company quality documents. Pre-approval is secured for any departures from such documents that may affect quality.

In addition, to the QA Plan, Quality Systems allows for QA Project plans (QAPjP) and includes standard operating procedures and any other quality assurance program requirements defined by individual contracts. The QA Plan describes the quality standards that we apply to our laboratory operations. We use Quality Assurance Project Plans to specify individual project requirements. The QA Plan and supporting documents are verified to be understood and are implemented throughout the laboratory fractions to which they apply.

Finally, our Standards Operating Procedures (SOPs) are used to describe in detail those activities that affect quality. SOP's are prepared, authorized, changed and released in accordance with GL-ADM-E-001. SOPs are accessible electronically via GEL's Intranet.

### 3.3 **Document Control**

The control of quality documents is critical to the effective implementation of our Quality Program. We define and control this process in accordance with GL-DC-E-001 for Document Control. Responsibilities for document control are divided between the Group Leaders and the Document Control Officer (DCO).

#### Group Leaders are responsible for:

- Supporting the development and maintenance of controlled documents that apply to their respective departments
- Reviewing all quality documents annually for continued validity
- Ensuring documentation that the affected employees are aware of revisions to documents or manuals.

#### The Computer Services Team is responsible for:

- Electronic maintenance of all records required for control, re-creation and maintenance of analytical documentation
- Maintenance of electronic copies of archived data and the electronic log of how they were determined

#### The DCO is responsible for:

- Demonstrating strict adherence to and support of the company ethics policy.
- Managing the system for the preparation, authorization, change and release of the Quality Manual, QAP, project plans and standard operating procedures
- Ensuring that current controlled documents are accessible via GEL's Intranet.
- Managing a system to document current revision numbers and revision dates for all distributed documents and manuals
- Managing a system to identify the nature of document revisions.
- Maintaining hard or electronic copies of obsolete documents
- Maintaining electronic or hard copy originals of all controlled documents

Revisions to controlled quality documents are made by replacing individual sections or the entire document, as determined by the DCO.

### 3.4 Controlled Document Review

Internally generated controlled documents undergo a multi-level review and approval process before they are issued. These levels include a procedural review, technical and/ or quality review and the final authorization of the appropriate manager or director. To ensure that new or revised standard operating procedures are not implemented prematurely, SOPs are effective upon the date of the final approval signature.

### 3.5 Quality Records

Quality records provide evidence that specified quality requirements have been met and documented. We generate them in accordance with applicable procedures, programs and contracts. Quality records include but are not limited to:

- Observations
- Calculations
- Calibration data
- Certificates of analysis
- Certification records
- Chains of custody
- Audit records
- Run logs, instrument data and analytical logbooks
- Instrument, equipment and building maintenance logs
- Material requisition forms
- Monitoring logs
- Nonconformance reports and corrective actions
- Method development and start-up procedures including method detection limit studies
- Technical training records
- Waste management records
- Standard logs
- Software validation documentation
- Standard Operating Procedures (SOPs)
- Sample collection and field data

Our Quality Records are:

- Documented in a legible manner
- Indexed and filed in a manner conducive to ready retrieval
- Stored in a manner that protects them from loss, damage, and unauthorized alterations
- Accessible to the client for whom the record was generated

- Retained and disposed in the identified time period

The generation, validation, indexing, storage, retrieval, and disposition of our quality records are detailed in GL-QS-E-008 for Quality Record Management and Disposition. The Quality Records of subcontracted services are also required to meet the conditions established in this SOP.

### 3.6 Internal and Supplier Quality Audits

We conduct internal audits annually to verify that our operations comply with the requirements of our QA program and those of our clients. We perform supplier audits as necessary to ensure that they too meet the requirements of these programs. Both internal and supplier audits are conducted in accordance with GL-QS-E-001 for the Conduct of Quality Audits.

#### 3.6.1 Audit Frequency

Internal audits are conducted at least annually in accordance with a schedule approved by the Quality Systems Director. Supplier audits are contingent upon the categorization of the supplier, and may or may not be conducted prior to the use of a supplier or subcontractor (see GL-QS-E-001). Type I suppliers and subcontractors, regardless of how they were initially qualified, are re-evaluated at least once every three years.

Additional internal and supplier audits may be scheduled if deemed necessary.

#### 3.6.2 Audit Team Responsibilities

Internal and supplier audits are conducted by qualified staff under the direction of the Lead Auditor or Quality Systems Director. A qualified audit team member shall have the technical expertise to examine the assigned activities.

We do not allow staff to audit activities for which they are responsible or in which they are directly involved. It is the responsibility of the Lead Auditor to ensure that such conflicts of interest are avoided when the audit team is assembled.

The Leadership Team has a significant role in the internal audit process, including:

- Provision of audit personnel
- Empowerment of the audit team with authority to make the audit effective
- Development and implementation of timely corrective action plans



### 3.6.3 Identification and verification of OFIs

Opportunities for Improvement are identified conditions that may adversely affect the quality of products or services. Several examples of objective evidence are used to support an OFI, which might be classified as a finding, concern, observation, and/or recommendation.

The Lead Auditor may initiate a Nonconformance (NCR) or Corrective Action Request and Report (CARR) referencing the OFI. The NCR or CARR is then entered into the NCR system per GL-QS-E-012 for NCR Database Operation.

Implementation of a corrective action is later verified by a re-audit of the deficient area, review of new or revised documents, or, if the OFI does not warrant immediate action, the corrective action may be verified during the next scheduled audit.

### 3.7 Managerial and Audit Review

Our Leadership Team reviews the audit process at least yearly. This ensures the effectiveness of the corrective action plan and provides the opportunity to introduce changes and improvements.

We document all review findings and corrective actions. Implementation plans and schedules are monitored by the Quality Systems Team.

### 3.8 Nonconformances

Processes, materials, and services that do not meet specifications or requirements are defined as nonconforming. Such non-conformances can include items developed in-house or purchased from vendors, samples received from clients, work in progress, and client reports.

At GEL, we have a nonconformance reporting system (NCR) that helps us prevent the entry of defective goods and services into our processes and the release of non-conforming goods and services to our clients. Our NCR system provides a means for documenting the disposition of nonconforming items and for communicating these to the persons involved in the process affected by the adverse condition(s).

Nonconformances are documented according to GL-QS-E-004 for the Documentation of Nonconformance Reporting and Disposition and Control of Nonconforming Items. We regularly review SOPs, client complaints, and quality records, including completed NCRs, to promptly identify conditions that might result in situations or

services that do not conform to specified quality requirements.

Our Quality Group processes, categorizes and trends nonconformances. Trending information may be provided to the Leadership Team and Group Leaders of the affected areas.

### 3.9 Corrective Action

There are two categories of corrective action at GEL. One is corrective action implemented at the analytical and data review level in accordance with the analytical SOP. The other is formal corrective action documented by the Quality Systems Team in accordance with GL-QS-E-002. Formal corrective action is initiated when a nonconformance reoccurs or is so significant that permanent elimination or prevention of the problem is required.

We include quality requirements in most analytical SOPs to ensure that data is reported only if the quality control criteria is met or the quality control measures that did not meet the acceptance criteria are documented.

Formal corrective action is implemented according to GL-QS-E-002 for Conducting Corrective/Preventative Action and Identifying Opportunities for Improvement and documented according to GL-QS-E-012 for NCR Database Operation.

Any employee at GEL can identify and report a nonconformance and request that corrective action be taken. Any GEL employee can participate on a corrective action team as requested by the QS team or Group Leaders. The steps for conducting corrective action are detailed in GL-QS-E-002.

In the event that correctness or validity of the laboratory's test results is doubted, the laboratory will take corrective action. If investigations show that the results have been impacted, affected clients will be informed of the issue in writing within 21 calendar days of the discovery.

### 3.10 Performance Audits

In addition to internal and client audits, our laboratory participates in annual performance evaluation studies conducted by independent providers. We routinely participate in the following types of performance audits:

- Proficiency testing and other inter-laboratory comparisons.

- Performance requirements necessary to retain certifications (Appendix D).
- Evaluation of recoveries of certified reference and in-house secondary reference materials using statistical process control data.
- Evaluation of relative percent difference between measurements through SPC data.

We also participate in a number of proficiency testing programs for federal and state agencies and as required by contracts. It is our policy that no proficiency evaluation samples be analyzed in any special manner.

Our annual performance evaluation participation generally includes a combination of studies that support the following:

- US Environmental Protection Agency Discharge Monitoring Report, Quality Assurance Program (DMR-QA). Annual national program sponsored by EPA for laboratories engaged in the analysis of samples associated with the NPDES monitoring program. Participation is mandatory for all holders of NPDES permits. The permit holder must analyze for all of the parameters listed on the discharge permit. Parameters include general chemistry, metals, BOD/COD, oil and grease, ammonia, nitrates, etc.
- Department of Energy Mixed Analyte Performance Evaluation Program (MAPEP). A semiannual program developed by DOE in support of DOE contractors performing waste analyses. Participation is required for all laboratories that perform environmental analytical measurements in support of environmental management activities.
- ERA's MRAD-Multimedia Radiochemistry Proficiency test program. This program is for labs seeking certification for radionuclides in wastewater and solid waste. The program is conducted in strict compliance with USEPA National Standards for Water Proficiency study.
- ERA's InterLab RadChem Proficiency Testing Program for radiological analyses. This program completes the process of replacing the USEPA EMSL-LV Nuclear Radiation Assessment Division program discontinued in 1998. Laboratories seeking certification for radionuclide analysis in drinking water also use the study. This program is conducted in strict compliance with the USEPA National Standards for Water Proficiency Testing Studies.
- Water Pollution (WP). Biannual program for waste methodologies. Parameters include both organic and inorganic analytes.
- Water Supply (WS): Biannual program for drinking water methodologies. Both organic and inorganic parameters are included.

At GEL, we also evaluate our analytical performance on a regular basis through statistical process control acceptance criteria. Where feasible, this criterion is applied to both measures of precision and accuracy and is specific to sample matrix.

We establish environmental process control limits at least annually. In Radiochemistry, quality control evaluation is based on static limits rather than those which are statistically derived. Our current process control limits are maintained in AlphaLIMS.

We also measure precision through the use of matrix duplicates and/or matrix spike duplicates. The upper and lower control limits (UCL and LCL respectively) for precision are plus or minus three times the standard deviation from the mean of a series of relative percent differences. The static precision criteria for radiochemical analyses are 0 - 20% for activity levels exceeding the contract reporting detection limit (CRDL).

Accuracy is measured through laboratory control samples and/or matrix spikes, as well as surrogates and internal standards. The UCLs and LCLs for accuracy are plus or minus three times the standard deviation from the mean of a series of recoveries. The static limit for radiochemical analyses is 75 - 125%. Specific Instructions for out-of control situations are provided in the applicable analytical SOP.

### 3.11 Essential Quality Control Measures

Some quality control measures are method-specific. There are, however, general quality control measures that are essential to our quality system. These quality measures include:

- Monitoring of negative and positive controls
- Defining variability and reproducibility through duplicates
- Ensuring the accuracy of test data including calibration and/or continuing calibrations, use of certified reference materials, proficiency test samples, etc.

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- Evaluating test performance using method detection limits and quantitation limits or range of applicability such as linearity
- Selecting the appropriate method of data reduction
- A copy of GEL's Ethics and Integrity Agreement is provided in Appendix F.

## SECTION 4

### FACILITIES

#### Section 4 - Facilities

Our laboratory is designed with a full-service approach to handling environmental needs. The layout provides dedicated space for radiochemical analyses, bioassay analysis, organic extractions, semi-volatile organic analyses, volatile organic analyses, metals analyses, general chemistry analyses, and air analyses.

The laboratory and support offices occupy approximately 85,000 square feet engineered to meet the stringent quality control and utility requirements of the modern environmental laboratory. Records are temporarily stored on-site then warehoused in a climate-controlled building off-site. The diagram in Appendix H depicts the layout of the laboratories.

Discussed in this section are:

- Facility security
- Utility services and deionized water
- Prevention of contamination
- Assessment of contamination

#### 4. Facility Security

Our facility features secured laboratory and storage areas. Restricted entry assures sample integrity and client confidentiality, which satisfies clients and potential national security interests.

Visitors cannot gain entry without being escorted through the laboratory by authorized personnel. A designated sample custodian and a bar-coded chain-of-custody provide a second level of security.

#### 4.2 Utility Services

Each defined laboratory area is equipped with the following utilities:

- Cold Water
- Hot Water
- Deionized Water
- Compressed Air
- Natural Gas
- Vacuum
- 110 Volt AC
- 208 Volt AC (at selected stations)
- Specialty gases (as required)

#### 4.2.1 Deionized Water

We have two independent deionized water (DI) systems. One serves radiochemistry while the other serves the remaining laboratories. DI water is made from city water flowing through a deionization system capable of producing 5 gallons per minute of Type II laboratory water. Tables 1 and 2 list the minimum requirements for Type I and Type II DI water.

**Table 1: ASTM Type I DI Water**

Quality Parameter	Limits
Bacteria, CFU/mL	<10
pH	not specified
Resistivity, min. MΩ-cm at 25C	>16.67
Conductivity, max. μmho/cm at 25C	≤ 0.06
Trace Metals, Single (Cd,Cr,Cu,Ni,Pb, Zn)	< 0.05 mg/L
Trace Metals, Total	< 0.1 mg/L
Free Chlorine	not specified
Ammonia/Organic Nitrogen	not specified
TOC	not specified
Organic Contaminants	Activated carbon

**Table 2: ASTM Type II DI Water**

Quality Parameter	Limits
Bacteria, CFU/mL	< 1000
pH	not specified
Resistivity, min. MΩ-cm at 25C	> 1.0
Conductivity, max. μmho/cm at 25C	≤ 1.0
Trace Metals, Single (Cd,Cr,Cu,Ni,Pb, Zn)	< 0.1 mg/L
Trace Metals, Total	not specified
Free Chlorine	< 0.1 mg/L
Ammonia/Organic Nitrogen	< 0.1 mg/L
TOC	< 1.0 mg/L
Organic Contaminants	not specified

We monitor compliance with the above limits according to GL-LB-E-016 for Collection and Monitoring the DI Water Systems. Our monitoring activities and frequencies can be found in Table 1 of the SOP.

#### 4.3 Prevention of Contamination

Work areas that are free of sample contaminants, constituents and measurement interferences are important to the generation of quality data. With this in mind, we designed our laboratories to prevent contamination and reinforce this design with good laboratory practices.

In addition to keeping our work areas free of dust and dirt accumulations, policies and features that prevent or minimize contamination include:

- An air conditioning system that controls the environment of individual laboratories for optimum performance of sensitive instruments and to eliminate potential cross contamination
- Segregation of volatile and semi-volatile laboratories to minimize potential contamination associated with the use of commonly required solvents
- Negative and positive pressure air locks to isolate selected laboratories to prevent the entry of airborne contaminants
- Fume hoods to remove fumes and reduce the risk of aerosol and airborne contaminants and personnel safety hazards are monitored in accordance with GL-FC-E-003 for Fume Hood Face Velocity Performance Checks.

- Restricted access to the volatiles laboratory (authorized personnel only)
- Designated area for glassware preparation wherein all glassware used in sample prep and analysis is cleaned according to GL-LB-E-003 for Glassware Preparation
- Segregated storage areas for volatiles and radioactive samples
- Production, use and monitoring of Type I and Type II DI water
- Tracking and trending of any significant sample and/or reagent spills using the AlphaLIMS NCR system, allowing efficient analysis of any potential contamination.

#### 4.4 Assessment of Contamination Levels

We evaluate contamination resulting from the following sources on the basis of quality assurance and quality control data derived from the analytical method and method blanks.

- Sample containers
- Reagent water
- Reagents and solvents
- Sample storage
- Chemical and physical interference
- Constituent carryover during analysis

Contamination in each of the volatile storage coolers is monitored by the weekly analysis of water blanks. Four DI water blanks are placed in the cooler at the beginning of each month with one being analyzed each week. If the concentration of any target analyte exceeds the PQL, corrective action is implemented to eliminate the source of contamination, evaluate the effect of samples stored in the cooler, and to notify clients.

**SECTION 5****EQUIPMENT and REFERENCE MATERIALS****Section 5 - Equipment and Reference Materials**

GEL's ability to efficiently generate data that are reproducible, accurate, and legally defensible is attributable to our use of high-quality instruments, equipment, and reference materials.

Provided in this section are:

- GEL's policies governing instruments, equipment, and reference materials
- Identification of instrumentation and support equipment
- Procurement protocol

**5.1 General Policies**

It is our policy to purchase instrumentation, equipment and high-quality reference materials that meet or exceed the method and regulatory requirements for the analyses for which we are accredited. If we need to use instruments or equipment not under our permanent control, we ensure that it also meets these standards.

Instrumentation and equipment is placed into service on the basis of its ability to meet method or regulatory specified operating conditions such as range and accuracy. All laboratory instrumentation and testing equipment is maintained in accordance with standard operating procedures (SOPs).

Instrumentation and equipment is used in a manner that assures, where possible, that measurement uncertainty is known and consistent with specified quality requirements. Instruments and equipment are taken out of service and segregated or labeled as such under the following conditions:

- Mishandling and/or overloading
- Results produced are suspect
- Demonstrated defect or malfunction

Tagged or segregated instruments and equipment remain out of service until repaired and shown by test, calibration, or verification to perform satisfactorily. Instruments that are in service and normally calibrated prior to and during use are not tagged.

Each item of equipment, including reference materials is, if appropriate, labeled, marked or otherwise identified to indicate its calibration status. We maintain records for each major item of equipment,

instrumentation, and all reference materials significant to quality performance. These records are often in the form of maintenance logs, which are kept in accordance with GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other record Keeping Devices.

Documentation included in these records includes but is not limited to:

- Equipment name
- Manufacturer's name
- Type identification
- Serial number or other unique identification
- Date received and date placed in service (if available)
- Current location
- Condition when received (if known)
- Manufacturer's instruction, where available
- Dates and results of calibrations and or verifications
- Date of next calibration and/or verification, where written procedures do not specify frequency
- Details of maintenance carried out to date and planned for the future
- History of any damage, malfunction, modification or repair

**5.2 Instrumentation and Support Equipment**

Appendix G lists the instruments we use for the analysis of environmental, radiochemical and bioassay samples. Where feasible, our instruments are equipped with autosamplers that improve efficiency and facilitate consistent sample introduction to the sample detector. They are also connected to an area network to facilitate data transfer.

Devices that may not be the actual test instrument but are necessary to support laboratory operations are referred to as support equipment. We also maintain this equipment in proper working order. Support equipment utilized at GEL includes:

- balances
- ovens
- refrigerators
- freezers
- incubators
- water baths
- temperature measuring devices



- volumetric dispensing devices
- muffle furnaces
- distillation apparatus
- grinders and homogenizers
- hot plates and heating mantles
- ultraviolet sterilizers.

Guidelines for the required calibration and evaluation of this equipment are discussed in Section 7.

We perform radiochemical and bioassay analytical services in accordance with the instrumentation and reference methods approved by the Department of Energy (DOE), the Environmental Measurements Lab (EML), the Environmental Protection Agency (EPA), ASTM, and Los Alamos Health and Environmental Chemistry (LAHEC). Modifications to these methods may be appropriate as a result of Performance Based Measurement Systems (PBMS).

SOPs are used to describe our procedures for all routine analyses performed by our labs. These procedures include step-by-step instructions for sample collection, storage, preparation, analysis, instrument calibration, quality control, disposal, and data reporting.

### 5.3 Procurement and Control of Purchased Items

Materials, equipment and services that affect the quality of our products are designated as Quality Materials, Equipment and Services and are only purchased from approved suppliers. We approve and document suppliers according to GL-QS-E-001 for the Conduct of Quality Audits.

At GEL, we maintain documentation of specific quality requirements for Quality Materials and Services. Records that document the quality of a product or service may include:

- certificates of analysis and traceability
- verifications of chemical quality
- inspections of equipment or materials
- verifications or inspections of vendor product specifications

Our procedure for requisitioning supplies, instruments, equipment and other common use material is described in GL-RC-E-002 for Material Requisition. These requests typically include:

- The date and name of person(s) requesting materials
- Account, department, project number to which the material is to be billed
- Recommended supplier or vendor
- Additional information necessary to expedite the purchase request
- Specifications that could affect the quality of products and services
- Vendor's material part number
- Amount of material needed
- Description of material
- Cost per unit
- Person(s) authorizing the purchase
- Time frame in which the material is needed

The equipment, instruments and reference materials we purchase are inspected upon receipt in accordance with GL-RC-E-001 for the Receipt and Inspection of Material and Services. This inspection is to verify that procured items meet the acceptance criteria defined in the procurement documentation. Staff performing initial inspection routinely:

- Open and inspect all items for damage
- Compare the items with the issued purchase order or contract for catalog or part number, description or procurement specification, quality requirement, and acceptance criteria
- Label items with a limited shelf life with the date received
- Determine if the items conform to the specifications agreed to by the vendor.

The individual responsible for the technical acceptance of the item provides procurement and receiving staff with the proper acceptance documentation. Items found not to conform to quality standards are returned to the supplier, identified as nonconforming or disposed according to the established procedures in GL-QS-E-004 for Documentation of Nonconformance Reporting and Dispositioning, and Control of Nonconforming Items.

**SECTION 6****HEALTH and SAFETY****Section 6 - Health and Safety**

GEL maintains a safe work environment and promotes healthy work practices. Our corporate Safety, Health and Chemical Hygiene Plan was developed by a resident certified industrial hygienist. Procedures outlined in the plan are consistent with Occupational Safety and Health Administration, CERCLA, the Environmental Protection Agency, and SCDHEC.

All employees are trained in the safety practices applicable to their job functions. This training is conducted in accordance with GL-HR-E-002 for Employee Training.

Discussed in the section are:

- Fire safety and safety equipment
- Safety equipment and procedures related to handling radioactive samples

**6.1 Fire Safety**

Our facility is equipped with a fire alarm system designed to detect smoke in all areas of the facility. Certain high-risk areas, such as, the cold and ambient storage areas, organic sample preparation lab, hazardous waste lab, and solvent storage are additionally equipped with automatic halon systems. Fire blankets and dry chemical extinguishers are located at strategic points throughout the lab. We routinely inspect these extinguishers in accordance with GL-FC-E-004. Lab personnel are trained in the proper use and selection of fire extinguishers.

In order to decrease the risk of fire, bulk solvents are stored in a halon protected storage room.

**6.2 Evacuation**

In the unlikely event of a fire (or other emergency), we have defined evacuation routes depicted in Appendix H. This diagram is posted in pertinent areas of the facility and designated staff serve as evacuation leaders for the work groups.

**6.3 Safety Equipment**

Safety equipment, including safety glasses, lab coats, safety goggles, protective gloves, hard hats, and coveralls, is available to all employees as needed. We also provide respirators when needed to those who have

completed training in the use of this specialized equipment.

Eyewashes and overhead showers are located throughout the laboratory. We routinely inspect these as directed in GL-FC-E-002 for Testing of Emergency Eyewash and Shower Equipment.

**6.4 Radiation Safety**

Since GEL specializes in the handling of radioactive material, we have health physics procedures to ensure its safe handling. While lab personnel do not encounter significant levels of radiation requiring personal monitoring, a Dosimetry Program is in effect utilizing personal dosimeters for designated personnel. These dosimeters are exchanged quarterly and records of exposure are maintained. Instructions for the proper use of dosimeters are addressed in GL-RAD-S-009 for Personnel Dosimetry.

We take special precautions to ensure that samples are safely processed. Upon receipt, trained personnel use a survey meter to screen all samples for the presence of radioactivity. Protocols for the receipt of radioactive samples and for surveying suspected or known radioactive samples are detailed in GL-RAD-S-007 for Receiving Labeled Radioactive Samples and GL-RAD-S-001 for Radiation Survey Procedures. This process is described in Section 9.

Upon leaving a radiologically controlled area, personnel check their hands and feet for potential contamination. This is done utilizing detection instrumentation that employs Geiger-Mueller or scintillation technologies. In addition, stations with portable detection instruments are set up for personnel frisking and in-process contamination surveys.

Key areas throughout the facility are surveyed:

- Laboratory analytical areas (Monthly smears)
- Radioactive Sample Storage Areas (Monthly smears and exposure rate)
- Sample Receipt and Waste Handling Areas (Monthly smears and exposure rate)
- Unrestricted and Radioactive Material Prohibited Areas (Quarterly smears)



**SECTION 7****MEASUREMENT, TRACEABILITY, AND CALIBRATION****Section 7 - Traceability and Calibration**

Traceability of measurements and the calibration of testing equipment are imperative to our ability to produce accurate and legally defensible data. As such, we have implemented procedures to ensure that equipment calibration and measurement verification are traceable to nationally recognized standards.

Where possible, calibration certificates provide traceability to national standards of measurement. Calibration certificates provide measurement results and any associated uncertainty of measurement, and/or a statement of compliance with the identified specification. Calibration certifications are maintained as quality records.

When traceability to a national standard is not applicable, verification of measurement is achieved through in inter-laboratory comparisons, proficiency tests, or independent analyses.

