Bryte Chemical Laboratory
Quality Manual

Quality Assurance Technical Document 8

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California Department of Water Resources
Bryte Chemical Laboratory
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1. Introduction

Bryte Chemical Laboratory's primary role within the Department of Water Resources (DWR) is to provide analytical, chemical, and biological laboratory services for DWR and other governmental agencies and stakeholders. This manual addresses the quality assurance and quality control measures used by the laboratory in determining the organic, inorganic, and biological contaminants found in California waters as well as all activities that are essential in the operation of the analytical laboratory.

Through a formal documented system of planned activities, Bryte Chemical Laboratory meets or exceeds the Quality Assurance/Quality Control (QA/QC) requirements set by the State Water Resources Control Board's Division of Drinking Water, Environmental Laboratory Accreditation Program, ISO 17025, the USEPA, and other appropriate governmental entities to assure that all analytical data generated are scientifically valid, defensible, comparable, and of known acceptable precision and accuracy.

1.1 Purpose

The purpose of this Quality Manual is to outline the quality system for the laboratory in order to generate data that are technically sound, accurate, and legally defensible. Accordingly, the manual is used to:

1. Communicate to staff the laboratory's quality policy, objectives, and processes used to achieve compliance with quality requirements.
2. Inform the laboratory's clients within DWR, as well as other government agencies and stakeholders, about the quality policy, the implemented quality management system, and measures of compliance with quality.

1.2 Scope & Objectives

The objectives of the laboratory are to produce accurate, reliable and timely analytical results, maintain an effective quality management system, and ensure compliance with relevant regulatory and safety requirements.

The Quality Management system is implemented by the Laboratory QA Officer who reports directly to the Chief of Bryte Chemical Laboratory. It covers all aspects of sample receiving, storage, preparation, analysis, and reporting.

The Quality Manual is based on DWR policies and guidelines including the Water Resources Engineering Memorandum 60, the Quality Assurance Management Plan for Environmental Monitoring Programs (Quality Assurance Document 5), and the Quality Assurance Guidelines for Analytical Laboratories (Quality Assurance Technical Document 1).

1.3 Glossary of Terms

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

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

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

Aliquot: A discrete, measured, representative portion of a sample taken for analysis.

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

Analyte: The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

Assessment: The evaluation process used to measure the performance or effectiveness of a system and its elements against specific criteria.

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of up to 20 environmental samples of the same 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. An analytical batch can include prepared samples originating from various environmental matrices and may exceed 20 samples.

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 subjected 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.

Blind Sample: A sub-sample 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.

Bracketing: Bracketing is the use of standards to bracket the expected concentration of the analyte in the samples.

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

1) In calibration of support equipment the values realized by standards are established through the use of Reference Standards that are traceable to the International System of Units (SI).

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

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

Calibration Range: The range of concentrations between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low- level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.

Chain of Custody: A record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses.

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

Continuing Calibration Verification: The verification of the initial calibration that is required during the course of analysis at periodic intervals.

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

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

Definitive Data: Analytical data of known quality, concentration, and level of uncertainty.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate acceptable accuracy.

Detection Limit (DL): The smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence.

Digestion: A process in which a sample is treated (usually in conjunction with heat) to convert the sample to a more easily measured form.

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.

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

Environmental Monitoring: The process of measuring or collecting environmental data.

Holding Times: The maximum time allowed to be elapsed from the time of sampling to the time of extraction or analysis, or from extraction to analysis, and still be considered valid.

International System of Units (SI): The coherent system of units adopted and recommended by the General Conference on Weights and Measures.

Instrument Blank: A clean sample (e.g., deionized water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.

Laboratory Control Sample (may be otherwise named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system.

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

Limit of Quantitation (also known as Reporting Limit or Practical Quantitation Limit): The lowest concentration that produces a quantitative result within specified limits of precision and bias. Typically, the LOQ is set at or above the concentration of the lowest initial calibration standard.

Matrix: The substrate of a test sample

- Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.
- Non-Potable Water: Any aqueous sample excluded from the definition of Drinking Water matrix. Includes surface water, groundwater, effluents, water treatment chemicals, and other extracts.
- Solid and Chemical Materials: Includes soils, sediments, sludges, products and by-products of an industrial process that results in a matrix not previously defined.

- Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Matrix Spike (spiked sample or fortified sample): A sample 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.

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

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

Method Detection Limit: One way to establish a Detection Limit, as defined in 40 CFR Part 136, Appendix B.

Non-conformance: An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements.

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

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

Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

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

Proficiency 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.

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 with a stated level of confidence.