The following measurement and traceability practices are described in this section:

- Calibration criteria for support equipment
- General requirements
- Balances
- Temperature sensitive devices and temperature monitoring
- Air displacement pipets
- Calibration criteria for instruments
- Calibration verification
- Initial calibration verification
- Continuing calibration verification

**7.1 Calibration Criteria for Support Equipment**

This section addresses calibration protocols for support equipment, including balances, temperature - sensitive equipment, and air displacement pipets. The general criteria applicable to the calibration of support equipment is as follows:

- Equipment is maintained in proper working order. Records of all maintenance activities including service calls are kept.
- Calibrations or verifications over the entire range of use, using NIST traceable references when available, are conducted annually.

- If results of calibration and verification are not within the specifications for the equipment's application, then:
  1. The equipment is removed from service until repaired
  2. Under certain conditions, a deviation curve may be prepared. All measurements are corrected for the deviation, recorded and maintained.
- Prior to use each day, balances, ovens, freezers, refrigerators, incubators and water baths are checked with NIST traceable references (where possible) in the expected use range.
- If prescribed by the test method, additional monitoring is performed for a device used in a critical test (such as an incubator or water bath).
- Support equipment is used only if the reference standard specifications (provided by the supplier or described in the analytical method) are met.
- Reference standards of measurement such as Class S or equivalent weights or traceable thermometers may be used for calibration when demonstrated that their performance as reference standards will not be invalidated.
- Reference standards of measurement are calibrated by a body that can provide, where possible, traceability to a national standard.
- Reference standards and measuring and testing equipment are, subject to in-service checks between calibrations and verifications, in accordance with ANSI/ISO/IEC 17025-2005.
- Reference materials, where possible, are traceable to national or international standards of measurement, or to national or international standard reference materials.
- Mechanical volumetric dispensing devices, except Class A glassware, are checked monthly for accuracy.

**7.1.1 Balances**

Our balances are under a service contract for annual calibration, maintenance and cleaning. Each balance is labeled with a serial number, service date,

date of next service, and signature of the service technician.

Balances are setup, calibrated, and operated in the range required by the analytical method in accordance with GL-LB-E-002 for Balances. Prior to using a balance, the analyst is responsible for checking its calibration.

Calibration and calibration verification are performed using weights that are or have been calibrated against Class S or equivalent weights. These weights are traceable to NIST and calibrated annually by a calibration service provider which meets the requirements of the ANSI/ISO/IEC 17025-2005 standard).

Calibration and calibration verification is recorded in the balance calibration logbook. If the calibration or calibration verification does not meet the specified acceptance criteria, the balance is recalibrated. If the calibration criteria are still not met, the balance is removed from service and tagged as such.

#### *7.1.2 Refrigerators, Freezers, Incubators, Ovens, Water Baths and Similar Devices*

Careful control of temperature is often central to the production of acceptable data. Temperature excursions beyond the established limits may invalidate a procedure and the associated data. Constant monitoring in accordance with GL-LB-E-004 for Temperature Monitoring assures us that regulatory and/or method temperature requirements are being met.

We measure temperatures with thermometers that are calibrated annually against a NIST traceable thermometer. The NIST traceable thermometers are independently calibrated at least annually by a calibration service which meets the requirements of the ANSI/ISO/IEC 17025-2005 standard. The protocol for thermometer calibration is described in GL-QS-E-007. We monitor the temperature of the following equipment according to GL-LB-E-004:

- Refrigerators and freezers used to store samples, standards, and other temperature sensitive materials
- Incubators
- Ovens
- Water Baths
- Autoclaves

We monitor the temperatures of refrigerators and freezers prior to use on each working day. The temperatures of ovens, water baths, and other devices

used as part of an analytical process must be monitored prior to, during, and immediately after use. Incubators and other devices used for microbiological or other specialized analytical methods may require more frequent monitoring as specified in the corresponding SOP.

Temperature measurements are documented on logs specific to each piece of equipment. The logs are posted on or near each refrigerator, freezer, waterbath, oven, or other temperature control device. Each log includes the following information:

- Date and time of each measurement
- Initials of person taking measurement
- Acceptance limits for device being monitored
- Whether device conforms with specifications at time of measurement
- Name, location and number of device being monitored
- Notation of any out of control condition

The sterilization pressure of each autoclave run must be documented in addition to the sterilization temperature. When the process to maintain and document temperatures within acceptance limits does not conform to specifications, a nonconformance report (NCR) is issued. Appropriate action is then taken to disposition the nonconformance according to GL-QS-E-004 for Nonconformance Identification, Control, Documentation, Reporting, and Dispositioning.

Examples of nonconformances are:

- Failure to maintain process temperature within acceptance limits
- Failure of device to achieve calibration
- Total failure of temperature control device
- Failure to monitor the temperature as required

#### *7.1.3 Air Displacement Pipets*

Air displacement pipets offer a level of precision and accuracy exceeded only by Class A transfer pipets. Due to disposable tips, these pipets eliminate the possibility of cross-contamination.

We calibrate air displacement pipets monthly using five replicate measurements of a frequently used volume setting in accordance with GL-LB-E-010 for Maintenance and Use of Air Displacement Pipets. As specified in the SOP, the calibration of an air displacement pipet is verified daily prior to use, based on a single point measurement.

The acceptance criteria for each measurement are based on the standard deviation of the five calibration measurements. Tolerance limits for commonly used verification volumes and accuracy and precision checks are included in the pipet calibration logbook. Calibrations and daily calibration verifications are traceable to each pipet using the unique identification found on its label.

If a pipet does not meet the calibration tolerance limits, it is removed from service until it again demonstrates compliance after being cleaned and/or repaired. Analysts whose jobs may require the use of air displacement pipets are trained in their proper use and calibration.

## 7.2 Instrument Calibrations

To ensure that the data generated by an instrument is accurate, we calibrate the instrument using standards containing known concentrations of target analytes. We verify the accuracy of calibration standards by analyzing an additional standard containing the target analytes. This initial calibration verification standard (ICV) originates from a second source. The stability of the instrument over the calibration range is verified by the analysis of a continuing calibration verification standard (CCV).

Traceability of calibration, calibration verification, and other quality control standards to the recognized standard is documented per GL-LB-E-007 for Laboratory Standards Documentation. Individual identification numbers are assigned to each source standard and each subsequent intermediate and working standard prepared.

The identification number makes it possible to trace a standard to a parent standard and ultimately to the source standard. The date each standard is prepared, the recipe used in the preparation, the person preparing the standard, and the standard's expiration date are documented in the appropriate standards log, usually maintained in the laboratory LIMS. The information is accessible via the standard ID number.

We record standard and reagent ID numbers on instrument run logs, analytical logbooks, sample preparation logs, and instrument raw data. Calibration standards that are used in the analysis of a particular sample or group of samples can be traced to NIST, US EPA, or other nationally recognized standard.

Calibration procedures for specific instruments, and the frequencies of performance for defined methods, are described in the applicable operating or analytical SOP. Calibration is discussed in general terms in GL-QS-E-014 and includes standard laboratory practices and formulas

used for determinations made by these practices. General guidelines include:

- Verification of initial calibrations with a standard obtained from a second source (unless one is not available).
- Analysis of verification standards (ICV and CCV) with each initial calibration within 15% of the true value unless historical data has demonstrated that wider limits are applicable.
- Preparation of calibration curves as specified in the reference method.

If a test method does not specify the number of calibration standards, the minimum number is two not including blanks with one at the lowest quantitation limit. The reference SOP must establish the initial calibration requirements.

## 7.3 Calibration Verification

Unless otherwise specified by the method or demonstrated through historical data, the recovery of target analyte(s) in calibration verification standards shall be between 85 - 115%. We discuss additional requirements below.

### 7.3.1 Initial Calibration Verification (ICV)

- If an initial calibration curve is not established on the day of analysis, the integrity of the curve should be verified each day of use or every 24-hour period. Verification requires the initial analysis of a blank and standard from a second source. The standard concentration should be at the method-defined level. If not specified, a standard at a mid-level concentration may be used.
- If the initial calibration verification does not meet acceptance criteria, the analytical procedure is stopped and evaluated, and appropriate corrective measures are taken. Initial calibration verification must be acceptable before any samples are analyzed.

### 7.3.2 Continuing Calibration Verification

Additional standards called CCVs are analyzed after the initial calibration curve or the integrity of the initial calibration curve is accepted. CCVs are analyzed at a frequency of 5% or every 12 hours, whichever is more frequent. If instrument consistently drifts outside acceptance criteria before the next calibration, the frequency is increased.

CCVs may be from the same source as the calibration standards or a second source. The concentration is determined by the anticipated or known concentration of the samples and/or method-specified levels. At least one CCV shall be at a low-level concentration.

To the extent possible, we bracket the samples in each interval (every 20 samples or every 12 hours) with CCV concentrations closely representing the lower and middle range of reported sample concentrations. If this is not possible, the standard calibration checks should vary in concentration throughout the range of the data being acquired.

If the recovery of a CCV does not meet the acceptance criteria and routine corrective actions fail to produce a second consecutive check within acceptance criteria, a new initial calibration curve should be constructed. Analytes of interest found in corresponding environmental samples may be reported, however, if all of these criteria are met:

1. CCV recovery for target analyte exceeds the acceptance criteria (biased high)
2. Target analyte in the environmental sample is not detected at a concentration exceeding the level required by client contract (i.e., MDL, PQL).  
Non-detects that meet this criteria are also referred to as "passable non-detects."

If samples are found to contain target analytes that exceed the associated quantitation limits and the CCV recovery does not meet the acceptance criteria, the affected samples are re-analyzed. This occurs only after a new calibration curve has been established, evaluated, and accepted.

#### **7.4 Bioassay Instrument Calibration and Frequency**

Our Bioassay instruments are calibrated at the frequency of the instrument's use, stability, and method requirements. The calibration procedure for each instrument is described in the corresponding analytical SOP and is performed by those individuals proficient in the analyses described in the SOP.

**SECTION 8****ANALYTICAL METHODS AND STANDARD OPERATING PROCEDURES****Section 8 - Analytical Methods and Standard Operating Procedures (SOPs)** and quality concerns have been resolved by GEL's management.

We provide a wide array of parameters including volatile organics, extractable organics, metals, general inorganic/wet chemistry, radiochemistry, radiobioassay and limited microbiology. The procedures we use to determine these parameters are consistently executed due to our extensive system of SOPs and our training requirements for analytical staff.

A list of our SOPs and the analytical methods they represent (if applicable) is provided in Appendix I. Discussed here are:

- Selection of analytical methods
- Standard operating procedures
- Method validation and initial demonstration of capability
- Sample aliquots
- Data verifications
- Standard and reagent documentation and labeling (Refer to Section 10.1)
- Computers and data requirements

**8.1 Selection of Analytical Method**

Project Managers are ultimately responsible for selecting the test codes and methods assigned to a client based on client requirements and sample collection techniques. In selecting methods, our goal is to meet the specific needs and requirements of the client while providing data that is scientifically valid.

When the use of a specific test method is mandated, only that method is used. If the analysis cannot be performed by the client-requested method, we notify the client. We do not perform method substitutions without the client's consent. We recommend that clients who submit data to regulatory agencies also obtain the agency's approval of method modifications.

When clients have specific process or reporting deviations from GEL's standard practices, the laboratory may document the deviations in contracts, case narratives and/or with specific work instructions from the project Management Team to the laboratory. Approval of the deviations is made after consideration of all safety

A Project Management AlphaLIMS User Manual (GL-CS-M-001) is available to assist PMs and PMAs in selecting test codes and methods and communicating the client's analytical and data reporting specifications.

**8.2 Standard Operating Procedures (SOPs)**

We determine each parameter by the protocol detailed in the corresponding SOP. The defined protocol originates from the analytical method or methods referenced in the SOP and may incorporate regulatory and client requirements. Descriptions of the methods we employ can be found in:

- EPA SW846 3<sup>rd</sup> Edition, Revision III
- EPA/600/479/020
- Official Methods of Analysis of the Association of Official Analytical Chemists (AOAC)
- American Society for Testing and Materials (ASTM)
- Standard Methods for the Examination of Water and Wastewater (SM)
- South Carolina Department of Health and Environmental Control (SCDHEC)
- Code of Federal Regulations (CFR) Titles 40 and 49
- Department of Energy Environmental Measurements Laboratory (EML)
- Los Alamos Health and Environmental Chemistry (LAHEC)
- DOE
- HASL
- EPA CLP

In addition to these references, a number of our radiochemistry procedures were developed in conjunction with Florida State University (FSU) under the guidance of Dr. Bill Burnett.

Laboratory sections have access to GEL's SOPs to ensure that each operational system and analytical procedure is performed in a uniform manner. SOPs are controlled according to GL-DC-E-001 for Document Control and are posted on the Intranet by the Document Control Officer.



We write and issue SOPs in accordance with GL-ADM-E-001 for the Preparation, Authorization, Change and Release of Standard Operating Procedures. A technical and/or quality review is made of each new or revised SOP prior to its implementation.

Technical reviews ensure that procedures are technically sound and method-compliant, and are conducted by a senior analyst, group leader, or data reviewer. The quality review is an independent review by a member of the Quality Systems team and ensures that the quality requirements of the method, regulatory agencies, and GEL are adequately and accurately identified.

SOPs are modified when:

- Instruments or equipment change
- An error is identified
- Improvements in technology and/or reagents need to be incorporated
- Reference methods are revised or discontinued

Proposed revisions are submitted for review on Documentation Initiation and Revision Request (DIRR) forms. Changes are not implemented without a technical and quality review.

We review our SOPs annually and revise them as necessary. Analytical SOPs either contain or reference other SOPs that contain:

- reference method
- applicable matrix or matrices
- method detection limit
- scope and application including parameters to be analyzed
- method summary
- definitions
- interferences and limitations
- specific safety requirements
- required equipment and supplies
- reagents and standards
- sample collection, preservation, shipment, and storage
- quality control
- calibration and standardization
- procedure
- calculations
- method performance
- pollution prevention

- data assessment and acceptance criteria for quality control measures
- corrective actions for out of control or unacceptable data
- waste management
- references
- tables, diagrams, flowcharts, validation data
- identification of any modifications we have made to the published procedure

### 8.3 Method Validation and Initial Demonstration of Capability

An initial demonstration of method performance is required before a new analytical method is implemented and any time that there is a significant change in instrumentation or methodology. Exempted from this requirement are microbiological analyses and any tests for which spiking solutions are not available. Analyses that are exempt include those for determining:

- total dissolved, total suspended, total volatile, and total solids
- pH
- odor
- color
- free liquids
- temperature
- dissolved oxygen
- turbidity

We conduct the initial demonstration as described in 8.3.1. Records of initial demonstration are maintained in accordance with GL-QS-E-008 for Quality Records Management and Disposition. These records are available upon request.

After we demonstrate our ability to perform a specific analysis, we continue to demonstrate method performance through the analysis of laboratory control samples and performance evaluation samples.

If spiking solutions or quality control samples are not available, an analyst is trained by a qualified trainer to conduct the analysis. Analyst capability and proficiency is evaluated by the appropriate Group Leader before the analyst is qualified to perform the analysis on client samples. The evaluation is documented and maintained according to GL-HR-E-003 for Maintaining Technical Training Records.

### 8.3.1 Procedure for Initial and Continuing Demonstrations of Capability (IDOC and DOC)

We conduct initial demonstrations of capability for mandated analytical or EPA reference test methods following the procedure outlined below. This procedure is adapted from the EPA test method published in 40CFR part 136, Appendix A and the 2003 NELAC Standard. DOCs are completed whenever there is a change in instrument type, method or personnel.

**Step 1:** A quality control sample is obtained from an outside source (if possible). If one is not available, the sample may be prepared internally using stock standards that are prepared independently from those used in instrument calibration. The concentration is not known to the analyst

**Step 2:** The QC sample is diluted in a volume of clean matrix. Sufficient volume of the diluted QC sample is prepared so that at least four aliquots of the required method are analyzed. Alternatively, four matrix spike samples may be evaluated levels of precision and accuracy.

**Step 3:** Four aliquots of the diluted quality control sample are prepared and analyzed according to the analytical test method. This may occur concurrently or over a period of days.

**Step 4:** With the results obtained from the analysis of the diluted QC sample, the average recovery ( $\bar{x}$ ) in the appropriate reporting units (such as  $\mu\text{g/L}$ ) and the standard deviation of the population sample ( $n-1$ ) (in the same units) is calculated for each parameter of interest.

**Step 5:** For each parameter, the standard deviation ( $s$ ) and the average recovery ( $\bar{x}$ ) are compared to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria. If " $s$ " and " $\bar{x}$ " for all parameters meet the acceptance criteria, analysis of samples may begin. If any one parameter exceeds the acceptance range, the performance is unacceptable for that parameter.

**Step 6:** When one or more tested parameters fail one or more of the acceptance criteria we locate and correct the source of the problem and repeat the test for every parameter of interest.

Other options for successful IDOCs are the following:

- PT Study- successful analysis of a PT Sample. The PT sample may be single-blind to the analyst or double blind to the laboratory
- Supervised Analysis- where other options are not practical, supervised analysis of a procedure may be used to demonstrate capability.
- Analysis of authentic sample with results statistically matching those obtained by another trained analyst.
- Other – this option may be used for certain personnel having sufficient analytical skills to develop a new procedure, as deemed appropriate by the supervisor or Quality Assurance personnel.

### 8.4 Sample Aliquots

When obtaining aliquots from a sample, it is imperative that the subsamples be representative of the parent sample. This ensures that the results obtained from the analysis of the aliquots are representative of the entire parent sample, not just the subsample. We employ different techniques to obtain subsamples. GEL's SOP for subsampling is GL-LB-E-029.

We can obtain representative aliquots of soil samples for the determination of metals through quartering. This involves the repeated quartering of the sample until the resulting quarter is equivalent to the amount of sample needed for analysis. Quartering may not be appropriate for obtaining subsamples for volatiles or other analyses where potential contamination or loss of target analytes is a concern.

Water samples are inverted several times prior to the collection of a subsample. This ensures a thorough mix and is absolutely required for the accurate determination of analytes like total and total suspended solids.

The appropriate techniques for obtaining sample aliquots for designated analyses are discussed in the applicable SOPs.

### 8.5 Data Verification

All of the data we include in final reports to our clients undergoes extensive data verification. At GEL, we have a multi-level review process that takes place in all areas of the laboratory beginning with sample login. This process and the responsibilities of each level of review are delineated in a number of procedures, including GL-OA-E-044 for Organics Data Validation, GL-GC-E-092 for General Chemistry Data Validation and Packaging,

GL-MA-E-017 for Metals Data Validation, and GL-RAD-D-003 for Data Review, Validation, and Package Assembly.

#### 8.5.1 *Sample Login:*

Samples are analyzed by the methods and for the target analytes identified when samples are logged into our database. If there is an error in this entry that is not promptly identified, the incorrect analytical method may be used or certain analytes may not be determined.

To prevent this, the person who enters the information into the database is generally the client's assigned Project Manager or PM Assistant. This entered information is reviewed against the client confirmation letter and/or chain of custody. If errors are identified, they are immediately corrected.

#### 8.5.2 *Data Validation in the Laboratory*

The multi-level review process in our laboratory includes initial review by the analyst, a second review by a peer, and a final review by a group leader or data reviewer. Where appropriate based on personnel and client needs, the industrial division institutes two levels of review.

Our analytical data reviews ensure that:

- The analytical procedures comply with current SOPs.
- Quality control samples are analyzed at the frequency specified in the SOP or client specifications.
- The acceptance criteria for quality control samples is met, including recoveries of matrix spikes and laboratory control samples, the relative percent difference for matrix duplicates, matrix spike duplicates, laboratory control sample duplicates, and concentrations of target analytes in the method blank.
- Instrument data, run logs, and logbooks are reviewed to ensure that all method quality control criteria were met (e.g., calibration, initial calibration verifications, and continuing calibration verifications).
- Documentation is sufficient to reconstruct the analytical procedure.
- Data is maintained according to GL-LB-E-008, "Basic Requirements for the Use and

Maintenance of Laboratory Notebooks, Logbooks, and Other Record Keeping Devices."

- Raw data is in agreement with the computer generated batch sheets and data reports.
- The calculations, dilution factors, concentration reported, and nominal concentrations are verified.
- Comments, qualifiers, or nonconformances for noncompliant or questionable data are documented.
- Data generated when the analytical process appears to be out of statistical control is not reported.

#### 8.5.3 *Validation of Data Reports and Packages*

Before we report data to the client, we review the requested data report for package accuracy, completeness, and client-specifications. Responsibilities for review are dependent upon the type of report or package being generated. (Refer to Section 11 for Data Report Formats.)

When a client is receiving a certificate of analysis or certificate of analysis and Quality Control Summary Report, the Project Manager (PM) or Project Manager Assistant (PMA) reviews the information for accuracy, completeness and the addition of pertinent comments made by the laboratory about the analysis or sample. The PM or PMA also reviews data for consistency as described in the Project Management AlphaLIMS Manual, GL-CS-M-001.

If a client requests a case narrative, our data validators review the analyst-prepared case narrative for accuracy and to assure its consistency with the information included on the certificate of analysis and Quality Control Summary Report. If a client requests a more detailed level of data package up to and including a CLP-like package, every laboratory fraction of data is reviewed by that fraction's data validator. The data is then compiled into a final data package.

#### 8.6 **Standard and Reagent Documentation and Labeling**

The documentation and labeling of standards and reagents is addressed in GL-LB-E-007 for Laboratory Standards Documentation, and in Section 10.1 of the QAP, Record Keeping System and Design.



**8.7 Computer and Electronic Data Related Requirements**

Our Information Management System SOPs (IT) describe the way in which we manage our software programs and hardware systems. Control of software development and modification activities is described in GL-IT-E-003, "Requirements, Design, Operation, Validation and Removal of Hardware and Software Systems." All development and revision activities are

validated, verified, and controlled with revision software or other procedures prior to production use.

Analytical software that is purchased from a vendor is validated and verified in accordance with GL-IT-E-005 for the Requirements, Design, Operation, Validation and Removal of Applications Used by The GEL Group, Inc. Documentation requirements are also described in this SOP.

## SECTION 9

## SAMPLE HANDLING, ACCEPTANCE, RECEIPT &amp; INTERNAL CHAIN OF CUSTODY

**Section 9 - Sample Handling, Acceptance, Receipt, and Internal Chain of Custody**

The way we receive and handle samples is critical to providing our clients with data that is of the highest quality and legally defensible. We have strict policies that govern the acceptance and receipt of a sample, sample handling and integrity, maintenance of the internal chain of custody, and storage of the sample upon completion of the required analytical processes. This section describes the policies and practices that we employ, including the following:

- Agreements to perform analysis
- Proper labeling of submitted samples
- Chains of custody
- Sample receipt procedures
- Sample receipt procedures for radioactive samples
- Sample tracking
- Sample storage
- Sample disposal

**9.1 Agreement to Perform Analysis**

Before we accept samples, we should have an agreement with the client that specifies the analytical methods, the number of samples to be analyzed, the price for the analysis, the date by which the client must receive results, and the reporting format. Any special requirements the client may have, such as non-routine methods and reporting limits, should be part of that agreement.

An agreement to perform analysis should be in one of three forms, further detailed in our Analytical Services Reference Manual and the SOPs for Delegated Authorization to Commit the Company and Request for Proposal (RFP)/Contract Review (GL-CO-E-002 and GL-CO-E-003):

- Client confirmation letter (CCL) between the client and project manager for a specific group of samples. This letter includes the cost, turn-around time, requested analysis, sample matrix, number of samples, and type of client report.
- Sample acceptance by the Project Manager from an established client based on previously agreed to

conditions and confirmed by the client's submission of the sample(s).

- Contractual agreement for analytical services over a designated time period or project that delineates the specifications agreed upon.
- When the laboratory agrees to perform analyses with exceptional departures from normal processes, these exceptions are clearly defined in the client-laboratory agreement.

**9.2 Sample Labels and Chain of Custody Forms**

Once an agreement is established, we assume joint responsibility with the client to ensure that the samples submitted are properly labeled and accompanied by full and complete documentation that includes chain of custody and, where possible, material safety data sheets. Samples that are submitted without proper documentation may be refused.

Sample labels should include the:

- client's sample identification
- location, date, and time of collection
- collector's name
- chemical preservatives used
- constituents of interest (if space permits)

When requested, we ship labeled sample containers with appropriate preservatives and a chain of custody to the client for use during sample collection. There are several advantages to using these containers, including:

- Dedication of appropriate type sample container for the intended analyte or analytical method.
- Proper sample preservation for analytical test
- Traceability of bottle lot number to the manufacturer's certification that the containers are clean and show no signs of contamination.

Chain of custody forms include the following information and are initiated at the time of sample collection:

- name and address of client
- client sample identification
- date and time of sample collection

- sample matrix
- description of sampling site location
- number of containers
- methods, chemical and physical constituents for which the analyses are to be conducted
- preservatives
- date and signature of person who collected the sample
- date of transfer and signature of person relinquishing sample to the laboratory.

When our Field Services personnel collect samples, our standard chain of custody form and certified containers are automatically used. Our standard chain of custody forms are also available to our clients and are included with each shipment of pre-labeled and preserved containers. GEL chain of custody forms should always be used unless otherwise agreed to by contract.

### 9.3 Sample Conditions

In addition to properly documenting sample container labels and the chain of custody form, we need to make sure that samples meet the established requirements for analytical testing. This is particularly critical for samples that are being analyzed to meet regulatory requirements.

Samples should be collected in the appropriate type of container, preserved as directed, and stored in the conditions specified in the analytical method or established regulatory guidelines. In addition, samples should be submitted with sufficient time to conduct the specified analysis within the regulatory or method holding time. Aliquots should be of sufficient volume to perform the requested analyses. A summary of these conditions and holding times for routine analyses can be found in Appendix J.

### 9.4 Sample Receipt

Samples submitted to us are received in a central sample receiving area by our sample custodian or login clerk. Every sample is subject to the protocols established in GL-SR-E-001 for Sample Receipt, Login, and Storage.

Our sample custodian acknowledges receipt of a sample by signing the chain of custody and recording the date and time custody was transferred from the client to the laboratory. The date, time, and person receiving the sample are also recorded on a standard or client-specific Sample Receipt and Review form.

The sample custodian is also responsible for noting the condition of a sample upon its arrival. This information is recorded on both the sample chain of custody and the Sample Review and Receipt form. As detailed in GL-SR-E-001, the sample custodian should:

- Inspect all sample containers for integrity.
- Document any unusual physical damage or signs of tampering with custody seals.
- Place any samples that appear to be leaking or have unusual odor under the fume hood while notifying the responsible project manager.
- Review the chain of custody submitted by the client for completeness.
- Compare descriptions and other information on the sample container labels to that listed on the chain of custody.
- Verify the sample is within the regulatory holding time for the analyses.
- Measure and record the temperature of sample aliquots that are to be used for analyses requiring thermal preservation.
- Measure and record the pH of all sample aliquots submitted for analyses that require chemical preservation to a specific pH.
- Verify that there are adequate sample aliquots for the requested analyses.
- Verify that appropriate sample containers were used for requested analyses.

If the sample custodian discovers any abnormalities or departures from standard conditions, the PM is informed immediately. The PM will then notify the client as quickly as possible so that a decision can be made to proceed with the analysis or submit another sample or additional sample aliquots.

Common abnormalities or departures from standard conditions include:

- Sample containers with signs of damage, leaking, or tampering.
- Incomplete/missing chain of custody.

**NOTE:** If a nonradioactive sample has no chain of custody, the sample custodian should initiate one. "INITIATED ON RECEIPT" should be documented on the chain of custody.

- Discrepancies between the information on the chain of custody and the sample container labels.

- Method or regulatory holding time is exceeded.
- Sample is not preserved to the method or regulatory-required pH.
- The sample container does not meet method or regulatory criteria.
- The sample temperature exceeds or falls below the thermal preservation regulation or method requirement by more than 2°C.

**NOTE:** If a sample is hand delivered to the laboratory immediately after collection with evidence that the chilling process has begun (arrival on ice), the sample shall be deemed acceptable.

- Radioactivity that exceeds that allowed by our radioactive license. (The handling of radioactive samples is discussed in 9.5.)

Samples that are not appropriate for the requested analyses or have no full test specifications require:

- Retention of all correspondence and records of conversations concerning the final disposition of the sample.
- Full documentation on the chain of custody and Sample Receipt and Review form of the nonconforming condition and a decision to proceed with analysis.
- Documentation that the analysis is qualified appropriately on the final report.

### 9.5 Receipt of Radioactive Samples

The radioactive samples we receive are subject to the same monitoring identified in 9.4 when radioactivity levels do not exceed the level permitted by our license. Special procedures governing the receipt of radioactive samples are described in the GL-RAD-S-007 for the Receiving Labeled Radioactive Packages. These procedures prevent the inadvertent spread of radioactive contamination.

Because we cannot exceed the limits of our radioactive license, it is imperative that our clients notify us of impending shipments of radioactive samples. We reserve the right to refuse and return any radioactive sample where the radioactivity:

- Exceeds our permitted level by itself or in combination with other samples already on site; or
- Exceeds our administrative level of 25mR/hr.

The following special requirements for receiving radioactive samples are applicable:

- Only designated staff trained in the proper handling of radioactive materials handle radioactive samples.
- If a sample is labeled as "Radioactive II", the custodian will not open the sample but will immediately inform the Radiation Safety Officer (RSO).
- The radioactivity of the sample will be measured by scanning the exterior surface of the cooler using a survey meter calibrated in mR/hr. See GL-RAD-S-001 for our Radiation Survey Procedures.
- If the radioactive level of the exterior of the cooler exceeds 0.5 mR/hr, the RSO will be notified before the cooler is opened.
- If the radioactivity level of a sample or group of samples is found to exceed 25mR/hr, the RSO will be notified immediately. The client will be contacted and arrangements will be made to return the sample(s) or reduce the per sample exposure.
- If a chain of custody is not submitted with a sample, it will be placed on hold until a chain of custody is submitted.
- The inside of the cooler will be surveyed to ensure that no leakage or contamination has occurred.
- Each sample container will be surveyed and the highest reading will be documented on the Radioactive Shipment Inventory.

### 9.6 Sample Tracking

We track the samples we receive by a unique laboratory identification number that is automatically assigned when information pertaining to the sample is first entered into our database. Pursuant to GL-SR-E-001, the following information is entered for each sample received:

- client and/or project code
- client sample ID
- sample matrix
- equivalent laboratory sample matrix
- type of report format specified by client
- date and time of collection
- date received
- initials of person making entries
- number of containers submitted for the sample
- requested analyses
- pertinent observations or comments affecting the sample analysis or rejection

As soon as this information is entered, AlphaLIMS automatically assigns a unique number to the sample and its containers. We use the number to track the location of a sample container and to link to any subsamples and subsequent digestates and extracts.

The unique laboratory identification number is printed on a durable barcode label that contains the client identification, sample date and time. Once labeled, the sample container's identification number is uploaded into the database by scanning the barcode. Information included in the database at the time of sample scanning is the container's storage location, bottle type and volume, physical characteristics of the bottle, preservative, and the initials of the person entering this information. Entering of this information into the database is an important part of initiating our electronic internal chain of custody.

### 9.7 Internal Chain of Custody

Chain of custody procedures ensure traceability and sample integrity. Our legal and evidentiary chain of custody protocol establishes a continuous record of the physical possession, storage, and disposal of sample containers, collected samples and aliquots, and sample digestates or extracts.

The internal chain of custody starts with the scanning of a container's barcode label into an electronic database while identifying the location of the sample and the person having custody, or placing the sample in a secured storage area. If we supply the containers, the chain of custody may begin when the containers are provided to the client.

With regard to the internal chain of custody, a sample is defined as being in someone's custody if:

- It is in one's actual physical possession
- It is in one's view after being in one's physical possession
- It is in one's possession and then is locked up so that no tampering may occur
- It is kept in a secured area restricted to authorized personnel only

The protocol for ensuring sample integrity using the internal chain of custody is detailed in GL-LB-E-012 for Verifying the Maintenance of Sample Integrity. The electronic internal chain of custody works in conjunction with the chain of custody submitted by the client with a sample to:

- Account for all time associated with a sample, its subsamples, and extracts or digestates from the time the sample is received at GEL to its disposal.
- Identify all individuals who physically handled the sample
- Provide evidence that the sample was stored in accordance with method and regulatory protocols

The electronic internal chain of custody is stored in AlphaLIMS so that information demonstrating the proper maintenance of custody can be provided to the client on the data reports or electronic data deliverables.

### 9.8 Sample Storage

In order to ensure the maintenance of sample integrity, all aliquots are stored in secured areas designated for sample storage. The storage location of each sample aliquot can be tracked using the internal chain of custody. Areas designated for sample storage include:

- Main cooler where most samples requiring maintenance at a temperature range of 2° - 6° C are stored.
- Volatile coolers for samples to be analyzed for volatile contaminants.
- Radioactive cooler for segregation of radioactive sample aliquots requiring refrigeration.
- Ambient storage for non-radioactive samples not requiring refrigeration.
- Ambient storage for radioactive samples.
- Refrigerators for the storage of samples requiring bacteriological analysis and temporary storage for those requiring the determination of biochemical oxygen demand.

The temperature of each refrigerated storage unit is monitored at least twice a workday and documented per "Temperature Monitoring and Documentation Requirements for Refrigerators Freezers, Ovens Incubators, and Other Similar Devices," (GL-LB-E-004). In addition, the main and radioactive coolers are monitored twenty-four hours a day by temperature sensors that are connected to our main security system. If the temperatures exceed the required range, an alarm is sounded and the security system notified the facilities manager or his designee immediately. This allows corrective actions to be initiated promptly.



Prior to and immediately after analysis, samples and their digestates and extracts are stored in compliance with the requirements of the requested analytical methods and GL-SR-E-001 for Sample Receipt, Login, and Storage. If a single aliquot is supplied for analyses by several methods, the most stringent analytical storage requirements are applied to the sample.

If samples are to be analyzed for volatile organic compounds, they are stored in designated volatile coolers that are maintained at a temperature range of 2° - 6° C. No sample aliquots are stored in these refrigerators unless they are to be analyzed for volatiles. These storage units are monitored on a weekly basis for contamination by the analysis of volatile cooler storage blanks.

At the beginning of each month, eight 40 mL vials are filled with treated deionized water, which is used for volatile method blanks and placed in each volatiles cooler. Each week, two vials are analyzed by EPA 8260B and the data is reported to the Quality Department. If the analysis reveals evidence of potential contamination, appropriate corrective actions are immediately implemented.

Sample aliquots for non-volatile analysis, which also should be maintained at 2° - 6° C, are stored in the main cooler unless they are radioactive. In order to reduce the chance of contamination, radioactive samples are stored in a designated cooler.

Sample aliquots designated for the determination of total coliform bacteria, fecal coliform bacteria, or total plate count are delivered to the bacteriology laboratory and stored in the designated refrigerator at a temperature range of 2 - 6° C. This allows easy access for the analyst ensuring that the short regulatory holding times are met. After analysis is complete, the remaining sample aliquot is disposed of in accordance with the Laboratory Waste Management Plan.

Sample aliquots to be analyzed for biochemical oxygen demand (BOD) are also delivered to the bacteriology laboratory and stored in the designated BOD cooler. This cooler is also maintained at 2° - 6° C. After initiation of this analysis, the sample aliquots are returned to the main cooler.

After all analyses are complete and results are submitted to the client, sample aliquots are transferred to the sample archive area. They are stored in this area until they are disposed.

Radioactive and non-radioactive samples remain segregated in archive to reduce the risk of contamination.

## 9.9 Sample Disposal

Our policies concerning sample disposal are described in the Laboratory Waste Management Plan (GL-LB-G-001) and can be divided into two categories: those governing the disposal of sample laboratory waste, and those directing the disposal of remaining sample aliquots after the completion of all analyses.

### 9.9.1 Sample laboratory waste

Unless otherwise requested by contract, laboratory sample waste is collected throughout the laboratory in designated satellite containers found in sample collection and accumulation areas. Sample wastes are segregated based on the type of analysis by which they were generated, by matrix, and radioactivity. This contains certain process contaminants thus decreasing the amount of waste material that may be labeled hazardous. It also ensures that solid and aqueous wastes are not mixed.

We have separate radioactive and non-radioactive staging areas. The composited sample wastes then undergo hazardous waste characterization. The analyses allows GEL to properly characterize the waste according to EPA regulations.

Sample waste is disposed in accordance with the Laboratory Waste Management Plan (GL-LB-G-001).

### 9.9.2 Remaining Sample Aliquots

Sample not consumed during the sample preparation or analytical procedures is either returned to the client in accordance with GL-SR-E-002 for Transportation and Shipping of Samples and Pre-Preserved Sample Containers or disposed pursuant to the Laboratory Waste Management Plan. Non-radioactive samples are returned to a client under the conditions and terms agreed to by contract. A chain of custody listing the laboratory waste technician as the relinquishing party is enclosed with each set of samples being returned to a client. Unless otherwise specified by the client, all non-radioactive samples are shipped by an approved package carrier. If the samples are radioactive, the procedure for shipment is delineated in GL-SR-E-002 for Transportation and Shipping of Samples and Pre-Preserved Sample Containers.

It is our policy to hold samples for a minimum of thirty days after invoicing and before disposal, unless otherwise specified by contract or if the sample is part of

litigation. If the sample is part of litigation, disposal of the physical sample shall occur only with concurrence of the affected legal authority, sample data user, and/or client.

When sample analyses are complete and regulatory and/or contractual holding times have expired, samples are moved from their storage locations to the radioactive or non-radioactive archives. Samples that are to be returned to the client or held for an extended time period

are segregated from the other samples. Radioactive and non-radioactive samples remain segregated.

When internal or client-specified storage time expires, samples with like matrices are composited into appropriate containers. The composites are then subject to the same treatment and disposal protocol as described in 9.9.1. Samples that are approved for disposal are scanned into our data base and assigned the status of "Disposed".

**SECTION 10**  
**RECORDS****Section 10 - Records**

Our quality records provide the documentation we need to support analytical results and conclusions. Documented evidence that quality assurance and quality control requirements have been met is critical to providing data that fulfills the specifications of applicable procedures, programs and contracts.

As described in Section 3 of this Quality Assurance Plan (QAP), quality records include but are not limited to:

- Observations
- Calculations
- Calibration data
- Certificates of analysis
- Certification records
- Chains of custody
- External, supplier, and internal audits
- Run logs
- Instrument data and analytical logbooks
- Instrument, equipment and building maintenance logs
- Material requisition forms
- Monitoring logs
- Nonconformance reports
- Corrective actions
- Method development and start-up procedures including MDL studies
- Training records
- Waste management records
- Standard logs
- Software validation
- Standard operating procedures (SOPs)
- Sample collection and field data

Our procedures provide a legal and evidentiary chain of custody are described in Section 9 of this QAP. Described in this section are:

- Record keeping system and design
- Records management and storage
- Sample handling records
- Records of support activities
- Analytical records
- Administrative records

**10.1 Record Keeping System and Design**

We manage, maintain and store our quality records according to GL-QS-E-008 for Quality Records Management and Disposal. The protocols established in this document work in conjunction with those for specific types of records addressed in other SOPs to govern our record keeping system. Our record keeping system allows the historical reconstruction of all laboratory activities that produced analytical data.

We facilitate historical reconstruction by maintaining the following records and information, from the time a sample is received until it is disposed.

- A master list of all employee signatures and initials is maintained in Human Resources. This allows the identification of any GEL personnel who accept, handle, analyze, prepare, review, store, or dispose of a sample, its subsamples, associated data and reports, and other related documentation.
- If we provide bottles and containers to a client or sampling personnel, these records are kept in accordance with GL-SR-E-002 Transportation and Shipping of Sample and Pre-preserved Sample Containers. These electronic and paper records include:
  - Supplier and lot numbers of containers and/or bottles provided
  - Certifications that the containers are free of contaminants that may bias the analyses
  - Addition of preservatives and identity of person responsible for this preservation.
  - Barcode of containers supplied to a particular client or for a specific field-sampling event.

The person or agency responsible for collecting a sample is documented on the chain of custody and entered into Alpha LIMS. Other records supporting the acceptance of a sample include:

- Date and time of sample receipt
- Person accepting sample
- Condition of sample upon receipt
- Client-confirmation letter and/or sample quote
- Client chain of custody



- Electronically generated sample ID numbers specific to each sample aliquot and linked to the client's sample description, sample collection and receipt information, and analyses to be performed.
- Identification of each person who has custody of a sample, its subsamples, extracts, or digestates. (This is provided through the internal chain of custody procedures described in Section 9.)

Documentation that materials purchased for use in the analysis or preparation of samples meet specifications is maintained in accordance with GL-RC-E-001 for Receipt and Inspection of Material and Services.

Records of equipment calibrations are maintained and traceable by date and ID number to a specific analysis. These records include certifications of calibration and service that have been initialed or signed.

Our thermometers are calibrated against the NIST traceable thermometer and records of this calibration are maintained as described in GL-QS-E-007 for Thermometer Verification. Records of the daily and monthly calibration verifications of our analytical balances are kept in accordance with GL-LB-E-002 for Balances. The calibration records for our air-displacement pipets are maintained in pipet calibration logs specific to each pipet according to GL-LB-E-010 for Maintenance and Use of Air Displacement Pipets.

When methods and/or regulations specify that samples, subsamples, extracts, and/or digestates be stored at designated temperatures, or when the method, itself, has temperature sensitive steps, we document those temperatures on monitoring logs at the frequency defined in the corresponding SOPs. We can trace the specific storage location of a sample through the internal chain of custody.

We require that the initials of all personnel responsible for monitoring temperatures be recorded in the temperature monitoring logs pursuant to GL-LB-E-004, "Temperature Monitoring and Documentation Requirements for Refrigerators, Freezers, Ovens, Incubators, and Other Similar Devices." The logs are reviewed for completeness in accordance with GL-QS-E-005 for the Review of Monitoring Devices Logs.

Documentation on the instruments and equipment used for the analysis of samples is recorded in run logs, laboratory logbooks, instrument data and/or sample preparation logs. Routine or corrective maintenance that

is performed on equipment or instruments is recorded in the maintenance log specific to the instrument. We document these records in accordance with GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Forms and Other Record Keeping Devices.

The standards containing known quantities of target analytes that we use in instrument calibration, calibration verification, and as quality control samples, such as matrix spikes and laboratory control samples, are documented according to GL-LB-E-007 for Laboratory Standards Documentation. These records contain the following information.

- Recipe by which each standard was prepared
- Traceability of each child standard to its parent
- Date each standard was prepared
- Initials of person preparing the standard
- Expiration dates
- Concentration of each standard

This information allows us to document that the standards used were prepared in accordance with the established protocol, produced using source standards that meet the method and regulatory criteria, and used prior to their expiration date.

If required, reagents used in the preparation, dilution, and analysis of samples are verified to be free of interferences or target analytes. We record these verifications in the reagent logs in accordance with GL-LB-E-008, "Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Forms and Other Record Keeping Devices".

Analytical and sample preparation methods applied to each sample aliquot are documented via the internal chain of custody, method information, and information recorded in lab notebooks, sample preparation logs, run logs, and instrument data. The laboratory protocol we employ during analysis is dictated by the SOP in effect at the time the sample was analyzed or prepared by a specific method.

Run logs, laboratory notebooks, instrument data and sample preparation logs are used to document the preparation and analysis of samples and the associated instrument calibrations. These logs and notebooks are governed by GL-LB-E-009 for Run Logs and GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Record Keeping Devices. As stated in

these SOPs, sample preparation and analytical records that are not electronically generated should be:

- Legible
- Recorded in permanent ink
- Corrected using one line marked through the error, initialed and dated
- Initialed by the responsible party

We maintain electronic records for each analytical batch. These records include the ID numbers of each client and quality control sample prepared and/or analyzed together, the method of preparation and analysis, and the matrix of the samples included in the batch.

Through our electronic statistical process control system (SPC), the acceptance criteria applied for all quality control (QC) samples is stored and maintained. The acceptance limits for target analytes are method, matrix, and time-period specific, which allow us to regenerate the criteria applied to QC samples associated with identified client samples.

Our Quality Systems Team maintains the records of nonconformances and corrective actions associated with specific samples, batches, and processes. We maintain these records according to GL-QS-E-004 for the Documentation of Non-conformance Reporting and Dispositioning, and Control of Nonconforming Items; and GL-QS-E-002 for Conducting Corrective/Preventative Action and Identifying Opportunities for Improvement.

Electronic data records are maintained in a secured database designed to protect the integrity of the data. Data that is uploaded directly from instruments and that manually entered is backed up by a second system.

Permanent records of electronic data deliverables are maintained along with the corresponding sample preparation and analytical data review records. This documentation includes the initials of the reviewer and date of the review.

Records of the data we report to our clients are maintained in a manner that protects client confidentiality, as well as any potential national security concerns. These records include copies of certificates of analysis, quality control summary reports, case narratives, CLP forms, and other information we provided to the client. The copies may be paper or electronic. The majority of the data packages submitted to Federal clients are stored electronically prior to being submitted to the client.

Records of samples being disposed or returned to the client are documented in accordance with GL-SR-E-002 for Transportation and Shipping of Samples and Pre-Preserved Sample Containers. Such records include the date samples are returned or disposed, the destination of the samples, and name of the person transferring the samples.

## 10.2 Record Storage

We store quality records in compliance with GL-QS-E-008 for Quality Records Management and Disposition. The records are:

- Stored in a secured area to maintain data integrity and protect client confidentiality, including any national security concerns.
- Kept in areas where they are protected from fire loss, environmental deterioration, and, in the case of electronic records, electronic or magnetic sources.
- Indexed and filed in a manner allowing for ready retrieval.
- Accessible to the client for whom the record was generated.
- Retained for an identified period of time that equals or exceeds five years as determined by applicable law and client contract requirements.

Electronic data records are stored on compact disks.

All of the hardware and software we need to reconstruct data is maintained according to GL-IT-E-003 for Requirements, Design, Operation, Validation and Removal of Hardware and Software Systems. Records that are stored or generated by network or personal computers have either hard copy or write-protected backup.

## 10.3 Sample Handling Policy

Records of all procedures applicable to samples are maintained in our possession. These records include documents that pertain to:

- Preservation, including sample container and holding time
- Sample identification, receipt, acceptance or rejection, and login
- Sample storage and tracking including shipping receipts, transmittal forms, routing and assignment records

- Sample preparation (ID codes, cleanup and separation protocols, volumes, weights, instrument printouts, meter readings, calculations, reagents)
- Sample analysis
- Standard and reagent origin, receipt, preparation, and use
- Equipment receipt, use, specification, operating conditions and preventative maintenance
- Instrument calibration frequency and acceptance criteria
- Data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions
- Method performance criteria including expected quality control requirements
- Quality control protocols
- Electronic data security, software documentation and verification, software and hardware audits, backups and records of any changes to automated data entries
- Automated sample handling systems
- Disposal of hazardous samples

#### 10.4 Records of Laboratory Support Activities

In addition to sample handling records, we maintain the following:

- Original raw data for calibrations, samples and quality control measures, including worksheets and data output records (chromatograms, strip charts, and other instrument readout records)
- A written description of or reference to the specific method used, including the computational steps used to translate parameter observations into a reportable analytical value
- Copies of final reports
- Archived standard operating procedures
- Correspondence relating to project-specific laboratory activities
- Corrective action reports, audits and audit responses
- Proficiency test results

#### 10.5 Analytical Records

We document and maintain analytical records, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs according to GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Record Keeping Devices, and GL-LB-E-009 for Run Logs.

The information that is documented in analytical records includes:

- Laboratory sample ID code
- Date and time of analysis
- Instrument ID and operating conditions/parameter (or reference to such data)
- Method of analysis
- All calculations
- Dilutions
- Initials of analyst or operator
- Units of measurement

Our policy is to produce and maintain analytical records that are:

- Accurate
- Reviewed and verified
- Legible and understandable
- Traceable and authentic to their source
- Grouped in a contemporary manner with data entered and information recorded as it is obtained

#### 10.6 Administrative Records

A number of pertinent records are maintained by Human Resources or Quality Systems, including:

- Staff qualifications and experience.
- Training records, including initial demonstrations of proficiency. (See procedure GL-HR-E-002 for Employee Training.)
- A log of names, initials and signatures for individuals having responsibility for initialing laboratory records.

We monitor continuing demonstrations of proficiency through AlphaLIMS per GL-HR-E-002 for Employee Training.

**SECTION 11****LABORATORY REPORT FORMAT and CONTENTS****Section 11 - Laboratory Report Format and Contents**

Accurate data is of little benefit to a client unless it is reported in a format that is easy to interpret and provides all pertinent information relating to the analysis of a sample. At GEL, we have developed certificate of analysis report formats that meet the different needs of our clients yet provide all of the information necessary to satisfy regulatory requirements while allowing for the interpretation of the data. Each format provides accurate, clear, unambiguous and objective data.

In addition to a certificate of analysis, a client can request and receive an extended data package. This package may include any of the following: certificates of analysis; summaries of quality control; case narratives; instrument data; sample preparation data; measurement traceability and calibration information; and electronic data deliverables. If clients require the reporting of data following the established contract laboratory protocol (CLP), we can provide a CLP-like data package that will meet their needs.

It is important that the certificate of analysis format and data package requirements be discussed with the client prior to our acceptance of the samples. Project Managers and contract staff are responsible for establishing an agreement with the client concerning data reporting and the potential cost to the client for data packages and/or specialized reporting. Our analytical data is reported to three significant figures, unless otherwise required by client contract.

Laboratory reports and data packages are stored and transmitted in a manner that protects client confidentiality and potential matters of national security. No reports or data packages are released to persons or organizations outside GEL without the expressed consent of the client. If directed by a regulatory agency or subpoenaed to submit documents to a court of law, we will notify the client of the demand and the records being released.

The following elements of report formats and data packages are described in this section:

- Certificates of analysis (C of A)
- Quality control summary reports (QCSR)
- Analytical case narratives

- Electronic data deliverables (EDDs)
- Types of data packages and reporting formats
- Review of data packages and reports

**11.1 Certificates of Analysis**

We have two primary C of A report formats, Level 1 and Level 2. Both contain the following information when applicable:

- Title
- GEL address and phone number
- Name of PM or person serving as the primary client contact
- Barcode identification of the C of A
- Number of page and total number of pages
- Name and address of client, where appropriate
- Project name or code if applicable
- Client-provided sample description
- Unique laboratory ID number for the sample
- Sample matrix
- Characterization and condition of the sample where relevant
- Date of receipt of sample
- Date and time of sample collection, if provided
- Date and time of sample analysis, reanalysis, and/or sample preparation
- Initials of analyst and person responsible for sample prep
- Analytical batch number
- Sample analysis and preparation methods (or unambiguous description of any non-standard method used)
- Reference to sampling procedure
- Additions to or deviations or exclusions from the test method, and other information relevant to a specific test, such as environmental conditions and the use and meaning of data qualifiers
- Nonconformances that affect the data
- Whether data is calculated on a dry weight or wet weight basis
- Identification of the reporting units, such as ug/L or mg/kg

- Statement of the estimated uncertainty of the test result, if applicable
- Signature and title of the person(s) accepting responsibility for the content of the C of A
- Date C of A was issued
- Clear identification of data provided by outside sources, such as air temperature or ambient water temperature
- Identification of the reporting detection limit (RDL) or practical quantitation limit (PQL) for each analyte, if applicable.