Quality Assurance (Project) Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

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 needs of users.

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. QC samples may be Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking.

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

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

Quantitation Range: The range of values in a calibration curve between the LOQ and the highest successfully analyzed initial calibration standard. The quantitation range lies within the calibration range.

Replicate Analyses: The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval.

Reporting Limit: A client-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

Sample: Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis

Second Source Calibration Verification (ICV): A standard obtained or prepared from a source independent of the source of standards for the initial calibration. Its concentration should be at or near the middle of the calibration range and analyzed after the initial calibration.

Selectivity: 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 method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

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

Standard Method: A test method issued by an organization generally recognized as competent to do so.

Standard Operating Procedure (SOP): 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.

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.

Target Analytes: Analytes specifically named by a client (also called project-specific analytes).

Test Method: An adoption of a scientific technique for performing a specific measurement as documented in a laboratory SOP or as published by a recognized authority.

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.

Tuning: A check and/or adjustment of instrument performance for mass spectrometry as required by the method.

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

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

Sources

- ANSI/ASQ E4-2004, "Quality Systems for Environmental Data and Technology Programs – Requirements with guidance for use," 20041
- International Standards Organization (ISO) Guides 2, 30, 8402
- National Institute of Standards and Technology (NIST)
- Intergovernmental Data Quality Task Force, 2005, "Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs," EPA-505-B-04-900A and DTIC ADA 427785

2. Facilities, Organization, and Personnel

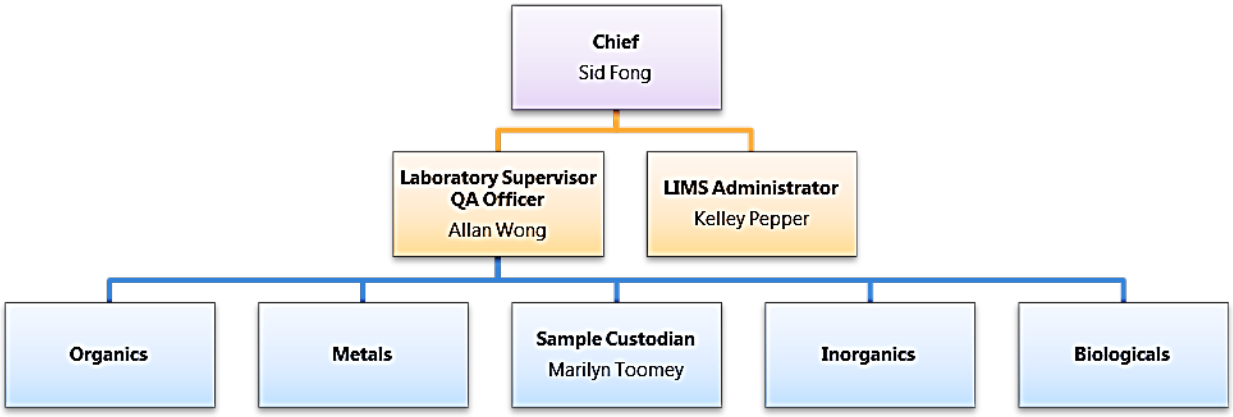
2.1 Facilities and Laboratory Equipment

Bryte Chemical Laboratory located in West Sacramento, California is a fully equipped 10,000 square foot facility. Laboratory facilities are designed so that the accuracy of analyses is not adversely affected due to environmental conditions. The fully air conditioned laboratory contains one large main room and smaller individual rooms with adequate hood area that is appropriately spaced with sufficient room to accommodate all personnel and equipment. The laboratory is divided into sections to manage the wide spectrum of chemical analyses performed on waters and wastewaters. The major sections consist of receiving, volatile organics, semi-volatile organics, trace metals, wet chemistry, nutrients, biological, and storage. Most of the instrumentation used in the chemical laboratory is fully automated and computerized (see Appendix C, Laboratory Equipment).

2.2 Organization

Executing an effective QA program in the laboratory demands the commitment and attention of both management and staff. All laboratory personnel within the organization play a vital role in ensuring a shared commitment to the quality of work. See Figure 1, Bryte Chemical Laboratory Organizational Chart.