If a portion of the sample analysis is subcontracted, the C of A will identify the subcontractor or applicable accreditation number, and the data that was determined by the subcontracting laboratory

.Level 2 Certificates of analysis contain the following additional information:

- Dilution factors
- Method detection limits
- Surrogate recoveries and the acceptance criteria for all organic analyses
- Estimated concentrations determined for nondetects and appropriate "U" and "J" qualifiers for nondetects and concentrations that fall between the MDL and PQL respectively.

Once issued, a C of A is not altered unless a subsequent C of A is identified as a revised report.

## 11.2 Quality Control Summary Report (QCSR)

We prepare and analyze samples in groups of twenty or less. The quality control data that demonstrates the sample preparation and/or analytical efficiency of the batch is summarized on a QCSR. The data reported on the QCSR may be limited to a sample delivery group contained in the batch or may include all quality control for the batch. Information reported on QCSR includes:

- Quality control sample ID number
- Type of quality control sample
- Concentrations determined, where applicable, for method blanks, matrix spikes, matrix spike duplicates, matrix duplicates, laboratory control samples, serial dilutions, and laboratory control sample duplicates
- Acceptance criteria for matrix spikes, matrix spike duplicates, matrix duplicates, laboratory control samples, and laboratory control sample duplicates

- Nominal concentrations of matrix spikes, matrix spike duplicates, LCSs, and LCS duplicates
- Concentration of parent sample for the matrix spikes, matrix spike duplicates, or sample duplicates
- Percent recoveries for LCS and matrix spikes
- Relative percent differences for the matrix spike duplicates, matrix duplicates, and LCS duplicates
- Analytical batch number with which the quality control data is associated
- Parent sample numbers for matrix spikes, matrix duplicates, and matrix spike duplicates
- Sample or sample delivery group ID
- Project code
- Date issued, page numbers/total number of pages
- Identification of recoveries or relative percent differences that do not meet the acceptance criteria

## 11.3 Analytical Case Narratives

Analytical case narratives are written by an analyst or data validator to describe the overall conditions affecting the analysis of a batch or a specific sample in the batch. Case narratives usually include:

- Sample delivery group ID number
- Analytical batch number
- Methods of preparation and analysis
- Sample matrix
- Initial of person preparing and/or reviewing the narrative
- Specific sample ID numbers
- Identification and description of batch quality control samples including parent sample identification
- Affirmation that all sample preparation conditions specified by the method or regulatory agencies were met or identification of specific deviations
- Affirmation that all analysis criteria specified by the method or regulatory agencies were met or identification of specific deviations
- Instrumentation employed if applicable and verification of its calibration
- Summary of batch quality control as compared to acceptance criteria
- Identification of nonconformances
- Pertinent comments and observations of factors that affect sample data quality



#### 11.4 Electronic Data Deliverables (EDDs)

Electronic data deliverables are generated according to client specifications. EDDs use programs supplied by the client or created internally by our EDD team. Internally generated EDDs are usually written in Perl and/or PL/SQL.

#### 11.5 Types of Data Packages and Reports

We offer three levels of data reports and the ability to design packages to meet the needs of our clients. The levels of data reports are summarized in Table 1.

Table 1: Data Report Formats

Level	Contents
1	Level 1 C of A
2	Level 2 C of A plus QCSR
3	Level 2 plus Case Narrative

If a client so requests, the above reports can be accompanied by EDDs, case narratives, copies of associated nonconformance reports, and other support documentation. The client's specific requirements are communicated to the laboratory and data reviewers through Alpha LIMS.

GEL's SOP GL-CS-E-002, The Internal Review of Contractually Required Quality Criteria for Client Package Delivery defines preparation and review of the package.

If a client requests a CLP-like data package, and we agree to provide one, it is compiled in accordance with GL-LB-E-013 for CLP-Like/DOE Data Packages Assembly and Revision. If a client does not request a full CLP-like data package but asks for data to be provided on CLP forms generated from software, we follow the applicable procedures in GL-LB-E-013.

#### 11.6 Review of Data Reports, EDDs, and Data Packages

Level 1 and Level 2 data reports are reviewed for accuracy and completeness by the PM or PMA. Level 3 and CLP-like data packages are reviewed in the laboratory by a data reviewer, who is responsible for reviewing specific fractions of the data package for accuracy, consistency, and completeness in accordance with the SOP for that lab area.

No data package fraction is to be provided to the data packaging team without the approval of the appropriate data reviewer.

CLP-like data packages are reviewed in compliance with the basic protocol. Specific requirements are described in GL-LB-E-013 for the CLP-Like/DOE Data Packages Assembly and Revision.



## SECTION 12

### SUBCONTRACTING ANALYTICAL SAMPLES & OUTSIDE SUPPORT SERVICES

#### Section 12 - Subcontracting Analytical Samples and Outside Support Services

We provide a full array of organic, inorganic, and radiochemical analyses. The subcontracting of samples to other facilities, while infrequent, may occur when:

- The client has requested analytical services for which we are not certified or do not offer as a routine product.
- The regulatory or method holding times and/or client due dates are in danger of not being met as the result of instrument malfunction or the unexpected influx of a large group of samples.

No samples are subcontracted without the client's consent. The laboratories selected to receive subcontracted samples are expected to meet the following criteria:

- Demonstrated technical capability to provide data that meets and conforms to our quality standards.
- Established certification, if available, for the requested analyses.
- Successful proficiency evaluation results, if available.
- Commitment to meet time requirements for delivery of results to the client.
- Agreement to provide all documentation requested in conjunction with the analysis.

- NELAP or ISO/IEC 17025 accreditation for the analysis if required by the client.

We audit potential subcontractors for technical and administrative compliance as directed in GL-QS-E-001 for Conduct of Quality Audits. An audit may be in the form of a book audit or an on-site review.

If there is evidence of a technical, administrative, or quality deterioration, the laboratory is removed from our list of approved subcontractor laboratories pending further evaluation, which may include an on-site audit. Once the laboratory again demonstrates compliance with GEL's standards, it can be reclassified as an approved subcontractor laboratory.

At GEL, we have a multi-faceted and trained staff. There are occasions, however, when it may be necessary to obtain the services of professionals outside of GEL. This may be due to such things as sample workload, introduction of a new instrument or method requiring special knowledge, or employee leaves of absence.

Any outside support services or service personnel are subject to the same scrutiny as a subcontract laboratory. If a service fails to meet our standards for excellence, the appropriate parties are promptly notified. If immediate corrections are not implemented and services are not of adequate quality to maintain confidence, the contract is canceled.

## SECTION 13 CLIENT SATISFACTION

### Section 13 - Client Satisfaction

Meeting the needs and expectations of our clients is essential to meeting our commitment to be the environmental laboratory of first choice. An important part of meeting this commitment involves receiving and resolving client concerns and complaints.

Client complaints that question the quality of laboratory data or data deliverables are directed to Quality Systems. These concerns are responded to with input from the laboratory, EDD team or data packaging group as may be needed.

The types of complaints, area(s) affected, and any impacts on quality are trended on a quarterly basis. This information is available to members of the Leadership Team and other managers and group leaders.

We use AlphaLIMS to monitor client complaints, nonconformances and corrective actions. Every complaint is entered into the system upon receipt and assigned an internal and external due date. The external due date is often established by client contract. The internal due date allows time for the Quality Systems Team to review the response and transmit it to the client on or before the due date.

If we notice a trend that significantly affects the quality of our data, a corrective action is initiated following GL-QS-E-002 for Conducting Corrective/Preventative Action and Identifying Opportunities for Improvement . The implementation and verification of the corrective action affirms an effective and permanent solution.

The Quality Systems Team promptly audits those areas of activity or responsibility for which a complaint or concern has been stated.

***APPENDIX A: REFERENCES***

- National Environmental Laboratory Accreditation Program, NELAP, 2003.
- 10 CFR 50, Appendix B, US Code of Federal Regulations.
- 40 CFR Part 136, October 1984, Part VII, EPA 600 Series Methodologies for the Analysis of Organic Contaminants.
- DOE Order 414.1, Quality Assurance, U.S. Department of Energy.
- EPA Requirements for Quality Assurance Project Plans (QAPPs), US EPA QA/R5.
- Model Statement of Work for Analytical Laboratories, Prepared for Department of Energy Albuquerque Operations Office by AGRA Earth and Environmental, Rev 4, February 2002.
- Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs, American National Standard ANSI/ASQC E4-1994.
- Measurement Associated Instrument Quality Assurance for Radiobioassay Laboratories ANSI N42.23-1995.
- US Department of Defense Quality Systems Manual for Environmental Laboratories, June 2002.
- US Department of Defense Quality Systems Manual for Environmental Laboratories, Version 3 Draft
- US Department of Energy Quality Systems for Analytical Services, Revision 2.2, October 2006.
- MARLAP- Multi-Agency Radiological Laboratory Analytical Protocols
- 10 CFR Part 21- Reporting of Defects and Noncompliance
- 10 CFR Part 50 Appendix B -Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants
- 10 CFR Part 61- Licensing Requirements for Land Disposal and Radioactive Waste
- NRC REG Guide 4.15 and NRC REG Guide 4.8
- ANSI/ISO/IEC 17025-2005

**APPENDIX B: DEFINITIONS**

The following definitions are used throughout the text of our Quality Systems Plan. These definitions were reprinted from "Definitions for Quality Systems," NELAC, July 2, 1998. The original source of each definition is provided.

**AlphaLIMS:** GEL's laboratory information management system.

**Acceptance Criteria:** specified limits placed on characteristics of an item, process, or service defined in the requirement documents. (ASQC)

**Accreditation:** the process by which an agency or organization evaluates and recognizes a program of study or an institution as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one.

**Accuracy:** the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (Glossary of Quality Assurance Terms, QMAS, 8/31/92)

**Analytical Detection Limit:** the smallest amount of an analyte that can be distinguished in a sample by a given measurement procedure throughout a given (e.g., 0.95) confidence interval. (Applicable only to radiochemistry)

**Analytical Reagent (AR) Grade:** designation for the high purity of certain chemical reagents and solvents given by the American Chemical Society. (Quality Systems)

**ANSI** American National Standards Institute his consensus standards body approves standards as a guide to aid the manufacturer, the consumer and the general public who may be concerned with its scope and provisions.

**Batch:** environmental samples, which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same NELAC-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. (Quality Systems)

**Blank:** a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subject to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC, Definitions of environmental Quality Assurance Terms, 1996)

**Blind Sample:** a subsample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

**Calibrate:** to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device, or the correct value for each setting of a control knob. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements.

**Calibration:** the set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure, and the corresponding known values of a measurement. (VIM - 6.13)

**Calibration Curve:** the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their analytical response.

**Calibration Standard:** a solution prepared from the primary dilution standard solution or stock standard solutions and the internal standards and surrogate analytes. The calibration solutions are used to calibrate the instrument response with respect to analyte concentration. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Certified Reference Material (CRM):** a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30 - 2.2)

**Chain of Custody:** an unbroken trail of accountability that documents the physical security of samples, data and records.

**Confirmation:** verification of the presence of a component through the use of an analytical technique that differs from the original test method. These may include:

- Second column confirmation
- Alternate wavelength
- Derivatization
- Mass spectral interpretation
- Alternative detectors or
- Additional cleanup procedures

**Corrective Action:** action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

**Data Audit:** a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria).

**Data Reduction:** the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useful form.

**Detection Limit:** the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated degree of confidence. See Method Detection Limit.

**Document Control:** the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC, Definitions of Environmental Quality Assurance Terms, 1996)

**Duplicate Analyses:** the analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

**Environmental Detection Limit (EDL):** the smallest level at which a radionuclide in an environmental medium can be unambiguously distinguished for a given confidence interval using a particular combination of sampling and measurement procedures, sample size, analytical detection limit, and processing procedure. The EDL shall be specified for the 0.95 or greater confidence interval. The EDL shall be established initially and verified annually for each test method and sample matrix. (NELAC, Radioanalysis Subcommittee)

**Holding Times (Maximum Allowable Holding Times):** the maximum times that samples may be held prior to analysis and still be considered valid. (40 CFR Part 136)

**Initial and Continuing Demonstrations of Capability:** procedure to establish the ability of the laboratory to generate acceptable accuracy and precision which is included in many of the EPA's analytical test methods. In general, the procedure includes the addition of a specified concentration of each analyte in each of four separate aliquots of laboratory pure water or authentic samples. These are carried through the analytical procedure and the percentage recovery and the standard deviation are compared to specified limits. (40 CFR Part 136, 2003 NELAC)

**Internal Standard:** a known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method.

**ISO/IEC 17025** The International Organization for Standardization and International Electrotechnical Commission form this specialized system for worldwide standardization. Members of ISO or IEC participate in the development of

International Standards through technical committees established by their organization to deal with particular fields of activity. Other international organizations, government and non-government, also take part in development of these standards. The ANSI/ISO/IEC 17025-2005 is approved as an American National Standard and covers general requirements for the competence of testing and calibration laboratories.

**Laboratory:** body that calibrates and/or tests.

**NOTES:**

1. In cases where a laboratory forms part of an organization that carries out other activities besides calibration and testing, the term "laboratory" refers only to those parts of that organization that are involved in the calibration and testing process.
2. As used herein, the term "laboratory" refers to a body that carries out calibration or testing
  - ◇ at or from a permanent location
  - ◇ at or from a temporary facility, or
  - ◇ in or from a mobile laboratory. (ISO 25)

**Laboratory Control Sample:** a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias to assess the performance of all or a portion of the measurement system. (NELAC)

**Laboratory Duplicate:** aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.

**Legal Chain of Custody (COC):** an unbroken trail of accountability that ensures the physical security of samples, data and records. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Limit of Detection (LOD):** the lowest concentration level that can be determined by a single analysis and with a defined level of confidence to be statistically different from a blank. (Analytical Chemistry, 55, p.2217, Dec. 1983, modified)(See also Method Detection Limit.)

**Limit of Quantitation (LOQ):** ): the lowest concentration level of the initial calibration curve used to quantitate an analyte. The LOQ is usually 3X to 10 X the LOD.

**Matrix:** the component or substrate that contains the analyte of interest. For purposes of batch determination, the following matrix types shall be used:

- ◇ Aqueous: any aqueous sample excluded from the definition of a drinking water matrix or saline/estuarine source. Includes surface water, groundwater and effluents.
- ◇ Drinking Water: any aqueous sample that has been designated a potable or potential potable water source.
- ◇ Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt-water source.
- ◇ Non-aqueous liquid: any organic liquid with <15% settleable solids.
- ◇ Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
- ◇ Solids: includes soils, sediments, sludges and other matrices with >15% settleable solids.
- ◇ Chemical Waste: a product or by-product of an industrial process.
- ◇ Air Samples: media used to retain the analyte of interest from an air sample such as sorbent tubes or summa canisters. Each medium shall be considered as a distinct matrix. (Quality Systems)

**Matrix Spike:** prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate 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. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)



**Matrix Spike Duplicate (spiked sample/fortified sample duplicate):** a second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**May:** permitted, but not required. (TRADE)

**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 containing an analyte of interest through all steps of the analytical procedures. (NELAC)

**Method Detection Limit:** the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136 Appendix B)

**Must:** denotes a requirement that is required to be met. (Random House College Dictionary)

**Negative Control:** measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

**NELAC:** National Environmental Laboratory Accreditation Conference. A voluntary organization of state and federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of National Environmental Laboratory Accreditation Program.

**Performance Audit:** the routine comparison of independently obtained quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

**Performance Based Measurement System (PBMS):** a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.

**Positive Control:** measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

**Precision:** the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

**Preservation:** refrigeration and or reagents added at the time of sample collection to maintain the chemical and or biological integrity of the sample.

**Proficiency Test Sample (PT):** a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Proficiency Testing:** determination of the laboratory calibration or testing performance by means of inter-laboratory comparisons. (ISO/IEC Guide 2 - 12.6, amended)

**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 in comparison to peer laboratories and the collective demographics and results summary of all participating laboratories.

**Protocol:** a detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed.

**Pure Reagent Water:** shall be water in which no target analytes or interferences are present at a concentration which would impact the results when using a particular analytical test method.

**Quality Assurance:** an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality within a stated level of confidence. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Quality Control:** the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the need of users. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Quality Manual:** a document stating the quality policy, quality system and quality practices of an organization. This may also be called a Quality Assurance Plan or a Quality Plan. NOTE: the quality manual may call up other documentation relating to the laboratory's quality arrangements.

**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. (ANSI/ASQC E-41994)

**Quantitation Limits:** the maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user. For organic and general chemistry

**Range:** the difference between the minimum and the maximum set of values.

**Raw Data:** any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes, which have been transcribed verbatim, dated and verified accurate by signature), the exact copy or exact transcript may be submitted.

**Reagent Blank (method reagent blank):** a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Reference Material:** a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30 -2.1)

**Reference Standard:** a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM - 6.08)

**Requirement:** a translation of the needs into a set of individual quantified or descriptive specifications for the characteristics of an entity in order to enable its realization and examination.

**Selectivity:** (Analytical chemistry) the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances.

**Sensitivity:** the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

**Shall:** denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there will be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled. (*Style Manual for Preparation of Proposed American National Standards*, American National Standards Institute, eighth edition, March 1991P)

**Should:** denotes a guideline or recommendation whenever noncompliance with the specification is permissible. (*Style Manual for Preparation of Proposed American National Standards*, American National Standards Institute, eighth edition, March 1991P)

**Standard Operating Procedures (SOPs):** a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Spike:** a known mass of target analyte added to a blank sample or subsample; used to determine recovery efficiency or for other quality control purposes.

**Standard Reference Material (SRM):** a certified reference material produced by the U.S. National Institute of Standards and Technology and characterized for absolute content, independent of analytical test method.

**Surrogate:** a substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Test:** a technical operation that consists of the determination of one or more characteristics or performance of a given product, material equipment, organism, physical phenomenon, process or service according to a specified procedure.

**NOTE:** the result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2 - 12.4)

**Test Method:** defined technical procedure for performing a test.

**Tolerance Chart:** a chart in which the plotted quality control data is assessed via a tolerance level (e.g. +/- 10% of a mean) based on the precision level judged acceptable to meet overall quality/data use requirements instead of a statistical acceptance criteria (e.g. +/-3 sigma). (ANSI N42.23-1995, Measurement and Associated Instrument Quality Assurance for Radiochemistry Laboratories)

**Traceability:** the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.

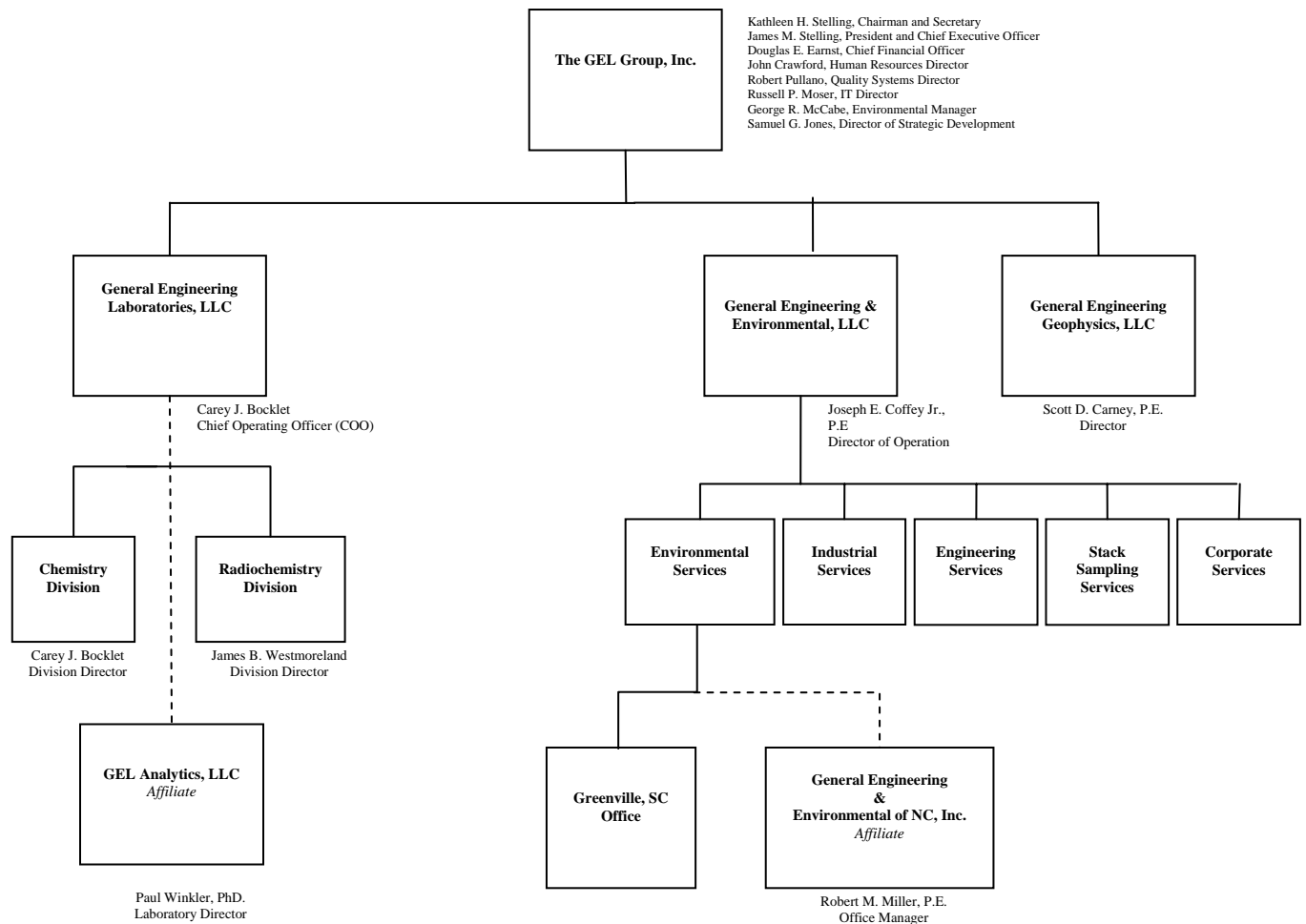
**Verification:** confirmation by examination and provision of evidence that specified requirements have been met.

**NOTE:** 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.

The result of verification leads to a decision either to restore in service, to perform adjustments, or to repair, or to downgrade, or to declare obsolete. In all cases it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

**Validation:** the process of substantiating specified performance criteria

**APPENDIX C: CORPORATE ORGANIZATION CHART**



**APPENDIX D: CERTIFICATIONS**

GEL Laboratories, LLC maintains environmental laboratory certification in many states, including primary NELAP in Florida and secondary in California, Illinois, Kansas, Louisiana, New Jersey, New York, Pennsylvania, Texas and Utah. We expand our list of certification as needed.

Original Scope of Accreditations are maintained in the Quality Assurance work area. Electronic copies are available in pdf form on the GEL intranet. *Please call to confirm the status of any certification of interest to you.*

- **U.S. Department of Energy (DOE)** - Established Basic Ordering Agreement (BOA) in support of ICPT, for use by DOE and its eligible subcontractors. Audited by DOE's Office of Environmental Management under the Department of Energy Consolidated Audit Program (DOECAP)
- **U.S. Army Corps of Engineers (USACE)** - Validation by the Hazardous, Toxic and Radioactive Waste (HTRW) Center of Expertise
- **U.S. Navy** - approval for Naval Facilities Command Southern Division Remedial Action Contract
- **U.S. Department of Agriculture** - Foreign soil importation permit # S-52597
- **National Environmental Laboratory Accreditation Program (NELAP)** - Primary issued through the State of Florida - Department of Health – Bureau of Laboratories; Secondary issued through the States of California, New York, New Jersey and Utah
- **Clinical Laboratory Improvement Amendments (CLIA)** U.S. Department of Health and Human Services, Certificate of Compliance for Acceptance of Human Specimens (GEL ID: 42D0904046)
- **USEPA** Office of Ground Water and Drinking Water, Perchlorate under UCMR
- **USEPA Region 5** Radiochemical Parameters for the Safe Drinking Water Act (SDWA)
- **Alaska** Department of Environmental Conservation, Contaminated Sites Program (UST-062)
- **Arkansas** Department of Environmental Quality Laboratory Certification Program for Wastewater, Groundwater, Solid Waste  
Reciprocal Certification to SC DHEC
- **California** Environmental Laboratory Accreditation Program Certification (GEL ID: 01151CA)
- **Colorado** Department of Public Health and Environment, Reciprocal Certification to SC DHEC Environmental Laboratory Certification Program for Safe Drinking Water Chemistry and Radiochemistry
- **Connecticut** - Department of Public Health - Potable Water, Waste Water and/or Trade Waste, Sewage and/or Effluent, Soil and Radiochemistry Reciprocal Certification (GEL ID: PH-0169)

- **Florida** Department of Health - Office of Laboratory Services, Safe Drinking Water, Clean Water Act and RCRA Certification (Lab ID: E87156)
- **Georgia** Department of Natural Resources, Reciprocal Certification to SC DHEC Environmental Laboratory Certification Program for Safe Drinking Water (inorganics) (GEL ID: 938)
- **Illinois** EPA Environmental Laboratory Accreditation for Drinking Water, Waste Water and Hazardous & Solid Waste (GEL ID: 200029)
- **Kansas** Department of Health and Environmental Laboratory, Non-potable Water and Solid and Hazardous Waste (GEL ID: E-10332)
- **Kentucky** Department of Environmental Protection for Drinking Water (GEL ID: 90129)
- **Maryland** Department of Health and Mental Hygiene, Laboratories Administration, Reciprocal Certification to SC DHEC Environmental Laboratory Certification Program for Safe Drinking Water -Radiochemistry (GEL ID: 270)
- **Massachusetts** Department of Environmental Protection, Division of Environmental Analysis – Potable Water Radiochemistry (GEL ID: M-SC-012)
- **Nevada** Department of Human Resources, Health Division, Bureau of Licensure and Certification, Radiologicals and Non-Radiologicals (GEL ID: SC-12-2002-57)
- **New Jersey** Department of Environmental Protection, Safe Drinking Water, Solid and Hazardous Waste, and Water Pollution Certification (GEL ID: SC002)
- **New York** Department of Health, Environmental Laboratory Approval Program Certification, Potable Water, Non-potable Waters and Solids/Hazardous Wastes (GEL ID: 11501)
- **North Carolina** Division of Environmental Management Lab Certification Program, Waste Waters/Ground Waters. (GEL ID: 233)
- **North Carolina** Department of Health and Human Services, North Carolina State Laboratory Public Health Environmental Sciences, Safe Drinking Water. (GEL ID: 45709)
- **North Dakota** State Department of Health for Drinking Water, Waste Water and Hazardous & Solid Waste (GEL ID: R-158)
- **Oklahoma** Department of Environmental Quality, General Water Quality/Sludge Testing Laboratory Dual Certification (GEL ID: 9904)
- **Pennsylvania** Department of Environmental Protection - Bureau of
- **South Carolina** Department of Health and Environmental Control - Environmental Laboratory Certification Program, Clean Water, Safe Drinking Water and Solid/Hazardous Wastes (GEL ID: 10120)
- **South Carolina** Department of Health and Environmental Control (DHEC) Radioactive Material License (License #362)



- **Tennessee** Department of Health - Division of Laboratory Services, Reciprocal Certification to SC DHEC Environmental Laboratory Certification Program, Safe Drinking Water-Radiochemistry and Non-radiochemistry (GEL ID: 02934)
- **Texas** Department of Health - Bureau of Laboratories, Reciprocal Certification to SC DHEC Environmental Laboratory Certification Program, Safe Drinking Water, including radiochemistry (GEL ID: TX 213)
- **Utah** Department of Health, Division of Epidemiology and Laboratory Services, Safe Drinking Water, Clean Water and Resource and Conservation and Recovery Act Certifications (Customer ID: GEL)
- **Vermont** Department of Environmental Conservation, Water Supply Division Reciprocal Certification
- **Virginia** Department of General Services - Division of Consolidated Laboratory Services, Safe Drinking Water Reciprocal Certification (Radiologicals and Non-Radiologicals) (GEL ID: 00151)
- **Washington** State Department of Ecology, Safe Drinking Water, Clean Water and Resource and Conservation and Recovery Act Certifications (GEL ID: C1641)

**APPENDIX E: ESSENTIAL QUALITY CONTROL REQUIREMENTS**

At GEL, we enforce strict adherence to quality control measures. Quality control measures for each type of analysis are delineated in the associated standard operating procedure and include those specified in the identified analytical method. Client requests for additional quality control agreed to by us will be communicated to the laboratory by the project manager and performed accordingly.

All quality control measures are assessed and evaluated on an on-going basis. We use these measures to establish statistically derived quality control acceptance criteria. The acceptance criterion is used to evaluate whether the analytical process is in control, and to assist us in establishing the validity of the data. Our procedures for handling out of control situations are written in the analytical standard operating procedure.

Method-specific quality measures are described in the appropriate standard operating procedure. Essential but general quality control requirements are summarized in the sections below for chemical testing, including inorganic and organic analyses, microbiological analyses, and radiochemical testing.

**E1 Chemical Testing**

This section includes our quality control requirements for inorganic and organic analyses, and discusses:

- Negative controls
- Positive controls
- Analytical variability and reproducibility
- Method evaluation
- Method detection limits
- Data reduction
- Quality of standards and reagents
- Selectivity
- Constant and consistent test condition

**E1.1 Negative controls**

We implement a negative control at least once per analytical batch of samples having the same matrix, and where, if applicable, the same extraction or preparation method is employed. The negative control is a method blank that we use to determine the presence of contamination. If discovered, we must investigate the source of contamination and take measures to correct, minimize or eliminate the source if:

1. The concentration of target analyte exceeds the established practical quantitation limit and exceeds a concentration greater than 1/10 of the measured concentration of any sample in the analytical batch;
2. The concentration of a target analyte in the method blank exceeds that present in the samples and is greater than 1/10 of the specified regulatory limit.

If a method blank is indicative of contamination, we must assess each sample in that batch against the above criteria to determine if the data is acceptable. Any sample associated with a contaminated method blank shall be reprocessed for analysis, as needed, or we will report the results with appropriate data qualifiers.

**E1.2 Positive Control -Method Performance****E1.2.1 Laboratory Control Sample (LCS)**

**Purpose:** The LCS is used to evaluate the performance of the total analytical system, including all preparation and analysis steps. Results of the LCS are compared to established criteria and, if found to be outside of these criteria, indicates that the analytical system is "out of control". Any affected samples associated with an out of control LCS shall be reprocessed for re-analysis or the results reported with appropriate data qualifying codes, as necessary.

**Frequency:** The LCS is analyzed at a minimum of 1 per preparation batch. Exceptions would be for those analytes for which no spiking solutions are available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen

or turbidity. In those instances for which no separate preparation method is used (example: volatiles in water) the batch shall be defined as environmental samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

**Composition:** The LCS is a controlled matrix, known to be free of analytes of interest, spiked with known and verified concentrations of analytes. **NOTE:** the matrix spike may be used in place of this control as long as the acceptance criteria are as stringent as for the LCS. Alternatively the LCS may consist of a media containing known and verified concentrations of analytes or as Certified Reference Material (CRM). All analyte concentrations shall be within the calibration range of the methods. The following shall be used in choosing components for the spike mixtures:

The components to be spiked shall be as specified by the mandated test method or other regulatory requirement or as requested by the client. In the absence of specified spiking components the laboratory shall spike per the following:

For those components that interfere with an accurate assessment such as spiking simultaneously with technical chlordane, toxaphene and PCBs, the spike should be chosen that represents the chemistries and elution patterns of the components to be reported.

For those test methods that have extremely long lists of analytes, a representative number may be chosen. The analytes selected should be representative of all analytes reported. The following criteria shall be used for determining the minimum number of analytes to be spiked.

- a) For methods that include 1-10 targets, spike all components;
- b) For methods that include 11-20 targets, spike at least 10 or 80%, whichever is greater;
- c) For methods with more than 20 targets, spike at least 16 components.

**Note:** Unless otherwise noted in project quality assurance plans or if components interfere with an accurate assessment, all Dept. of Defense projects will have LCS, MS, and MSD that contain all target analytes.

**Evaluation Criteria and Corrective Action:** The results of the individual batch LCS are calculated in percent recovery. The laboratory shall document the calculation for percent recovery. The individual LCS is compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory determines internal criteria or utilizes client specified assessment criteria.

An LCS that is determined to be within the criteria effectively establishes that the analytical system is in control and validates system performance for the samples in the associated batch. Samples analyzed along with a LCS determined to be "out of control" should be considered suspect and the samples reprocessed and re-analyzed or the data reported with appropriate data qualifying codes as necessary.

### *E1.2.2 Sample Specific Controls*

The laboratory must document procedures for determining the effect of the sample matrix on method performance. These procedures relate to the analyses of matrix specific Quality Control (QC) samples and are designed as data quality indicators for a specific sample using the designated test method. These controls alone are not used to judge laboratory performance. Examples of matrix specific QC include: Matrix Spike (MS); Matrix Spike Duplicate (MSD); Post Spike (PS) and Post Spike Duplicate (PSD) sample duplicates; and surrogate spikes.

### *E1.2.3 Matrix Spike; Matrix Spike Duplicates, Post Spike ; Post Spike Duplicates:*

**Purpose:** Matrix specific QC samples indicate the effect of the sample matrix on the precision and accuracy of the results generated using the selected method. The information from these controls is sample/matrix specific and would not normally be used to determine the validity of the entire batch.

**Frequency:** The frequency of the analysis of matrix specific samples shall be determined as part of a systematic planning process (e. g. Data Quality Objectives) or as specified by the required mandated test

method.

**Composition:** The components to be spiked shall be as specified by the mandated test method. Any permit specified analytes, as specified by regulation or client requested analytes shall also be included. If there are no specified components, the laboratory shall spike per the following:

For those components that interfere with an accurate assessment such as spiking simultaneously with technical chlordane, toxaphene and PCBs, the spike should be chosen that represents the chemistries and elution patterns of the components to be reported.

For those test methods that have extremely long lists of analytes, a representative number may be chosen using the following criteria for choosing the number of analytes to be spiked. However, the laboratory shall insure that all targeted components are included in the spike mixture over a 2 year period.

- a) For methods that include 1-10 targets, spike all components;
- b) For methods that include 11-20 targets, spike at least 10 or 80%, whichever is greater;
- c) For methods with more than 20 targets, spike at least 16 components.

**Evaluation Criteria and Corrective Action:** The results from matrix spike/matrix spike duplicate and post spike/post spike duplicate are primarily designed to assess the precision and accuracy of analytical results in a given matrix and are expressed as percent recovery (% R) and relative percent difference (RPD).

Results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory should determine internal criteria and document the method used to establish the limits. For matrix spike or post spike results outside established criteria corrective action shall be documented or the data reported with appropriate data qualifying codes.

#### *E1.2.4 Matrix Duplicates:*

**Purpose:** Matrix duplicates are defined as replicate aliquots of the same sample taken through the entire analytical procedure. The results from this analysis indicate the precision of the results for the specific sample using the selected method. The matrix duplicate provides a usable measure of precision only when target analytes are found in the sample chosen for duplication.

**Frequency:** The frequency of the analysis of matrix duplicates may be determined as part of a systematic planning process (e. g. Data Quality Objectives) or as specified by the mandated test method.

**Composition:** Matrix duplicates are performed on replicate aliquots of actual samples. The composition is usually not known.

**Evaluation Criteria and Corrective Action:** The results from matrix duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD) or another statistical treatment (e. g., absolute differences). The laboratory shall document the calculation for relative percent difference or other statistical treatments.

Results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory shall determine internal criteria and document the method used to establish the limits. For matrix duplicates results outside established criteria corrective action shall be documented or the data reported with appropriate data qualifying codes.

#### *E1.2.5 Surrogate Spikes:*

**Purpose:** Surrogates are used most often in organic chromatography test methods and are chosen to reflect the chemistries of the targeted components of the method. Added prior to sample preparation/extraction, they provide a measure of recovery for every sample matrix.

**Frequency:** Except where the matrix precludes its use or when not available, or is not a method requirement, surrogate compounds are added to all samples, standards, and blanks for all appropriate test

methods.

**Composition:** Surrogate compounds are chosen to represent the various chemistries of the target analytes in the method. They are often specified by the mandated method and are deliberately chosen for their being unlikely to occur as an environmental contaminant. Often this is accomplished by using deuterated analogs of select compounds.

**Evaluation Criteria and Corrective Action:** The results are compared to the acceptance criteria as published in the mandated test method or determined using statistical process controls (SPC). Where there are no established criteria, the laboratory determines internal criteria and documents the method used to establish the limits.

Surrogates outside the acceptance criteria must be evaluated for the effect indicated for the individual sample results. The appropriate corrective action may be guided by the data quality objectives or other site specific requirements. Results reported from analyses with surrogate recoveries outside the acceptance criteria include appropriate data qualifiers.

### E1.3 Method Evaluation

The following procedures, as described in the other sections of the QAP, are in place in order to ensure the accuracy of the reported result:

- Procedure for initial demonstration of analytical capability performed initially (prior to the analysis of any samples) and if there is a significant change in instrument type, personnel, matrix or test method. Refer to Section 8
- Procedures for initial and continuing calibration protocols as specified in Section 7.
- Procedures for utilizing proficiency test samples to evaluate the ability of a procedure and/or analyst laboratory to produce accurate data as specified in Section 3.

### E1.4 Method Detection Limits

Method detection limits (MDLs) are determined as described in GL-LB-E-001 for the Determination of Method Detection Limits. This procedure is based on that established in 40 CFR Part 136, Appendix B.

Where possible, MDL studies are conducted for both aqueous and solid matrices using a clean matrix appropriate to the test method (such as laboratory pure reagent water or Ottawa sand.) MDL studies for the majority of routine parameters are conducted by:

- analyzing a minimum of seven replicates of the lowest calibration standard
- determining the standard deviation of the seven replicates
- multiplying the standard deviation by 3.143 (based on six degrees of freedom and representing a 99% confidence level) to obtain the calculated MDL.

If the MDL study is being conducted for a new method or target analyte, the following steps are taken:

- the MDL is estimated based on information provided in the method or analytical experience
- a standard with a concentration three to five times the estimated MDL is prepared and analyzed a minimum of seven times
- the MDL is calculated as above based on the standard deviation and degrees of freedom
- the MDL is evaluated for reasonableness by verification through analysis of a prepared standard solution two to three times the calculated MDL.

MDL studies are not performed for any target analyte for which spiking solutions are not available such as total volatile solids, pH, color, odor, temperature dissolved oxygen or turbidity.

Practical quantitation limits (PQLs) are determined by either multiplying the MDL by approximately 3 to 10 or are equal to that of the lowest calibration standard. Concentrations of a target analyte determined to be greater than its PQL are defined as quantitative results. All quantitative reported results are bracketed by calibration or calibration verification standards.

All MDL studies conducted by the laboratory are submitted to the Quality team for an independent review. Upon acceptance of the MDL study, the MDLs reported to clients via our computer system are updated unless otherwise specified by contract. PQLs are also updated as directed by the new MDLs or changes to procedures.

All data pertaining to the study and the calculation of the MD(s) is stored on compact discs. The compact discs are maintained as quality records in the Quality department.

#### **E1.5 Data Reduction**

The procedures for data reduction, such as use of linear regression, are documented in the individual analytical standard operating procedures. GEL's policy governing the manual integration of chromatographic data is detailed in GL-LB-E-017 for Procedure and Policy for Manual Integration. SOP GL-QS-E-014 includes discussion of Estimation of Total Analytical Uncertainty, Statistical Process Control (SPC) Limits and Calibration of Instrumentation. Understanding of the procedures used for data generation and reduction is an important part of an analyst demonstrating proficiency in an analytical procedure.

All analysts who may potentially perform manual integrations of chromatographic data are also trained to GL-LB-E-017.

Manual integrations of chromatographic peaks can only be performed in accordance with this GL-LB-E-017. This ensures that the integrations are done in a consistent and technically justifiable manner while meeting the requirements set forth under the Good Automated Laboratory Practices.

#### **E1.6 Quality of Standards and Reagents**

The quality of standards used in instrument calibration or quality control samples and reagents used in sample preparation and/or analysis must meet the criteria described in Section 7. In methods where the purity is not specified, analytical grade reagents are used. Reagents of lesser purity than those specified by the test method are never used. Upon receipt and prior to use the labels on the container are checked to verify that the purity of the reagents meets the documented requirements of the particular test method.

The quality of water sources is monitored and documented as described Section 4. The quality of water used in sample preparation or analysis meets the method-specified requirements. The type of water available in the laboratory is described in Section 4.

#### **E1.7 Selectivity**

Absolute and relative retention times aid in the identification of components in chromatographic analyses and to evaluate the effectiveness of a column in separating constituents. The procedures governing retention time windows are documented in the applicable analytical SOP and meet all regulatory and method requirements.

In addition to retention time windows, the acceptance criterion for mass spectral training is also documented in the appropriate analytical SOP. In all cases, the acceptance criteria meet or exceed those specified in the analytical methods.

Unless stipulated in writing by the client, confirmations are performed to verify the compound identification of positive results detected on a sample from a location that has not been previously tested by our laboratory. Such confirmations are performed on a second column for organic tests such as pesticides, herbicides, or acid extractable or when recommended by the analytical test method except when the analysis involves the use of a mass spectrometer. All confirmation is documented.

#### **E1.8 Constant and Consistent Test Conditions**

GEL's implementation of standard operating procedures that specify quality criteria including initial and continuing calibrations assures that our test instruments consistently operate within the specifications required of the application for which the equipment is used.

In addition to the specifications applied to instrumentation, glassware used for sample preparation or analyses is cleaned in a manner that reduced the potential for positive or negative interferences. Glassware is prepared in accordance with GL-LB-E-003 for Glassware Preparation.

This SOP details the procedures used to clean the following groups of glassware:



- That used for the determination of metals with a special section for bottles to be used for the determination of mercury by either EPA 7470 or 7471A.
- Reusable bottles and plasticware
- Bottles used for the determination of biochemical oxygen demand
- Glassware used in the determination of organic compounds
- That used for the determination of methylene blue active substances
- Glassware used in the determination of total organic halides
- Glassware used in the analyses of samples for total kjeldahl nitrogen and total phosphorous
- Generic glassware used in all other analyses

If the method specifies that the glassware be stored in a particular manner, this requirement is documented in the appropriate analytical SOP.

## **Section E2      Microbiology**

The quality control elements included in this section apply to microbiological analyses performed at GEL. The analyses include the determination of both total and fecal coliforms and standard plate counts.

Discussed in this section are:

- Negative controls
- Positive controls
- Test variability and reproducibility
- Method evaluation
- Test performance
- Data reduction
- Quality of standards, reagents, and media
- Selectivity
- Test conditions

### **E2.1      Negative Controls**

We demonstrate that the cultured samples have not been contaminated during sampling handling and analysis or environmental exposure by the use of negative controls. These negative controls include both sterility checks of media and method blanks.

All blanks and non-inoculated controls specified by the test methods are prepared and analyzed at the frequency stated in the method and in the corresponding standard operating procedure.

A minimum of one non-inoculated control is prepared and analyzed with analytical batches containing only one sample. If the analytical batch contains multiple samples, a series of method blanks is prepared. This series includes least one beginning and ending negative control with additional controls inserted after every 10 samples.

If the method blanks show evidence of contamination, the data obtained for the associated samples is not reported and the client is advised that resampling will be necessary.

Prior to initial use, each lot of media is subjected to a sterility check by analyzing an aliquot of sterile buffer water. If there is any evidence of contamination, the media is not utilized for the analysis of samples and is either returned to the supplier or disposed of in accordance with the Laboratory Waste Management Plan.

### **E2.2      Positive Controls**

Positive controls are used to demonstrate that the medium can support the growth of the target organism and that it produces the specified or expected reaction to that organism. Prior to the initial and then on a monthly basis each lot of media is tested using least one pure culture of with a known positive reaction. If the positive reaction does not occur, the media is not used for sample analysis and is either returned to the supplier or disposed of according to the Laboratory Waste Management Plan.

**E2.3 Test Variability and Reproducibility**

We demonstrate reproducibility of our data by analyzing sample duplicates for least 5% of the suspected positive samples. Each analyst performing microbiological analyses makes parallel analyses on at least one positive sample per month.

For analysis requiring sample volumes of less than 100mL or where the clients submit duplicate sample aliquots, a sample duplicates is analyzed with each analytical batch.

**E2.4 Method Evaluation**

Our ability to perform a specified analysis successfully for its intended purpose is demonstrated and documented in meeting at a minimum the acceptance criteria specified by the method, by the EPA, and by state programs under which we are certified. The acceptance criteria demonstrate that the test method as performed at GEL provides correct and expected results with respect to specified detection capabilities, selectivity, and reproducibility.

Proficiency of the analysis is demonstrated prior to the test method through the use of positive and negative controls. The validation of microbiological test methods is conducted under the same conditions as those for routine analysis.

All validation data is recorded in a logbook specified by the appropriate SOP. We maintain the data as long as the analysis is being conducted and for a minimum of five years after the retirement of an analytical method.

**E2.5 Test Performance**

Test performance is demonstrated for all growth and recovery media used by the appropriate growth and reaction of target organisms to the test media through the use of positive controls as discussed in E2.2.

**E2.6 Data Reduction**

All data is calculated and subjected to data reduction and statistical interpretations as specified by the method's SOP. These specifications incorporate those found in the associated analytical method.

For test methods specifying colony counts, such as membrane filter or colony counting, then the ability of individual analysts to count colonies is verified at least once per month. This verification includes having two or more analysts count colonies from the same plate.

**E2.7 Quality of Standards, Reagents and Media**

In addition to the performance of positive and negative controls, we ensure that the quality of the reagents and media meets or exceeds the requirements specified in the analytical methods. The commercially dehydrated powders used to prepare certain culture media as well as the media that is purchased ready for use are both subjected to positive and negative controls. In addition, all reagents, commercial dehydrated powders and media are used within the shelf life of the product as documented in Section 8.

We retain all manufacturer supplied "quality specification statements" which may contain such information as shelf life of the product, storage conditions, sampling regimen/rate, sterility check including acceptability criteria, performance checks including the organism used, their culture collection reference and acceptability criteria, date of issue of specification, or statements assuring that the relevant product batch meets the product specifications.

All media and buffers are prepared using deionized water that has been demonstrated to be free from bacterial contamination. The deionized water used for microbiological analyses and the monitoring of the deionized water is discussed in Section 4.

Media, solutions and reagents are prepared, used and stored in accordance with appropriate SOP. As described in 2.2, all laboratory media are evaluated at least monthly to ensure they support the growth of specific microbial cultures. In addition, selective media are checked to ensure they suppress the growth of non-target organisms.

The laboratory detergent is checked by use of the inhibitory residue test to ensure that its residues do not inhibit or promote growth of microorganisms.

**E2.8 Selectivity**

We perform all confirmation and verifications tests specified by the test method according to the procedures outlined in our SOPs.

In order to demonstrate traceability and selectivity, we use reference cultures of microorganisms obtained from a recognized national collection. We do not subculture bacterial working stocks. The storage and maintenance of all working and reference stocks are specified in the applicable analytical SOP.

## **E2.9 Test Conditions**

We monitor background levels by the use of method blanks and other negative controls. The acceptable background counts for each analysis and how to deal with situations in which these levels are exceeded are specified in the applicable SOP.

Walls, floors, ceilings and work surfaces of our microbiological laboratory are non-absorbent and easy to clean and disinfect. Measures are taken to avoid accumulation of dust by the provision of sufficient storage space and daily cleaning of exposed surfaces.

The temperature measuring devices such as liquid-in-glass thermometers used in incubators, autoclaves and other equipment are of the appropriate quality to achieve the specification in the test method.

The graduation of the temperature measuring devices is appropriate for the required accuracy of measurement. Each device is calibrated at least annually to national or international standards for temperature in accordance with GL-QS-E-007 for Thermometer Calibration.

The temperatures of incubators, refrigerators, autoclaves, and waterbaths are monitored and documented in accordance with GL-LB-E-004 for Temperature Monitoring and Documentation Requirements for Refrigerators, Freezers, Ovens, Incubators, and Other Similar Devices. While in use, each piece of equipment is maintained in the temperature range specified by the applicable SOP and test method.

Records of autoclave operations including temperature and time are maintained for every cycle.

Volumetric equipment such as automatic dispensers, air displacement pipets and disposal pipets are all used in the microbiology laboratory. This equipment is routinely checked for accuracy as discussed in Section 7.

Conductivity meters, pH meters, and other similar measurement instruments are calibrated according to the methods specified requirements detailed in the SOP.

Mechanical timers are checked regularly against electronic timing devices to ensure accuracy.

## **Section E3 Radiochemical Analysis**

This section describes the general quality control applied to radiochemical analysis. The specific quality control criteria applied to each analysis are delineated in the corresponding SOP. Detector Capabilities, Relative Bias, Relative Precision, and methods of calculating results for periodic Quality Control Determinations are discussed in the appropriate SOP's.

Discussed in this section are:

- Negative controls
- Positive controls
- Test variability/reproducibility
- Tracers and carriers
- Method evaluation
- Radiation measurement system calibration
- Data reduction
- Quality of standards and Reagents
- Test Conditions

### **E3.1 Negative Controls**

Method blanks serve as the primary negative controls providing a means of assessing the existence and magnitude of contamination introduced via the analytical scheme. A method blank is analyzed at a frequency of one per preparation or analytical batch and is one of the quality control measures to be used to assess batch acceptance.

The activity level determined for each target in the method blank is assessed against the specific acceptance criteria specified in the applicable SOP. These criteria are based on a designated sample aliquot size and include appropriate calculations to compare the blank to activity levels determined for different sizes of sample aliquots.