Figure 1 Organizational Chart



2.3 Chief of Bryte Chemical Laboratory

The Chief of Bryte Chemical Laboratory is responsible for all operational activities within the laboratory and is accountable for all data generated by the laboratory. Responsibilities of the Chief include:

- Ensuring personnel are free from any undue pressures which might affect the quality of work.
- Performing the final review of all data generated by the laboratory
- Serving as the final authority to release data to requestor
- Serving as final authority on all analytical procedures and SOPs used by laboratory personnel
- Coordinating with the Laboratory QA Officer to implement the laboratory QA plan and its policies, revisions, and any corrective action to ensure compliance
- Coordinating periodic audits of the QA plan to ensure the objectives and procedures are being followed

2.4 Laboratory Supervisor / QA Officer

The Laboratory QA Officer is independent and reports only to the Chief of Bryte Chemical Laboratory. The Laboratory QA Officer:

- Recommends QA policy to the Chief of Bryte Chemical Laboratory
- Reviews the effectiveness of the quality system
- Develops and manages the Quality Manual, revising as needed
- Oversees QC practices and data management in the laboratory
- Assists in method development
- Develops precision and accuracy guidelines/criteria
- Conducts and reviews data quality and laboratory performance audits
- Certifies the qualifications and training of the laboratory staff
- Prescribes and monitors corrective actions
- Approves SOPs
- Monitors laboratory performance, turnaround, and holding times

2.5 Laboratory Staff

Laboratory personnel must have a clear understanding of the quality system as described in this manual. Laboratory staff is responsible for:

- Complying with all QA/QC procedures as it pertains to their function.

- Ensuring the quality of their individual assignments and functional responsibilities.
- Reporting any non-conformance to the Chief, laboratory supervisor, or the QA Officer.
- Maintaining the necessary education training, technical knowledge and experience for the assigned positions.
- Performing all work according to written SOPs and other quality documents.
- Ensuring that all associated documentation is complete and accurate

3. Quality Control Systems

3.1 Document control

3.1.1 Procedural activities that affect quality are described in more detail in the Standard Operating Procedures (SOPs). Each analytical method routinely used is documented in the form of a SOP which contains detailed instructions to standardize the expected performance of the analytical method. Any deviations from published methodology are documented in the SOP. Standard Operating Procedures are maintained and revised on an "as needed" basis.

3.1.2 Program specific quality criteria are specified in the Quality Assurance Project Plan (QAPjP). A QAPjP or other project-specific requirements submitted by department program managers are reviewed to determine whether they are within the scope of the laboratory's analytical procedures. Any discrepancies are discussed and documented in advance of the beginning of the project.

3.1.3 All quality documents are reviewed and approved before being distributed to the laboratory and are available to, understood by, and implemented by the laboratory personnel.

3.1.4 All quality documents are periodically reviewed to ensure continuing effectiveness, suitability, and compliance with applicable requirements. Document changes are reviewed and approved by the appropriate personnel.

3.1.5 Any departures from policies or planned activities that affect quality are approved by management in advance.

3.1.6 Appropriate documents are made available at all locations where operations essential to the effective functioning of the laboratory are performed. Obsolete copies are removed from use.

3.2 Quality Control Procedures

The quality control (QC) procedures routinely followed evaluate method performance are specified by the method or project plan. Bryte Chemical Laboratory's internal quality control procedures include the analysis of method

blanks, duplicate samples, laboratory control samples, and matrix spikes. See Appendix B for Quality Control Acceptance Criteria.

3.2.1 Method Blanks are prepared from laboratory blank water, substituted for samples, and analyzed with every sample set. Method blanks are used to determine the level of contamination that exists in the analytical procedure. Contamination may or may not lead to elevated concentration levels or false positive data. Ideally, the concentration of an analyte in the method blank is below the method detection level for the analyte. However, for some analytical methods, elimination of blank contamination is extremely difficult; therefore, each analytical SOP has a method blank level of acceptance. If the acceptance contamination level is exceeded, the sample set is reanalyzed.

3.2.2 Laboratory Control Samples are analyzed routinely to verify the analytical method is in control and to also serve as a second source verification for the calibration standards of all routine analyses. The sources include, but are not limited to: QC samples, EPA, commercially prepared samples, or samples prepared in-house with different sources than those used in the calibration standards. Recovery data from the LCS are compared to the control limits which are established for those analytes monitored by the LCS. Before any data can be accepted, the analytes of interest in the LCS must fall within their expected control limits. If, for any reason, the results fall outside those limits, the sample results in the associated batch are unacceptable. Corrective steps are taken and filed with the QA Officer. After the corrective action has been proven effective and the LCS is within the specified control limits, the samples are reanalyzed.

3.2.3 Matrix Spike/Matrix Spike Duplicates are spiked environmental samples used to check for any matrix effects on the precision and accuracy of an analytical measurement. One pair of samples out of every 20 samples or one pair of samples per batch is spiked with a known concentration of the analyte of interest, and then analyzed in a normal manner. The percent recovery and relative percent difference are calculated and the results must fall within established control limits to ensure the generated data meets the QA objectives for the particular analytical method used.