The activity level of any target analyte in the method blank should be less than or equal to the contract required detection limit. The method blank may exceed this limit if the activity is less than 5% that of the lowest sample activity in the batch.

If the method blank acceptance criteria is not met, the specified corrective action and contingencies delineated in the SOPs are followed. Any failures of method blanks to meet the acceptance criteria are documented in the laboratory report and through GEL's nonconformance reporting system specified in GL-QS-E-004 for the Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items.

The activity levels determined for method blanks are not subtracted from those obtained for the samples in the associated preparation or analytical batch. Correction factors such as instrument background and analyte presence in the tracer may, however, be applied to all analyzed samples including both client samples and internal quality control samples.

### **E3.2 Positive Controls**

Positive controls routinely employed in radiochemical analyses include both laboratory control samples (LCS) and matrix spikes (MS.)

The laboratory standards used to prepare LCS and MS are from a different source than those used in instrument calibration, except when the calibration has been verified with a different source. This requirement may be superseded by client specific contract requirements. The activity levels of target analytes in the LCS and MS exceed ten times the prior detection limit and are less than one hundred times this detection limit. If a radiochemical method, however, has more than one reportable analyte isotope, the LCS and MS need to only include one of the analyte isotopes.

Gamma spectroscopy is the exception to this guideline requiring the LCS and MS to contain isotopes representing the low, medium, and high-energy range of the analyzed gamma spectra.

#### **E3.2.1 Laboratory Control Sample (LCS)**

Laboratory control samples are analyzed at a minimum of once per preparation or analytical batch containing twenty or less samples.

The recovery of target analytes in the LCS is compared to the acceptance criteria specified in the applicable analytical SOP. If the recovery of the LCS does not fall within the acceptance range, the corrective actions and contingency steps specified in the SOP are implemented. These steps include the completion of an internal nonconformance report in accordance with GL-QS-E-004 and noting the failure on the laboratory report.

#### **E3.2.2 Matrix Spike (MS)**

Matrix spikes are analyzed at a minimum of once per preparation or analytical batch containing twenty samples or less under the following conditions:

- The analytical method does not utilize an internal standard or carrier
- There is a physical or chemical separation process
- There is sufficient sample volume provided for the analysis.

The target analyte recoveries are one of the quality control measures used to assess batch acceptance. The recovery of target analytes in the MS is compared to the acceptance criteria specified in the applicable analytical SOP. If the recovery of the MS does not fall within the acceptance range, the data associated with that matrix spike is qualified accordingly.

### **E3.3 Test Variability/Reproducibility**

The reproducibility of measurements is evaluated by the use of matrix duplicates. Matrix duplicates are analyzed once per preparation or analytical batch of twenty samples. The relative percent difference (RPD) obtained between the activity levels obtained for the sample and its duplicate are evaluated against the range in the SOP.

**E3.4 Tracers and Carriers**

Two additional quality control measures specific to radiochemical analysis are tracers and carriers. If the analytical method requires a tracer or carrier, each sample result will be associated with a tracer recovery that is calculated and reported. For radiochemistry procedures requiring gravimetric or radiometric recovery (tracer yields), the acceptable limits are 15% - 125%. These limits may vary for specific clients and/or projects. If the applicable limits are not met, the corrective actions delineated in the SOP are implemented.

**E3.5 Method Evaluation**

GEL evaluates the radiochemical preparation and analytical methods to ensure the accuracy of the reported result. This evaluation includes initial demonstrations of capability as described in Section 8 and the analysis of proficiency test samples as described in Section 3. The suppliers of proficiency test samples conform to the requirements of ANSI N42.22 and ISO/IEC 17025-2005.

**E3.6 Radiation Measurement System Calibration**

It is not generally necessary or practical to calibrate radiochemical instrumentation each day of use due to its stability and the time-consuming nature of some of the measurements. There are, therefore, significant differences in the calibration requirements for radiochemical instrumentation from that used for chemical analyses.

Calibration differences include but are not limited to the following:

- The requirement in Section 7 for the determination of the appropriate number of standards for initial calibration is not applicable to radiochemical methods. If the radiochemical method requires multiple standards for initial calibration, the number of standards is included in the applicable SOP.
- If linear regression or non-linear regression is used to fit standard response or calibration standard results to a calibration curve, the correlation coefficient is determined. This differs from Section 7.
- The requirement identified in Section 7 for the bracketing of quantitative results by calibration or calibration verification standards is not applicable to radiochemical analyses due to the non-correlated event nature of decay counting instrumentation.
- As indicated in Section 7, the LCS may fill the requirements for the performance of an initial calibration and continuing calibration verification standard. The calibration verification acceptance criteria are same as specified for the LCS (75 -125%)
- Background calibration measurements are made on a regular basis and monitored using control charts. These values are subtracted from the total measured activity in the determination of the sample activity. The frequency of these measurements is indicated in the SOP GL-RAD-1-010.
- Instrument calibration shall be performed with reference standards as defined in Section E3.8.
- The frequency of calibration shall be addressed in the governing SOPs

**E3.7 Data Reduction**

All sources of method uncertainties and their propagation must be traceable to reported results. This is performed under the guidance of the ISO "Guide to the Expression of Uncertainty in Measurement" and the NIST Technical Note 1297 on "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results". Details of calculations and equations used in reporting Radiochemistry analytical results may be found in SOP GL-RAD-D-003.

**E3.8 Quality of Standards and Reagents**

The reference standards we use are obtained from the National Institute of Standards and Technology (NIST), EPA, or suppliers providing NIST standards. Reference standards should be accompanied by a certificate of calibration whose content is described in ANSI N42.22 - 1995, Section 8, Certificates. All reagents used shall be analytical reagent grade or better.

**E3.9 Test Conditions**

GEL adheres to written procedures that minimize the possibility of cross contamination between samples. This prevents incorrect analysis results from the cross contamination. Procedures are in place, for example, to separate known radioactive and nonradioactive samples from the time of sample receipt to analysis and sample disposal.

Instrument performance checks are performed on a regular basis and monitored with control charts. This ensures that the instrument is operating properly and that the calibration has not changed. The same check source used in the preparation of the control chart at the time of calibration is used in the performance checks of the instrument. The sources must provide adequate counting statistics for a relatively short count time and should be sealed or encapsulated to provide loss of activity and contamination of the instrument and laboratory personnel.

Instrument performance checks include checks on the counting efficiency and the relationship between channel number and alpha or gamma ray energy.



***APPENDIX F: ETHICS AND DATA INTEGRITY AGREEMENT***

**THE GEL GROUP INC.**

**ETHICS and DATA INTEGRITY AGREEMENT**

- I.** I, \_\_\_\_\_, state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at The GEL Group Inc.
- II.** I agree that in the performance of my duties at The GEL Group Inc.:
- A. I shall not intentionally report data values that are not the actual values obtained;
  - B. I shall not intentionally report dates and times of data analyses that are not the actual dates and time of data analyses; and
  - C. I shall not intentionally represent another individual's work as my own.
- III.** I agree to inform The GEL Group Inc. of any accidental or intentional reporting of non-authentic data by myself in a timely manner.
- IV.** I agree to inform The GEL Group Inc. of any accidental or intentional reporting of non-authentic data by other employees.

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Date)

**APPENDIX G: EQUIPMENT LIST**

**ORGANICS EXTRACTIONS**

#	Equipment	Model #	Purchase Date	ID/Serial #
2	Tekmar Sonic Distribution	600		22461D 16585F
1	J2 Scientific GPC	Accup-MP5	Jul-05	05C-1159-4-0
8	Zymark Turbovap	Turbovap II	May-96	TV9612N6726 TV9631N6975 TV9628N6939 TV9809R7994 TV0146N10597 TV0146N10596 TV0146N10598 TV0146N10595
4	Soxtherms	SOX416/SE416	Jan-05	4041427 4040014 4040019 4040018
2	N-Evaps Organomation	1218 115	Jun-95	15076 5673

**SEMIVOLATILE ANALYSIS**

#	Equipment	Model #	Purchase Date	ID/Serial #
3	LC/MS/MS - Water HPLC MicroMass Mass Spectrometer	QuattroMicro2795 QuattroUltima2795 1100 API 4000	May-02 May-02 Sep-05	D02SM9212M (LC)QAA212 (MS) D99SM9012R (LC) VB150 (MS) DE91608981(LC) V04290402(MS)
2	MassLynx (Software)	Version 3.5 Version 4.0	May-02	
1	Analyst (Software)	1.4.1	Sep-05	
3	ChemStation (Software)	A.08.03 A.08.03 A.09.03	Oct-99 Nov-99 Jun-05	
1	Hewlett Packard HPLC with Diode Array Detector	1100	Oct-99	DE91605558
1	Hewlett Packard HPLC with Diode Array Detector and Fluoresence Detector	1100	Nov-99	DE91608274
1	Hewlett Packard HPLC with Diode Array Detector and Fluoresence Detector	1100	Jun-05	DE91608331 DE14904242
1	Head Space Autosampler	CTC CombiPal	Jul-06	126292

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#	Equipment	Model #	Purchase Date	ID/Serial #
7	Hewlett Packard 5973 Gas Chromatograph/ Mass Spectrometer	5973	May-97 to Jun-05	US70810371(US00007297)MSD7 US82311610(US00028102)MSD8 US82311233(US00023050)MSD5 US52440275(CN10521005)MSD1 US82311417(US00025502)MSD6 US72010604(US00009213)MSD2 US82311481(US00026073)MSD4
7	MS ChemStation (Software)	G1701BA B.02.00 G1701BA B.02.00 G1701BA B.02.00 G1701DA D.02.00 G1701BA B.02.00 G1701BA B.02.00 G1701BA B.02.00	May-97 to Jun-05	MSD7 MSD8 MSD5 MSD1 MSD6 MSD2 MSD4
4	Hewlett Packard Gas Chromatograph-FID	5890	Feb-91 Aug-98	3033A33351 (CTC-H5500) 3203A41418(CTCA2005) 3203A41419(CTA2005) 2950A28331 (7673)
4	GC ChemStation (Software)	A.08.03	Feb-91 Aug-98	
7	Hewlett Packard Gas Chromatograph-ECD	6890	Aug-97 Nov-97 Mar-98 Jul-98	US00010134 (ECD7) US00009591 (ECD5) US00023402 (ECD1) US00023068 (ECD3) US10133016 (ECD8) US00028911 (ECD2) US00023343 (ECD6)
7	GC ChemStation (Software)	A.06.03 A.06.03 A.08.03 A.08.03 A.08.03 A.06.03	Aug-97 Nov-97 Mar-98 Jul-98	(ECD7) (ECD5) (ECD1) (ECD3) (ECD8) (ECD2) (ECD6)
1	Hewlett Packard Gas Chromatograph-ECD	5890	Prior to 1999	3336A51011 (Screen)
1	GC ChemStation (Software)	A.08.03	Prior to 1999	(Screen)
<b>VOLATILE ORGANIC ANALYSIS</b>				
#	Equipment	Model #	Purchase Date	ID/Serial #
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer with OI 4560 Purge and Arcon Autosampler	5973	Oct-99	US91911845(US00030386)VOA1

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#	Equipment	Model #	Purchase Date	ID/Serial #
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer with 014560/Arcon Autosampler	5973	Nov-98	US82311236(US00023264)VOA9
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer Chemstation with OI 4560/Arcon Autosampler	5972	May-93	3341A00976(VOA4)
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer Chemstation with OI 4560/Arcon Autosampler	5972	Jun-93	3251A00145(VOA0)
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer Chemstation with 014560/Arcon Autosampler	5973	Jan-98	US72010562(US00010331)VOA8
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer Chemstation with OI 4560/Arcon Autosampler	5973	Mar-99	US82311536(US00026725)VOA2
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer Chemstation with OI 4560/Arcon Autosampler	5973	Jul-06	US82311616(US00028288)VOA3
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer Chemstation with OI 4560/Arcon Autosampler	5973	Jul-05	US10442045(US10150081)VOA7
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer Chemstation with OI 4560/Arcon Autosampler	5975	Sep-05	US52430466(CN10525054)VOA6
1	Flame Ionization Detector and Tekmar LCS 200 with Arcon Autosampler	HP Series II	Aug-05	3336A51010
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer with OI 4560 Arcon Autosampler	5975		USG1332879 CN10606080 (VOA 5)

#	Equipment	Model #	Purchase Date	ID/Serial #
10	MS ChemStation (Software)	G1701 BA B.02.00 G1701 BA B.02.00 G1701 BA B.02.00 G1701 BA B.02.01 G1701 BA B.02.01 G1701 BA B.02.00 G1701 BA B.02.00 G1701 DAD.02.00 G1701 DAD.02.00 G1701 DAD.02.00 G1701 BA B.02.00		VOA 1 VOA 9 VOA 4 VOA 0 VOA 8 VOA 2 VOA 3 VOA 7 VOA 6 VOA 5 VOA FID

#### METALS ANALYSIS

#	Equipment	Model #	Purchase Date	ID/Serial #
2	Perkin Elmer Mercury Analyzer	Fims 400 Fims 100	Nov-97 Jul-01	4179 1536
2	AA WINLAB (Software)		Nov-97 Jul-01	
1	PS Analytical Atomic Fluorescence Mercury Analyzer	10.035	Aug-02	024
1	Millennium (Software)			
3	Perkin Elmer Inductively Coupled Plasma Mass Spectrometer	ELAN 6100 ELAN 9000 ELAN 9000	Dec-01 Apr-02 Jan-06	187000 P1160304 AJ0100590602
3	ELAN (Software)	2.3.1 2.4 SP3 2.4 SP3	Dec-01 Apr-02 Jan-06	
2	Optima 4300DV Spectrometer	4300DV	Apr-02 Apr-02	077N1030502 077N2061001
2	Winlab32 (Software)	Ver 3.1.0 Ver 3.0.0	Apr-02 Apr-02	
1	Thermo-Jarrell Ash Simultaneous Inductively Coupled Plasma Trace Analyzer with Autosampler and Ultrasonic Nebulizer	61E Trace	Jan-95	489890
1	Thermospec (Software)	61E Trace	Jan-95	
1	Mettler Toledo pH meter	V1.10		1226126036
1	Low Level Hg Analyzer	AFG+	Jan-06	5021 112-00067-1
1	WinHGRRunner (Software)	1.5 0.12	Jan-06	

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**GENERAL CHEMISTRY**

#	Equipment	Model #	Purchase Date	ID/Serial #
1	Schott Instruments Karl Fischer Analyzer	Titration KF	Jan-06	Karl001
1	Dohrman Total Organic Carbon Analyzer	DC190	May-93	9302211
1	OI Analytical, TOC 1010	1010	Jul-99	18935710267
1	WinTOC (Software)		Jul-99	
2	Horizon Speed Vap II	9000 9000	Oct-01 April-02	01-337 01-340
4	Environmental Express Midi Still	N/A	Mar-02 Mar-02	2022 2023 2017 0102 MC-100
2	Lachat QuikChem 8000	8000	Jul-01 Jul-02	A83000-1910 A83000-2077
2	Omnion (Software)	3.0.218 3.0.218	Jul-01 Jul-02	
1	Lachat QuikChem 8500	8500	Jan-06	060900000344
1	Omnion (Software)	3.0.219	Jan-06	
1	ThermoSpectronic	20D+	Nov-03	3DUD255001
2	Mitsubishi Total Organic Halogen Analyzers	TOX-10-C TOX-10-C	Jul-84 Jan-90	43R00334 43R31429
1	Dionex Ion Chromatograph	DX 500	Oct-99	99050260
1	PeakNet (Software)	5.21		
2	Dionex Ion Chromatograph	Series 4500I	Jun-89 Mar-93	873450 930613
2	AI 450 (Software)		Jun-89 Mar-93	
1	Turbidimeter	Micro100	Jun-03	205205
1	Dohrman DX 2000 TOX/EOX	DX2000	Feb-94	9309876
1	Metrohm Peak IC Detector	732	Jun-03	11173
1	IC Net (Software)	2.3	Jun-03	
2	TKN Block Digestor		Feb-06	4540A10265, 4540A10266
1	Midi Vap Cyan-Ten Midi Cyanide Distillation	MC-100	Jul-93	MCVA1390797

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#	Equipment	Model #	Purchase Date	ID/Serial #
3	NH3/TKN Distillation Unit	100	various(last one 2/2006)	9215306, 342930103, 498810510
1	Lab-Line Pyro Multi-Magnestire	59380		0300-0171
1	YSI Dissolved Oxygen Meter	59	Nov-05	05L1915 AE
1	IEC Clinical Centrifuge			428189 42831885
1	Pensky Martin Flashpoint Tester	HFP 380		23800146
1	Rapid Tester Setaflash	PetroLab		22012
2	Baxter TDS Ovens	DN63		DN63
1	VWR TSS Oven	1370FM		101399
1	Muffle Furnace			
1	Sartorius Balance	LP8200P	Jul-03	14908834
2	Precision Water Baths		Nov-03	R7U-1 602101333
1	Sartorius Analytical Balance	GEL# Bac745		90606745
1	Sartorius Analytical Balance	GEL# B003		39100015
1	Sartorius Analytical Balance	GEL# B006		39010019
2	HACH COD Reactor	COD Reactor	Jan-94	911005731C 9807000017919
1	Orion Conductivity Meter	160	Jan-94	32241041
1	Expandable Ionalyzer	EA940	Jan-90	2060
1	Parr 1261 Calorimeter	Parr 1261	Jan-89	289
1	Sartorius Balance	GEL #B005		3410156
2	Sartorius Analytical Balance	GEL #B-010 GEL #B-012		30505030 40245216
2	ThermoEnvironmental Instruments NOX Analyzer	N/A	Jan-92	10S-35093-251
1	20 Foot Mobile Laboratory Mounted on Diesel Truck Bed	N/A	Jan-92	VX16084096M31798
3	Olympus Phase Contract Microscopes (PCM #1, #2 and #3) Green Filter and Walton-Beckett Graticule	N/A	N/A	9F0062 9F0010 307222
1	Tekmar Head Space Autosampler	N/A	N/A	91168002
1	Olympus Stereo Zoom Microscope	N/A	Jan-92	SZ4045

**RADIOCHEMISTRY/BIOASSAY**

#	Equipment	Model #	Purchase Date	ID/Serial #
2	Tennelec LB-4100 Proportional Counter with 32 detectors	LB4100	Jun-93 Dec-98	18483 21938
4	Beckman Liquid Scintillation Counters	LS6000 LS6500 LS6500 LS6000 LS6500 LS6500 LS6000	Jun-93 Jun-93 Apr-94 Mar-03 Oct-03 Dec-98 Dec-98	7065155 7067083 7067404 7060655 7070506 7069123 7060656
20	Coaxial Germanium Detector for Gamma Spectroscopy	GC3018 GC3019 GC3518 GC3519 GC3520 GC4019 GC4020 GC6020 GC8021 GEM35190 GEM90210 NIGC3019 ERVDS30-45230 IGC3019	Oct-01 to Dec-06	11912876, 119128763, 1922864, 1943234, 9912854, 5933088, 09069163, 10059017, 2461, 09069175, 10059015, 04069118, 8943324, 1943199, 12922955, 100017444, CV-P122204CA, 30- TP30546-A, 2464, 6008
3	Wallac Liquid Scintillation Counters	Guardian/ Quantallus	Mar-97 Dec-98	4040127 2200082 4140299
4	Extended Range Germanium Detector for Gamma Spectroscopy	GR3520 BE3825 GMX45225-P-S GMX30200-P	Mar-98 to Jan-06	8932581 03068173 37-TN11260A TN10348
1	Germanium Well Detector for Gamma Spectroscopy System	GCW3523	Apr-94	3941466
3	Canberra Low Energy Germanium Detectors for X-ray Spectroscopy System	GL2020-S GL2820R	Feb-95 Jan-95 Mar-98	12922782 1954119 3984452
1	Canberra Gamma Analyst Automatic Sample Changer	GAM-AN2	Jun-05	12069216
4	Compaq/DEC Alpha Work Stations for Alpha/Gamma Data Management System	500AU 500AU 500AU DS-10	Nov-98 Nov-98 Jan-04 May-06	N183806280 N188806229 406DP9Z106C AY93206555
1	Perkin Elmer Automatic Gamma Counter	1480	Jun-05	4800440

#	Equipment	Model #	Purchase Date	ID/Serial #
96	Canberra Alpha Spectrometers for Alpha Spectroscopy System (Environmental)	7401	1992 to 1995	Various
276	Canberra Alpha Analyst Spectrometer with PIPS Detectors	7200	1988 to 2006	Various
6	Ludlum Scalers for Radium 226 Analysis/Lucas Cells	2000	Dec-00 May-92 Jun-93 Oct-93 Dec-98 Dec-00	086494 086493 084406 140731 078964 134331
3	Protean Automatic Proportional Counters	WPC 9550	Mar-02 Oct-03 Jul-04	0021910 0329438 924233
2	Laser Kinetic Phosphorimeter with Sample Changer	KPA-11 KPA-11	Mar-94 May-05	91-45050014 9445050064
1	Canberra Alpha/Gamma Data Management System (Software)	XG3100B	Feb-92	G-4470
1	Chemchek Instruments, Inc. Kinetic Phosphorescence Analyzer (Software)	KPAWin Ver 1.2.8	1998	GEL
10	Protean Multi-Detector (32) Proportional Counters	MDS-16	Apr-02 Jul-05 Oct-05	10751 10752 10753 10754 0525767 0525768 0531474 0531474 311437 311438
3	Mettler Balance	AE240 AT261 AE160		L28658 M64061 C31514
1	Beckman Centrifuge	TJ-6	1997	10788
3	Mettler Balance	AE240 AT261 AE160		L28658 M64061 C31514
3	Vulcan Oven	A-500	Pre-2001	AKV9819-106 AKV9819-107 AKV9819-108
1	Allegra 6 Centrifuge		2000	ALS00G25

#	Equipment	Model #	Purchase Date	ID/Serial #
10	Thermo IEC Centrifuges	Centra CL3	2006 2006 2004 2005 2005 2005 2005 2005 2004 2004	37502497 37502496 27501229 37502501 37502500 37502833 37502544 37502834 37502723 37502684
1	Yamato Drying Oven	DX600	2001	A9300029
12	Sartorius Balance	EB6DCE-L R300S LC 4200S LC 3201D BP 3100S U6100 A 200S I I I 12000 S I 2000D BP210S A 200S TE2101 CP2202S EB6DCE-L HD2000 D BP 310S LC6200S CP2002S CP 323S CP 323S	Pre-2001	15804126 38110047 40309539 60108592 51204863 36040216 38080204 40109033 39039003 70104421 40020046 16750207 17955156 15701734 39020004 50410272 30503785 17955160 18550299 19350208

#### LABORATORY INFORMATION MANAGEMENT SYSTEMS

#	Equipment	Model #	Purchase Date	ID/Serial #
1	SUN Sunfire V440 Solaris 10 4x1.6GHz 8GBRAM (2) 2X146GB (RAID1)	V440	Jul-05	0515AD1489
1	SUN Sunfire V440 Solaris 9 4x1.3GHz 16GBRAM (2) 2X36GB (RAID1) 750GB (RAID5) External Storage Array	V440	Mar-05	034ADIBAD

#	Equipment	Model #	Purchase Date	ID/Serial #
1	SUN Sunfire V890 Solaris 10 8x1.5GHz 32GBRAM 2X36GB (RAID1), 10x146GB (RAID5), Oracle 9 1000Mbps Ethernet Card	V890	Sep-06	0529AM019F
1	Windows NT Server, NT4, 2 CPU 256 MB RAM 10 GB Disk (rad_server), 100 Mbps Eth card, ORACLE 7	N/A	Aug-98	PC Server Class
1	HP9000 Dclass, HP-UX 11.0, 2x9GB (RAID1) 2x240MHz, 1GB RAM	HP-UX 11.0	Sep-05	2013978938
1	HP9000 Dclass, HP-UX 10.20, 2 cpu, 256 MB RAM, (hpclp1) 50GB Disk (mirrored and RAID%), Raid tower, 100 Mbps Eth card, Target Software	N/A	Nov-97	A3480A
1	HP9000 Dclass, HP-UX 10.20, 2 cpu, 256 MB RAM, (kilroy) 50GB Disk (mirrored and RAID5), Raid tower, 100 Mbps Eth card, Target Software	N/A	Nov-97	A3480A
1	SUN Ultra Enterprise 4500, Salaris 9 20 CMUs, 6 GB RAM, 720 GB Disk (mirrored RAID 5), Oracle 9, 100 Mbps Ethernet card	E4500	Feb-03	941H35EF
1	Rave - Ultra AX-MP 2 CPU's, 1024 MB RAM, 60 GB Disk (mirrored)	E450	Oct-99	257703
1	Rave - Ultra AX-MP 2 CPU's, 1024 MB RAM, 60 GB Disk (mirrored)	E250	Mar-00	302971
1	Aberdeen Sterling S38i 4x1.8 GHz, 1.5GB RAM, 168 GB (RAID5)	Sterling S38i		F14102A3420394
1	Aberdeen Sterling S38i 4x3.0 GHz, 1.5GB RAM, 168 GB (RAID5)	Sterling S38i		F14102A3470669

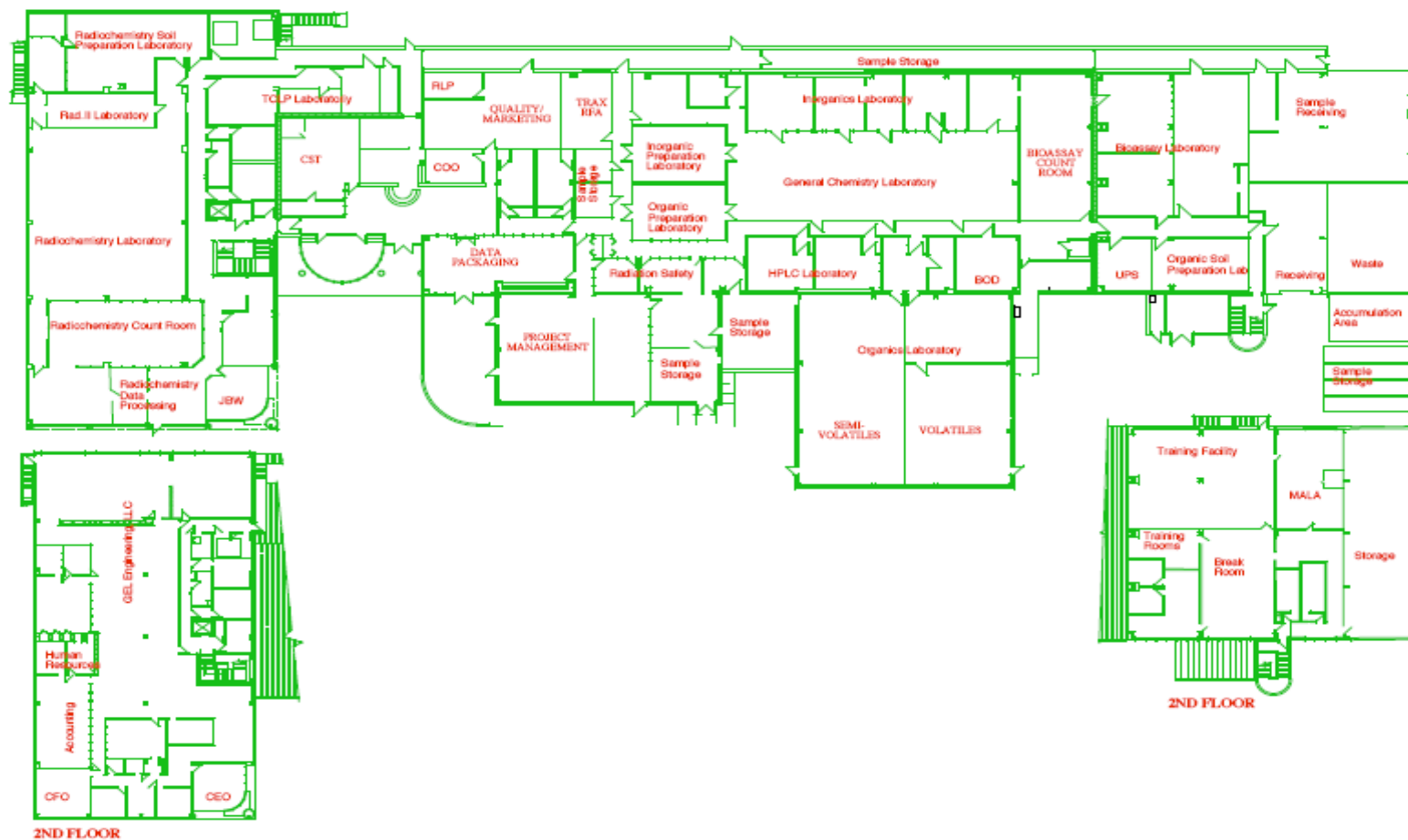
#	Equipment	Model #	Purchase Date	ID/Serial #
1	Apple- Xserve G5 2x2.5 GHz CPU's, 1.0 GB RAM, 3x400 GB Disks (mirrored)	Xserve G5		QP5020HKRTS
1	Apple-Xserve RAID 14x400 GB Disks (RAID5)	Xserve RAID		QP503007R56
1	Apple- Xserve G5 2GHz Power PC, 2GB RAM, 80GB (RAID 1)	0510.4.8 Server Xserve G5	Feb-06	21000D939E4A33
1	Apple- Xserve RAID 2GHz Power PC, 14x500GB RAM, 80GB (RAID 5+0)	Xserve RAID	Feb-06	QP6030EVU3H
1	Dell PowerEdge 2950 2xIntel Xeon 3GHz, 2GB RAM, 36GB RAID1 900GB RAID 5 Red Hat ES4	2950	Aug-05	DG2CNB1

**UNIVERSAL POWER SUPPLY**

#	Equipment	Model #	Purchase Date	ID/Serial #
1	Power ware 9315	9315	Jul-05	ES443ZXX57



*APPENDIX H: FACILITIES WITH EVACUATION ROUTES*



**APPENDIX I: STANDARD OPERATING PROCEDURES & ANALYTICAL METHODS**

<b>Standard Operating Procedures_Methods</b>		
<b>SOP #</b>	<b>SOP Title</b>	<b>Methods</b>
GL-ADM-E-001	Preparation, Authorization, Change, and Release of SOPs	N/A
GL-ADM-E-002	Process, Review, and Distribution of COAs and COA Packages	N/A
GL-AP-E-001	Invoicing Analytical Lab Numbers	N/A
GL-CO-E-001	Revising GEL Laboratories, LLC Catalog of Analytical Services	N/A
GL-CO-E-002	Delegated Authority to Commit the Company	N/A
GL-CO-E-003	Request for Proposal (RFP)/Contract Review	N/A
GL-CS-E-002	Internal Review of Contractually Required Quality Criteria for Client Package Delivery	N/A
GL-CS-E-005	Electronic Data Deliverables	N/A
GL-CS-E-006	Subcontracting Analytical Services	N/A
GL-CS-E-008	Prelogin, Login, and Login Review	N/A
GL-CS-M-001	Project Management AlphaLIMS Manual	N/A
GL-DC-E-001	Document Control	N/A
GL-FC-E-001	Facility Security	N/A
GL-FC-E-002	Testing Emergency Eyewash and Shower Equipment	N/A
GL-FC-E-003	Fume Hood Face Velocity Performance Checks	N/A
GL-FC-E-004	Inspection of Fire Extinguishers	N/A
GL-GC-E-001	Total Dissolved Solids	EPA 160.1, SM 2540C
GL-GC-E-002	Fluoride Determination by Ion Selective Electrode	EPA 340.2, SM 4500F-B, SM 4500F-C
GL-GC-E-004	General Chemistry Standards Definitions and Preparation	N/A
GL-GC-E-007	Total Organic Halogen (TOX) on Liquid Samples Using the Mitsubishi TOX-10 Analyzer	SM 1650C, SW-846 9020B
GL-GC-E-008	pH	150.1, 9040B, 9041A, 9045C, 4500 H
GL-GC-E-009	Conductivity and Salinity	120.1, 9050, SM 2510B, SM 2520B
GL-GC-E-010	Paint Filter Test	EPA 9095A
GL-GC-E-011	Total Solids	EPA 160.3, 2540B, 2540G
GL-GC-E-012	Total Suspended Solids	EPA 160.2, SM 2540D
GL-GC-E-017	Oil and Grease and Gravimetric Total Petroleum Hydro Carbons (TPH) Aqueous Samples	9070(Mod), SM 5520F, SM 5520B, 413.1
GL-GC-E-027	Pensky-Martens Closed Cup Flashpoint	SW- 846 1010
GL-GC-E-028	Carbonaceous Biochemical Oxygen Demand (CBOD)	EPA 405.1, SM 5210
GL-GC-E-029	Corrosivity Toward Steel	SW-846 1110(Mod)

Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
GL-GC-E-031	Fecal Coliform by Membrane Filter	SM 9222D
GL-GC-E-032	Carbon Dioxide (Total and Free) by Calculation	EPA 310.1, SM 4500-CO2-D
GL-GC-E-033	Alkalinity - Total, Bicarbonate Carbonate, Hydroxide, and Phenolphthalein	EPA 310.1(Mod), SM 2320B
GL-GC-E-034	Fecal Coliform Most Probable Number (5 Tube Dilution)	SM 9221-E1, SM 9221-E2
GL-GC-E-035	Volatile Suspended Solids	EPA 160.2, 160.4, SM 2540E
GL-GC-E-036	Color by Visual Comparison	EPA 110.2, SM 2120B
GL-GC-E-037	Turbidity	SM 2310, EPA 180.1
GL-GC-E-040	Pretreatment of Cyanide Amenable to Chlorination	335.1(Mod), 335.3 (Mod), 9010B, 9012A
GL-GC-E-044	Colorimetric Determination of Chromium, Hexavalent	7196A, SM 3500 Cr-D, 3060A
GL-GC-E-045	Biochemical Oxygen Demand (BOD)	EPA 405.1, SM 5210B
GL-GC-E-046	Orthophosphate	EPA 365.2, SM 4500-PE
GL-GC-E-047	Methylene Blue Active Substance	EPA 425.1, SM 5540C
GL-GC-E-048	Heating Value Determination by Bomb Calorimeter	ASTM D 240-00, 4809-00 (M), E711-87 (M)
GL-GC-E-050	Threshold Odor, Consistent Series EPA 140.1	EPA 140.1
GL-GC-E-052	Sulfide (Methylene Blue Method)	EPA 376.2(M), HACH 8131
GL-GC-E-053	Heterotrophic Plate Count (Standard Plate Count)	SM 9215B
GL-GC-E-054	Total Coliform by Membrane Filter	SM 9222B(M)
GL-GC-E-056	Sulfite	SM 4500-SO3 2-B, EPA 377.1
GL-GC-E-057	Volatile Solids and % Ash-550-Procedure for Water Samples	EPA 160.4, SM 2540E
GL-GC-E-058	Volatile Solids and % Ash-550-Procedure for Solid and Semi-Solid Samples	SM 2540G
GL-GC-E-059	Dissolved Oxygen Analysis by Membrane Electrode Method	SM 4500-O-G, EPA 360.1
GL-GC-E-061	Chemical Oxygen Demand (COD) - Digestion Reactor Method	EPA 410.4, HACH 8000
GL-GC-E-062	Total Carbon and Total Organic Carbon Analysis Using the Dohrmann DC-190 Boat Sampler	SW-846 9060(M), EPA 415.1
GL-GC-E-063	Total Coliform by Most Probable Number (5 Tube Dilution)	SM 9221B(M)
GL-GC-E-064	Density	ASTM D5057
GL-GC-E-065	Specific Gravity	ASTM D5057
GL-GC-E-066	Flashpoint by Setaflash	1020A
GL-GC-E-067	Cyanide Sample Preparation	9012A, 9010B, 335.1, 335.3, 335.4, 335.2

Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
		CLP-M
GL-GC-E-068	Viscosity	Manufacturer's Method
GL-GC-E-069	Reactive Cyanide and Sulfide	SW-846 Chap 7.3.3, SW-846 Chap 7.3.4
GL-GC-E-071	Total Phosphorous Sample Preparation	EPA 365.4, EPA 351.2
GL-GC-E-072	Ammonia-Nitrogen Sample Preparation	EPA 350.1, EPA 350.2, 4500-NH3-B
GL-GC-E-073	Free Cyanide Analysis by Microdiffusion	ASTM D 4282
GL-GC-E-074	Extractable Organic Halides (EOX) Using the Dohrmann DX-2000 Analyzer	SW846 9023
GL-GC-E-076	Total Residue Chlorine	SM 4500 CIG, 330.5
GL-GC-E-077	Cyanide Weak Acid Dissociable Sample Preparation and Analysis	335.4, 4500-CN-1
GL-GC-E-079	Bomb Preparation Method for Solid Waste	SW-846 5050
GL-GC-E-082	Acid-Soluble Sulfides	SW-846 9030B, SW-846 9034
GL-GC-E-086	Ion Chromatography (IC)	EPA 300.0, SM 4110B, SW-846 9056
GL-GC-E-087	Percent Water by Karl Fischer Titration	ASTM E203-96
GL-GC-E-090	Acidity	EPA 305.1, EPA 305.2, SM 2310B
GL-GC-E-091	Wavelength Verification of Sequoia-Turner and Thermospectronic Spectrophotometers	N/A
GL-GC-E-092	General Chemistry Data Review and Packaging	N/A
GL-GC-E-093	Total, Total Inorganic and Total Organic Carbon (TOC) using the O-I-Analytical Model 1010 TOC Analyzer	EPA 415.1, SW846 9060
GL-GC-E-094	N-Hexane Extractable Material (HEM, Oil and Grease) and Silica GEL Treated N-Hexane Extractable Material (SGT-HEM Non Polar material)	EPA 1664, SW846 9070A
GL-GC-E-095	Cyanide Analysis by Lachat QuikChem 8000 FIA	335.2 CLP-M, 335.1, 335.3. 335.4, 9010B, 9012A
GL-GC-E-096	Perchlorate by Ion Chromatography (IC)	EPA 314.0
GL-GC-E-097	Boiling Point	ASTM D 1120 (M)
GL-GC-E-098	Total Halogens	ASTM D 808-00
GL-GC-E-099	Ferrous Iron	SM 3500-Fe-D
GL-GC-E-100	Total Hardness by Titration	EPA 130.2
GL-GC-E-101	Hydrazine	ASTM D 1385-01
GL-GC-E-102	Total Recoverable Phenol Determination by the Lachat QuickC hem FIA+ 8000 Series	EPA 420.2, 9066
GL-GC-E-103	Total Phosphorus by the Lachat QuickChem FIA+ 8000 Series	EPA 365.4
GL-GC-E-104	Total Kjeldahl Nitrogen (TKN) using the Lachat QuickChem FIA+8000	EPA 351.2

Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
GL-GC-E-105	The Volumetric Determination of Settleable Solids	EPA 160.5, SM 2540F
GL-GC-E-106	Ammonia Determination by the Lachat Quickchem FIA + 8000 Series	EPA 350.1 Rev2
GL-GC-E-107	Inorganic Calculations	SM 2340B
GL-GC-E-127	Modified Elutriate test	N/A
GL-GC-E-128	Nitrate/Nitrite (NO <sub>3</sub> +NO <sub>2</sub> ) Analysis Using The Lachat QuickChem FIA + 8000 Series Instrument	EPA 353.2
GL-GC-E-129	Air Filter Particulate	N/A
GL-GC-E-130	Percent Ash Determined at 775 C Procedure for Solid and Semisolid Samples	ASTM D 482-03 Modified
GL-HR-E-002	Employee Training	N/A
GL-HR-E-003	Maintenance of Training Records	N/A
GL-IT-E-001	Information Technology Program of Good Laboratory and Good Manufacturing Practices	N/A
GL-IT-E-002	Computer Systems Team Roles and Responsibilities	N/A
GL-IT-E-003	Requirements, Design, Operation, Validation and Removal of hardware and Software Systems	N/A
GL-IT-E004	Change Control Requirements for Hardware and Software	N/A
GL-IT-E-005	Requirements, Design, Operation, Validation and Removal of Applications Used by The GEL Group, Inc.	N/A
GL-IT-E-006	Change Control Requirements for Applications	N/A
GL-IT-E-007	User Roles and Responsibilities for Personnel	N/A
GL-IT-E-008	Server Backup for GEL Analytics, LLC	N/A
GL-IT-E-009	Archive and Retrieval of Systems Information	N/A
GL-IT-E-010	Backup of Computer Controlled Instrumentation	N/A
GL-IT-E-011	System Security and Virus Protection	N/A
GL-IT-E-012	Application Tools used by Computer Services Personnel	N/A
GL-IT-E-013	Creation and Maintenance of the LIMS Audit System	N/A
GL-IT-E-014	Information Systems Disaster Recovery	N/A
GL-LB-E-001	Determination of Method Detection Limits	N/A
GL-LB-E-002	Balances	N/A
GL-LB-E-003	Glassware Preparation	N/A
GL-LB-E-004	Temperature Monitoring and Documentation Requirements for Refrigerators, Ovens, Incubators, and Other Similar Devices	N/A
GL-LB-E-005	Data Review/Validation	N/A
GL-LB-E-006	Toxicity Characteristic Leaching Procedure Preparation	EPA 1311
GL-LB-E-007	Laboratory Standards Documentation	N/A
GL-LB-E-008	Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbook, Forms and Other Record Keeping Devices	N/A
GL-LB-E-009	Run Logs	N/A

Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
GL-LB-E-010	Maintenance and Use of Air Displacement Pipets	N/A
GL-LB-E-012	Verifying the Maintenance of Sample Integrity	N/A
GL-LB-E-013	CLP/CLP-Like Data Package Assembly, Revision and Archiving	N/A
GL-LB-E-015	Control of Laboratory Standards	N/A
GL-LB-E-016	Collection and Monitoring of DI Water Systems	N/A
GL-LB-E-017	Procedure and Policy for Manual Integration	N/A
GL-LB-E-018	Instrument Clock Verification	N/A
GL-LB-E-020	Tuning of High Intensity Ultra-Sonic Processor	N/A
GL-LB-E-022	Generation of Swipe Data	N/A
GL-LB-E-023	Waste Extraction Test (Wet)	N/A
GL-LB-E-024	Synthetic Precipitation Leaching Procedure	EPA 1312
GL-LB-E-026	Container Suitability Testing	N/A
GL-LB-E-027	Bioassay Delivery Kit and Retrieval	N/A
GL-LB-E-028	Creation and Maintenance of Case Narratives	N/A
GL-LB-E-029	Laboratory Sub-Sampling	ASTM D 6323
GL-LB-E-030	Silica Gel and Air Filter Removal and Replacement	N/A
GL-LB-E-031	Sample Compositing	N/A
GL-LB-G-001	Laboratory Waste Management Plan	N/A
GL-LB-N-001	Safety, Health and Chemical Hygiene Plan	N/A
GL-MA-E-006	Acid Digestion of Total Recoverable or Dissolved Metals in Surface and Groundwater Samples for Analysis by ICP or ICP-MS	3005A, 200 Series
GL-MA-E-008	Acid Digestion of Total Metals in Aqueous Samples and Extracts for Analysis by ICP or ICP-MS	3010A, 200 Series
GL-MA-E-009	Acid Digestion of Sediments, Sludges, and Soils	3050B
GL-MA-E-010	Mercury Analysis Using the Perkin Elmer Automated Mercury Analyzer	245.1, 245.2, 245.5, 245.5 CLP-M, 7470A, 7471A, SM 3112B
GL-MA-E-012	Inorganic CLP Sample Digestions	ILMO 4.0, CLP
GL-MA-E-013	Determination of Metals by ICP	EPA 200.7, SW-846 6010B, and 200.7 CLP-M
GL-MA-E-014	Determination of Metals by ICP-MS	6020, EPA 200.8
GL-MA-E-016	Sample Preparation for Total Recoverable Elements by EPA 200.2	EPA 200 series 200.7, 200.8
GL-MA-E-017	Metals Data Validation	N/A
GL-MA-E-018	Mercury Analysis using the PS Analytical Millennium Automated Mercury Analyzer	EPA 1631
GL-MA-E-019	NIOSH 7300 Filter Digestion	7300
GL-MA-E-021	Total Digestion of Sediment Samples for Analysis by ICP or ICP-MS	N/A
GL-OA-E-001	Establishing Retention Time Windows for Gas	8000



Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
	Chromatographic Analysis	
GL-OA-E-002	Organic Standards Preparation and Traceability	ASTM, SW-846
GL-OA-E-003	Non-Volatile Total Petroleum Hydrocarbons by Flame Ionization Detector	8000B, 3510B, 8015B, 3550B, CA Method
GL-OA-E-004	Volatile Total Petroleum Hydrocarbons by Flame Ionization Detector	5030B, 8000B, 8015B, CA Method
GL-OA-E-009	Semivolatile Analysis by Gas Chromatograph/Mass Spectrometer	8270C, EPA 625
GL-OA-E-010	Extraction of Semivolatile and Nonvolatile Organic Compounds from Soil, Sludge, and Other Miscellaneous Samples	8270C, 8081, 8081A, 8082, 8015A, 8310, FL-PRO, CT-ETPH, AK 102, AK 103
GL-OA-E-011	Analysis of Chlorophenoxy Acid Herbicides by ECD	8150B, 8151, SM 6640B
GL-OA-E-013	Extraction of Semivolatile and Nonvolatile Organic Compounds from Groundwater, Wastewater, and Other Aqueous Samples	608, 625, 8270B, 8081, 8081A, 8082, 8015A, 8015B, 8310
GL-OA-E-015	Extraction of Herbicides from Groundwater, Wastewater, and Other Aqueous Samples	8151A
GL-OA-E-020	Percent Moisture	ASTM D2216 Modified
GL-OA-E-022	Volatile Organic Compounds by Gas Chromatograph/Mass Spectrometer Applicable to EPA Method 524.2	524.2
GL-OA-E-026	Volatile Organic Compounds (VOC) by Gas Chromatograph/Mass Spectrometer	624
GL-OA-E-027	Extraction of Herbicides from Soil and Sludge Samples	8151A
GL-OA-E-030	Polynuclear Aromatic Hydrocarbons	8000B, 8310
GL-OA-E-033	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC)	8330, 8000B
GL-OA-E-036	Florisil Cleanup of Organochlorine Pesticide Solvent Extracts	3510C, 3550B
GL-OA-E-037	Sulfuric Acid/Permanganate Cleanup of PCB Solvent Extract	3550B, 3610C, 8082
GL-OA-E-038	Volatile Organic Compounds (VOC) by Gas Chromatography/Mass Spectrometer	8260A, 8260B, 5030A, 5030B, 5035
GL-OA-E-039	Closed -System Purge-and-Trap Collection and Extraction Volatile Organics and Soil and Waste Samples	5035
GL-OA-E-040	Polychlorinated Biphenyls	8000B, 8082, 608
GL-OA-E-041	Organochlorine Pesticides and Chlorinated Hydrocarbons	8000B, 8080, 8081, 8081A, 8121, 608
GL-OA-E-044	Organics Data Validation	N/A
GL-OA-E-045	Sulfur Clean-up	3660B
GL-OA-E-046	Common Industrial Solvents, Glycols and Various Organic Compounds by Flame Ionization Detector	8000A, 3510B, 8015A, 3550A, CA Method

Quality Assurance Plan		
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Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
GL-OA-E-047	Gel Permeation Cleanup of Solvent Extracts	3640A, 3510C, 3550B
GL-OA-E-048	Determination of Petroleum Range Organics by GC-FID (FL-PRO and CT-ETPH)	3510C, 3550B, 8000B, 8015B, FL-PRO
GL-OA-E-049	Silica Gel Cleanup Using Solid Phase Silica Gel Extraction Cartridges	3550B, 3510C
GL-OA-E-050	Extraction of Semivolatile and Nonvolatile Organic Compound from Oil	N/A
GL-OA-E-052	The Determination of Petroleum Range Organics by GC-FID (TNRCC-Method 1005)	TNRCC Method 1005
GL-OA-E-053	Analysis of 1,4-Dioxane by Gas Chromatograph/Mass Spectrometer	SW 846 8260B
GL-OA-E-054	The Determination of Gasoline Range Organics Using Flame Ionization Detection Per Alaska Method- AK101	AK101
GL-OA-E-055	The Determination of Diesel Range Organics Using Flame Ionization Detection Per Alaska Methods AK102 and AK103	AK102, 103
GL-OA-E-056	Definitive Low Level Analysis Using Liquid Chromatography/Mass Spectrometer/Mass Spectrometry (LC/MS/MS) by SW 846 Method 8321 Modified (8321M)	8321 (M)
GL-OA-E-057	Sample Preparation for Perchlorate Analysis Using Liquid Chromatography/Mass Spectrometry/Mass Spectrometry	314.0, 6850 (M)
GL-OA-E-058	Volatile Storage Blanks	N/A
GL-OA-E-059	Analysis of 1,2-Dibromomethane EDB and 1,2-Dibromo-3-Chloropropane (DBCP) in Water by ECD by 504 or 8011	504, 8011
GL-OA-E-060	Extraction and Screening of Organic Compounds	N/A
GL-OA-E-061	Haloacetic Acids in Water	552.2
GL-OA-E-062	Preparation of Samples for Massachusetts Extractable Petroleum Hydrocarbons (EPH)	Massachusetts Method
GL-OA-E-062	Preparation of Massachusetts EPH	N/A
GL-OA-E-063	Massachusetts Method for Determination of Extractable Petroleum Hydrocarbons (EPH)	Massachusetts Method
GL-OA-E-064	Dissolved Gases in Water by Flame Ionization Detector (FID)	RSK-175
GL-OA-E-065	Reagents/Solvents/Standards Screening for Organic Prep	N/A
GL-OA-E-066	Automated Soxhlet Extraction	3541
GL-OA-E-067	Definitive Low Level Perchlorate Analysis Utilizing Liquid Chromatography / Mass Spectrometry /Mass Spectrometry (LC/MS/MS) by EPA Method 6850 Modified (6850M)	6850M
GL-QS-B-001	Quality Assurance Plan	N/A
GL-QS-E-001	Conduct of Quality Audits	N/A

Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
GL-QS-E-002	Conducting Corrective Action	N/A
GL-QS-E-003	Training and Qualifying Quality Assurance Audit Personnel	N/A
GL-QS-E-004	Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items	N/A
GL-QS-E-005	Review of Monitoring Device Logs	N/A
GL-QS-E-007	Thermometer Verification	N/A
GL-QS-E-008	Quality Records Management and Disposition	N/A
GL-QS-E-011	Method Validation and Initial Demonstration of Capability	N/A
GL-QS-E-012	NCR Database Operation	N/A
GL-QS-E-013	Handling of Proficiency Evaluation Samples	N/A
GL-QS-E-014	Quality Assurance Measurement Calculations and Processes	N/A
GL-QS-E-015	Use of Logos and Describing Accredited Status	N/A
GL-QS-E-016	Identification and Implementation of New and Revised Methods	N/A
GL-RAD-A-001	The Determination of Gross Alpha And Gross Non-Volatile Beta in Water	900.0, 9310
GL-RAD-A-001B	The Determination of Gross Alpha And Gross Non-Volatile Beta in Soil and Direct Count Air Filters	900.0 (M), 9310
GL-RAD-A-001C	Determination of Gross Alpha in Water by Coprecipitation	520/5-84-006 Method 00-02
GL-RAD-A-002	Determination of Tritium	906.0
GL-RAD-A-003	Determination of Carbon-14 in Water, Soil, Vegetation and Other Solid Matrices	N/A
GL-RAD-A-004	Determination of Strontium 89/90 in Water, Soil, Milk, Filters, Vegetation and Tissues	905.0 (M), DOE RP501 (M), HASL-300 (M)
GL-RAD-A-005	The Determination of Technitium-99	HASL-300(M), DOE RP550 (M)
GL-RAD-A-006	The Determination of Iodine	901.1(M), HASL-300(M)
GL-RAD-A-007	The Determination of Radon-222 in Water	SM 7500 Rn-B (M)
GL-RAD-A-008	The Determination of Radium-226	903.1 (M)
GL-RAD-A-009	The Determination of Radium-228 in Water	904.0 (M), Ra-05 (M)
GL-RAD-A-009B	The Determination of Total Alpha Emitting Radium and Radium-228 in Soil	HASL-300 (M)
GL-RAD-A-010	Total Alpha Radium Isotopes in Water	900.1 (M)
GL-RAD-A-011	Isotopic Determination of Americium, Curium, Plutonium, and Uranium	DOE RP800 (M), HASL-300 (M)
GL-RAD-A-013	The Determination of Gamma Isotopes	900.1 (M), HASL-300 (M)
GL-RAD-A-015	Digestion for Soil	N/A
GL-RAD-A-016	The Determination of Radiometric Polonium	N/A
GL-RAD-A-017	The Determination of Iodine-131 in Water	902.0, SM 7500-IB
GL-RAD-A-018	The Determination of Lead-210 in Liquid and Solid	N/A

Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
	Matrices	
GL-RAD-A-019	The Determination of Phosphorus-32 in Soil and Water	N/A
GL-RAD-A-020	The Determination of Promethium-147 in Soil and Water	N/A
GL-RAD-A-021	Soil Sample Preparation for the Determination of Radionuclides	N/A
GL-RAD-A-021B	Soil Sample Ashing for the Determination of Radionuclides	N/A
GL-RAD-A-022	Determination of Ni-59 and Ni-63	N/A
GL-RAD-A-023	Total Uranium in Environmental Samples by Kinetic Phosphorescence	ASTM D 5174
GL-RAD-A-026	Preparation of Special Matrices for the Determination of Radionuclides	N/A
GL-RAD-A-028	Radium-226 in Drinking Water by EPA Method 903.1	903.1
GL-RAD-A-029	The Determination of Strontium-89/90 in Drinking Water by EPA Method 905.0	905.0
GL-RAD-A-030	Determination of Radium-228 in Aqueous Samples	904.0, 9320
GL-RAD-A-031	Determination of Selenium and Tellurium	N/A
GL-RAD-A-032	Isotopic Determination of Neptunium/Thorium	N/A
GL-RAD-A-033	Determination of Chlorine-36 in Soil and Water Samples	N/A
GL-RAD-A-035	Isotopic Determination of Plutonium-241	DOE RP800 (M), HASL-300 (M)
GL-RAD-A-036	Isotopic Determination of Americium, Curium, and Plutonium in Large Soil Samples	DOE RP800 (M), HASL-300 (M)
GL-RAD-A-037	Radium-226 and Radium-228 in Drinking Water by Sulfate Precipitation and Gamma-Ray Spectrometry	N/A
GL-RAD-A-038	The Isotopic Determination of Thorium/Uranium	DOE RP800 (M), HASL-300 (M)
GL-RAD-A-040	The Determination of Fe-55 in Liquid and Solid Matrices by Liquid Scintillation Counter	N/A
GL-RAD-A-041	The Determination of Total Activity in Solids and Liquids	N/A
GL-RAD-A-042	The Isotopic Determination of Americium, Curium, Plutonium and Uranium in Liquid Samples by Vacuum Box Method	N/A
GL-RAD-A-044	Total Alpha Radium in Isotopes	903.0, 9315
GL-RAD-A-045	Isotopic Determination of Plutonium, Uranium, Americium, Curium and Thorium	HASL-300 (M)
GL-RAD-A-046	Isotopic Determination of Ra-224 and Ra-226 by Alpha Spectrometry	N/A
GL-RAD-A-047	48 Hour Rapid Gross Alpha Test	N.J.A.C. 7:18, EPA 600/4-80-032 Method 900.0 Modified
GL-RAD-A-048	Determination of Ca-45 in Soils and Waters	N/A
GL-RAD-A-049	The Determination of Sulfur-35 in Liquid Matrices	N/A
GL-RAD-A-050	The Determination of Tritium in Drinking Water Samples	600/4-80-032 Method

Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
		906.0
GL-RAD-A-051	The Rapid Determination of Strontium 89/90 in Environmental Matrices	600-4-80-32 Method 905.0 (Modified), DOE RP501 Rev1 ( Modified), EML-HASL-300 (Modified)
GL-RAD-B-001	Sequential Determination of Isotopic Americium, Curium, Californium, Plutonium, Strontium and Uranium in Urine	N/A
GL-RAD-B-002	Determination of Polonium-210, Radium-226, and Radium-228 in Urine	N/A
GL-RAD-B-003	Determination of Isotopic Thorium and Uranium in Urine Samples	N/A
GL-RAD-B-005	Management of Blank Populations	N/A
GL-RAD-B-008	Determination of Gross Alpha Activity in Nasal Swipes	N/A
GL-RAD-B-009	Bioassay Countroom Alpha Spectroscopy System	N/A
GL-RAD-B-010	Sequential Determination of Thorium, Plutonium and Uranium in Fecal Samples	N/A
GL-RAD-B-011	Determination of Tritium in Urine	906.0
GL-RAD-B-012	Ashing of Fecal, Bone and Tissue Samples	N/A
GL-RAD-B-013	Sequential Determination of Americium and Plutonium in Fecal Samples	N/A
GL-RAD-B-014	Preparation of Synthetic Urine and Fecal Material	N/A
GL-RAD-B-015	Determination of Protactinium in Urine	N/A
GL-RAD-B-016	Determination of Technetium-99 in Urine	N/A
GL-RAD-B-017	Determination of Neptunium in Urine	N/A
GL-RAD-B-018	Operation of the Chemcheck Automatic KPA	N/A
GL-RAD-B-019	Total Uranium in Bioassay Samples by Kinetic Phosphorescence	N/A
GL-RAD-B-020	The Determination of NI-59 and NI-63 in Urine	N/A
GL-RAD-B-022	The Determination of Gross Alpha Beta and Gross Nonvolatile Beta	N/A
GL-RAD-B-023	The Determination of Carbon 14 in Urine	N/A
GL-RAD-B-024	Managing Statistical Data in the Bioassay Lab	N/A
GL-RAD-B-025	The Combination and Preservation of Urine Samples	N/A
GL-RAD-B-026	Bioassay Data Review, Validation and Data Assembly	N/A
GL-RAD-B-027	Specific Gravity in Urine	ASTM D5057
GL-RAD-B-029	The Determination of Radiometric Iodine in Urine	N/A
GL-RAD-B-030	Gamma Prep in Urine	N/A
GL-RAD-B-031	Bioassay/REMP Quality Control Package Assembly	N/A
GL-RAD-B-032	Concentration of Tritium by Electrolysis	N/A
GL-RAD-D-002	Analytical Methods Validation for Radiochemistry	N/A
GL-RAD-D-003	Data Review, Validation, and Data Package Assembly	N/A
GL-RAD-I-001	Gamma Spectroscopy System Operations	N/A

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SOP #	SOP Title	Methods
GL-RAD-I-004	Beckman LS-6000/6500 Operating Procedure	N/A
GL-RAD-I-006	LB4100 Gross Alpha/Beta Counter Operating Instructions	N/A
GL-RAD-I-007	Ludlum Model 2000 Lucas Cell Counter Operating Instructions	N/A
GL-RAD-I-008	VAX/VMS Quality Control Software Program	N/A
GL-RAD-I-009	The Alpha Spectroscopy System	N/A
GL-RAD-I-010	Counting Room Instrumentation Maintenance and Performance Checks	N/A
GL-RAD-I-011	Operation of the Chemchek Kinetic Laser Phosphorimeter	N/A
GL-RAD-I-012	Managing Statistical Data in the Radiochemistry Laboratory	N/A
GL-RAD-I-013	Column Preparation	N/A
GL-RAD-I-014	WALLAC Guardian Model 1414-003	N/A
GL-RAD-I-015	WPC 9550 Gross Alpha/Beta Counter	N/A
GL-RAD-I-016	Multi-Detector Counter	N/A
GL-RAD-I-017	Wallac 1220 Quantalus Liquid Scintillation Counter	N/A
GL-RAD-I-018	Operation of Wallac 1480 Gamma Wizard	N/A
GL-RAD-M-001	Preparation of Radioactive Standards	N/A
GL-RAD-M-003	Magnetic Backup of Hard Drives for Alpha and Gamma Spectroscopy	N/A
GL-RAD-S-001	Radiation Survey Procedures	N/A
GL-RAD-S-002	Radiation Related Emergency Procedures	N/A
GL-RAD-S-003	Inventory and Tracking of Radioactive Material	N/A
GL-RAD-S-004	Radioactive Material Handling Procedure	N/A
GL-RAD-S-006	Radiation Worker Training	N/A
GL-RAD-S-007	Receiving of Radioactive Samples	N/A
GL-RAD-S-009	Dosimetry Procedures	N/A
GL-RAD-S-010	Handling of Biological Materials	N/A
GL-RAD-S-013	Air Sampling for Radioactivity	Guide 825
GL-RC-E-001	Receipt and Inspection of Material and Services	N/A
GL-RC-E-002	Material Requisition	N/A
GL-SR-E-001	Sample Receipt, Login, and Storage	N/A
GL-SR-E-002	Transportation and Shipping of Pre-Preserved Sample Containers	N/A
GL-SR-E-003	Inspection, Cleaning and Screening of Sample Coolers	N/A
GL-SR-E-004	Control of Foreign Soils	N/A
GL-SR-E-005	Wipe Test	N/A
GL-SVR-D-001	Design Requirements for Network Infrastructure	N/A
GL-SVR-D-002	Design Requirements for The Mail Server	N/A
GL-SVR-D-003	Design Requirements for Sansvr	N/A



Standard Operating Procedures_Methods		
SOP #	SOP Title	Methods
GL-SVR-D-004	Design Requirements for Pharmsvr01	N/A
GL-SVR-D-005	Design Specifications for Backupsvr01	N/A
GL-SVR-D-006	Design Specifications for Pharmsvr02	N/A
GL-SVR-E-001	Standard Operating Procedure for Network Infrastructure	N/A
GL-SVR-E-002	Standard Operating Procedure for The Mail Server	N/A
GL-SVR-E-003	Standard Operating Procedure for Sansvr	N/A
GL-SVR-E-004	Standard Operating Procedure for Pharmsvr01	N/A
GL-SVR-E-005	Standard Operating Procedure for Backupsvr01	N/A
GL-SVR-R-001	System Requirements for Network Infrastructure	N/A
GL-SVR-R-002	System Requirements for The Mail Server	N/A
GL-SVR-R-003	System Requirements for Sansvr	N/A
GL-SVR-R-004	System Requirements for Pharmsvr01	N/A
GL-SVR-R-005	System Requirements for Backupsvr01	N/A

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**APPENDIX J: SAMPLE STORAGE AND PRESERVATION REQUIREMENTS**

Parameter	Container <sup>1</sup>	Preservation	Holding Time <sup>2</sup>	Min. Volume <sup>5</sup>
<b>Inorganics</b>				
Acidity	P,G	4 <sup>0</sup> C	14 days	25 mL / NA
Alkalinity	P,G	4 <sup>0</sup> C	14 days	50 mL / NA
Demand (BOD)	P,G	4 <sup>0</sup> C	48 hours	500 mL / NA
Bromide	P,G	None	28 days	10 mL / 4 g
Chemical Oxygen Demand (COD)	P,G	4 <sup>0</sup> C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	2 mL / NA
Chlorine by Bomb	P,G	None	None	NA / 0.5 g
Chloride	P,G	4 <sup>0</sup> C	28 days	10 mL / 4 g
Color	P,G	4 <sup>0</sup> C	48 hours	50 mL / NA
Conductivity	P,G	4 <sup>0</sup> C	28 days	25 mL / NA
<b>Corrosivity by pH</b>	<b>P</b>	<b>None</b>	<b>Immediate</b>	<b>25 mL / 5 g</b>
Corrosivity to Steel	P	None	None	1000 mL / NA
Cyanide amenable to chlorination	P,G	4 <sup>0</sup> C, NaOH to pH>12, 0.6g ascorbic acid <sup>3</sup>	14 days <sup>4</sup>	50 mL / NA
Cyanide, total	P,G	4 <sup>0</sup> C, NaOH to pH>12, 0.6g ascorbic acid <sup>3</sup>	14 days <sup>4</sup>	50 mL / 1 g
<b>Dissolved Oxygen</b>	<b>G (bottle and tap)</b>	<b>None</b>	<b>Immediate</b>	<b>25 mL / NA</b>
Fixed and Volatile Solids	P,G	4 <sup>0</sup> C	7 days	100 mL / NA
Flashpoint	P,G	None	None	Call
Fluoride	P	4 <sup>0</sup> C	28 days	25 mL / 4 g
Hardness	P,G	HNO <sub>3</sub> to pH<2, H <sub>2</sub> SO <sub>4</sub> to pH<2	6 months	50 mL / NA
Heating Value	P	None	None	NA / 0.5 g
<b>Hydrazine</b>	<b>G</b>	<b>HC1 to pH&lt;2</b>	<b>Immediate</b>	<b>50 mL / NA</b>
Percent (%) Moisture	P	4 <sup>0</sup> C	None	2 mL / 2 g
Ammonia Nitrogen	P,G	4 <sup>0</sup> C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	100 mL / 5 g
<b>Nitrate</b>	<b>P,G</b>	<b>4<sup>0</sup>C</b>	<b>48 hours</b>	<b>10 mL / 4 g</b>
<b>Nitrite</b>	<b>P,G</b>	<b>4<sup>0</sup>C</b>	<b>48 hours</b>	<b>10 mL / 4 g</b>
Nitrate/Nitrite	P,G	4 <sup>0</sup> C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	4 mL / 4 g
Total Kjeldahl and Organic Nitrogen	P,G	4 <sup>0</sup> C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	100 mL / 5 g
<b>Odor</b>	<b>G</b>	<b>4<sup>0</sup>C, Zero headspace</b>	<b>Immediate</b>	<b>50 mL</b>
Oil and Grease	G	4 <sup>0</sup> C, HC1 or H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	1000 mL
<b>Orthophosphate</b>	<b>P,G</b>	<b>Filter immediately, 4<sup>0</sup>C</b>	<b>48 hours</b>	<b>25 mL / 4 g</b>
Total Phenols	G	4 <sup>0</sup> C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	50 mL / 1 g
<b>pH</b>	<b>P,G</b>	<b>None</b>	<b>Immediate</b>	<b>25 mL / 5 g</b>
Total Phosphorus	P,G	4 <sup>0</sup> C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	20 mL / 1 g
<b>Residual Chlorine</b>	<b>P,G</b>	<b>None</b>	<b>Immediate</b>	<b>25 mL / NA</b>
Salinity	P	None	28 days	25 mL / NA
Specific Gravity	P	4 <sup>0</sup> C	7 days	50 mL / NA
Sulfate	P,G	4 <sup>0</sup> C	28 days	10 mL / 4 g
Sulfide	P,G	4 <sup>0</sup> C, add ZNAce and NaOH to pH>9	7 days	200 mL / 20 g
<b>Sulfite</b>	<b>P,G</b>	<b>EDTA</b>	<b>Immediate</b>	<b>50 mL / NA</b>
Sulfur by Bomb	G	None	None	NA / 0.5 g
<b>Surfactants</b>	<b>P,G</b>	<b>4<sup>0</sup>C</b>	<b>48 hours</b>	<b>100 mL / NA</b>
Settleable Solid	P,G	4 <sup>0</sup> C	7 days	1000 mL / NA
Total Dissolved Solid	P,G	4 <sup>0</sup> C	7 days	25 mL / NA
Total Solid	P,G	4 <sup>0</sup> C	7 days	25 mL
Total Suspended Solid	P,G	4 <sup>0</sup> C	7 days	1000 mL
Volatile Solid	P,G	4 <sup>0</sup> C	7 days	25 mL / 1 g
Total Organic Carbon	P,G	4 <sup>0</sup> C, HC1 or H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	50 mL / 5 g
Total Organic Halides	G	4 <sup>0</sup> C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	50 mL / 1 g
Total Petroleum	G	4 <sup>0</sup> C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days	1000 mL / 20 g
Hydrocarbons				

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<b>Turbidity</b>	<b>P,G</b>	<b>4<sup>0</sup>C</b>	<b>48 hours</b>	<b>50 mL / NA</b>
Metals (except chromium VI and mercury)	P	4 <sup>0</sup> C,HNO <sub>3</sub> to pH<2	6 months	50 mL / 2 g
<b>Chromium VI - Aqueous</b>	<b>P</b>	<b>4<sup>0</sup>C</b>	<b>24 hours</b>	<b>25 mL / 4 g</b>
Chromium VI - Solids	P	4 <sup>0</sup> C	7 days for extraction	4 g
Mercury - Wastewater and Drinking water	P,G	4 <sup>0</sup> C,HNO <sub>3</sub> to pH<2	28 days	50 mL / 2 g
Mercury - Others	G	4 <sup>0</sup> C,HNO <sub>3</sub> to pH<2	28 days	50 mL / 2 g
<u>Bacteriology</u>				
Coliform, fecal	P,G	4, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>3</sup>	6 hours	100 mL / NA
Standard Plate Count	P,G	4 <sup>0</sup> C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	24 hours	100 mL / NA
Coliform, total - Wastewater	P,G	4 <sup>0</sup> C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	6 hours	100 mL / NA
Coliform, total - Groundwater	P,G	4 <sup>0</sup> C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	24 hours	100 mL / NA
Coliform, total - Drinking water	P,G	4 <sup>0</sup> C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	30 hours	100 mL / NA
<u>Organics</u>				
Base/Neutral and Acid Extractables - Water	Amber G, teflon-lined cap	4 <sup>0</sup> C 0.008% sodium thiosulfate solution	7 days for extraction 40 days after extraction for analysis	1000 mL / 50 g
Base/Neutral and Acid Extractables - Solid and Waste	G, teflon-lined cap	4 <sup>0</sup> C	14 days for extraction 40 days after extraction for analysis	1000 mL / 50 g
Base/Neutral and Acid Extractables - Concentrated Waste	G, teflon-lined cap	None	7 days for extraction 40 days after extraction for analysis	1000 mL / 50 g
BTEX - Solid and sludge	G, teflon-lined septum	4 <sup>0</sup> C	14 days	3x5 g Encores or 2 low and 1 high level vial s 3x40 mL
BTEX - Water	G, teflon-lined septum	4 <sup>0</sup> C, zero headspace	14 days	
TPH-GRO	G, teflon-lined cap	4 <sup>0</sup> C, HCl to pH s, zero headspace	14 days	3x40 mL
TPH-DRO	G, teflon-lined cap	4 <sup>0</sup> C	14 days	1000 mL / 50 g
Volatiles – Groundwater/wastewater	G, teflon-lined cap	4 <sup>0</sup> C, HCl to pH 2, zero headspace	14 days	3x40 mL
Chlorinated Herbicides - Water	Amber G, teflon-lined cap	4 <sup>0</sup> C 0.008% sodium thiosulfate solution	7 days for extraction 40 days after extraction for analysis	1000 mL
Chlorinated Herbicides - Solid and Waste	G, teflon-lined cap	4 <sup>0</sup> C	14 days for extraction 40 days after extraction	50 g
Volatiles - Drinking Water	G, teflon-lined cap	4 <sup>0</sup> C, zero headspace, HCL	14 days	3x40 mL
Volatiles (including 2 chloroethylvinylether) - Wastewater	G, teflon-lined cap	4 <sup>0</sup> C, zero headspace, unpreserved	7 days	3x40 mL
Volatiles - Wastewater/groundwater	G, teflon-lined cap	4 <sup>0</sup> C, zero headspace, unpreserved	7 days	3x40 mL
Volatiles - Solid and Sludge -	Encore Sampler	4 <sup>0</sup> C	48 hours	3x5 g Encores
Volatiles - Concentrated	G, teflon-	None	14 days	1x40 mL
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Waste	lined septum			
Industrial Solvents	G, teflon-lined septum	4°C	None	1x40 mL
Organochlorine	Amber G,	4°C	7 days for extraction	1000 mL / 50 g
Pesticides and PCBs	teflon-lined cap	0.008% sodium thiosulfate solution	40 days after extraction for analysis	
PCBs in Oil	G, teflon-lined cap	None	7 days for extraction 40 days after extraction for analysis	1x40 mL
Dioxin	G, teflon-lined cap	4°C	7 days for extraction 40 days after extraction for analysis	1000 mL / 50 g
Total Petroleum Hydrocarbon	G, teflon-lined septum	4°C	14 days	1000 mL / 50 g
EDB and DBCP	G, teflon-lined septum	4°C HCL to pH-2 0.4% sodium thiosulfate solution	7 or 14 days	3x40 mL
<u>Radiochemistry</u>				
Carbon-14 - Water and Soil	P	None	6 months	500 mL / 20 g
Gamma Isotopes - Water	P	HNO <sub>3</sub> to pH-2	6 months	2000 mL
Gamma Isotopes - Soil	P	None	6 months	200 g
Gross Alpha and Beta - Water	P	HNO <sub>3</sub> to pH-2	6 months	500 g
Gross Alpha and Beta - Soil	P	None	6 months	20 g
Iodine-129 - Water and Soil	P	None	6 months	1000 mL / 50 g
Iodine -131 - Water	P	None	8 days	1000 mL
Neptunium - Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Neptunium - Soil, Vegetation, and Air Filters	P	None	6 months	20 g
Plutonium - Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Plutonium - Soil, Vegetation, and Air Filters	P	None	6 months	20 g
Thorium - Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Thorium - Soil, Vegetation, and Air Filters	P	None	6 months	20 g
Uranium - Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Uranium - Soil, Vegetation, and Air Filters	P	None	6 months	20 g
Americium - Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Americium - Soil, Vegetation, and Air Filters	P	None	6 months	20 g
Curium - Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Curium - Soil, Vegetation, and Air Filters	P	None	6 months	20 g
Lead-210 – Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL

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Lead-210- Soil	P	None	6 months	200 g
Nickel-59 – Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Nickel-59 – Soil	P	None	6 months	20 g
Nickel-63 - Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Nickel-63 - Soil	P	None	6 months	20 g
Phosphorus-32 -Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Phosphorus-32 -Soil	P	None	6 months	20 g
Polonium -Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Polonium -Soil	P	None	6 months	20 g
Promethium-147 -Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Promethium-147 -Soil	P	None	6 months	20 g
Radium-223 - Water	P	None	6 months	1000 mL
Radium-224 - Water	P	None	6 months	1000 mL
Radium-226 - Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Radium-228 - Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
<b>Radon-222 - Water</b>	<b>40mL volatile bottle</b>	<b>None, Zero headspace</b>	<b>4 days</b>	<b>2x40 mL</b>
Strontium-89/90 -Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Strontium-89/90 -Soil	P	None	6 months	20 g
Technetium-99 -Water	P	HNO <sub>3</sub> to pH-2	6 months	1000 mL
Technetium-99 -Soil	P	None	6 months	20 g
Total Alpha Radium - Water	P	HNO <sub>3</sub> to pH-2	6 months	500 mL
Total Alpha Radium - Soil	P	None	6 months	20 g
Total Uranium -Water	P	HNO <sub>3</sub> to pH-2	6 months	100 mL
Total Uranium- Soil	P	None	6 months	20 g
Tritium - Water, Soil, Vegetation, and Air Filters	P	None	6 months	250 mL / 20 g
Iron 55 -Water	P	HNO <sub>3</sub> to pH-2	6 months	500 mL
Iron 55 -Soil	P	None	6 months	20 g

<sup>1</sup>P = Polyethylene; G = Glass

<sup>2</sup>Samples should be analyzed as soon as possible after collection. The holding times listed are maximum times that samples may be held before analysis and be considered valid.

<sup>3</sup>Used only in the presence of residual chlorine.

<sup>4</sup>Maximum holding time is 24 hours when sulfide is present. All samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If present, remove by adding cadmium nitrate powder until a negative spot test is obtained. Filter sample and add NaOH to pH12.