3.2.4 Sample Duplicates are environmental samples divided into two separate aliquots analyzed independently to determine the repeatability or precision of the analytical method. The difference in the duplicate results must be within established control limits to ensure the generated data meet the quality assurance objectives for the particular analytical method.

3.2.5 Calibration Standards are routinely run with every sample set. Calibration standards must fall within established QC limits before any sample results can be accepted. The limits are found in the particular analytical method SOP being used. If the calibration standards are unacceptable,

the sample results are rejected, corrective action taken, and the samples reanalyzed.

3.2.6 Check Standards are usually a midrange calibration standard used to monitor the analytical method. The check standard is analyzed every ten samples to provide evidence that the laboratory is performing the method within accepted QC guidelines. As long as check standard results fall within established control limits, the analysis can continue. If check standard results fall outside the control limits, the data are suspect and the procedure is stopped. The analytical procedure is checked for error step by step by the analyst. Once the procedure is again acceptable, reanalysis of samples begins with the last check standard that was within acceptable control limits.

3.2.7 Internal Standards are used in analyses such as ICP, ICP/MS, GC and GC/MS. The internal standard is similar in analytical behavior to the analytes of interest and is added to all samples, standards, and blanks. Usually, more than one internal standard is added to each sample to evaluate the measurement of the sample throughout the entire time of analysis. The internal standards help determine the individual response factors used to calculate the concentrations of the analytes of interest.

3.2.8 Surrogates are used in the analysis of organic compounds by gas chromatography (GC) and/or by a combination of gas chromatography and mass spectrometry (GC/MS). Like the internal standard, the surrogate compounds are similar in analytical behavior to the compounds of interest and are added to all samples, standards, and blanks. A known amount of surrogate is added to monitor the analytical performance of the method. The results of the surrogate compounds must fall within the established QC criteria for the analytical method. Samples that are outside the QC limits are reprepped and analyzed. If the reanalysis confirms the original analysis, both sets of data are reported with a flag attributing the out of control data to matrix interference.

3.2.9 Standard Method of Additions is the practice of adding known concentrations of analyte to a sample so that matrix effects (interferences) are minimized. Whenever sample interference is suspected, the method of standard additions is employed to verify the quality of the data.

3.3 Calculations

3.3.1 Percent Recovery (%R): Percent recovery is a measure of accuracy and is calculated according to the following expression:

$$\%R = \frac{(Amount\ Found)}{(Amount\ Spiked)}\ X\ 100$$

3.3.2 Relative Percent Difference (RPD): Precision is calculated from the concentrations of duplicate analyses, including samples, LCS, or matrix spikes by calculating the RPD using the following expression:

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{(C_1 + C_2)}{2}\right)} \times 100$$

3.3.3 Relative Standard Deviation (RSD): Also known as the coefficient of variation.

$$RSD = \frac{SD}{Mean} \times 100$$

4. Purchasing

Purchases of standards, laboratory supplies, and equipment are made only from approved vendors based on historical experience or quality certifications. Potential suppliers are evaluated to ensure quality requirements are met. Any purchased critical consumables, supplies, and equipment are inspected, calibrated, or otherwise verified as in compliance with the specifications relevant to the associated analyses prior to use and records of actions taken to check compliance are maintained.

5. Sample Receiving

The laboratory supplies all necessary sampling materials to DWR field sampling units. Using properly cleaned containers and correct preservatives as well as adhering to proper holding times are essential factors for maintaining sample integrity and representativeness. For proper containers, holding times, preservation techniques, and volumes required, see Appendix A.

Samples received from field samplers are inspected upon receipt to ensure that they meet the requirements for containers, holding times, preservation, and volume. All conditions, including deviations from standard conditions, are recorded on the sample receipt checklist and may be rejected.

Immediately after inspection, samples are logged into the Field and Laboratory Information Management System (FLIMS). A unique laboratory identification number is assigned to each sample at the time of login. All pertinent field data is tracked by FLIMS such as the date, time, location, field sampler, field data, laboratory tests requested, etc. and allows the sample to be tracked during storage, handling, and disposal.

The samples received by the laboratory are placed in appropriate storage or sent directly to the test area. The storage areas are located in the receiving room and consist of

refrigerators maintained at 0 – 6°C, freezers at < -10°C, and designated storage cabinets for other sample types (i.e., metals, standard minerals, etc.).

All samples are stored away from all standards; reagents, food, or any other potentially contaminating sources in such a manner as to prevent cross contamination.

Records of all procedures to which a sample is subjected to while in the laboratory are maintained.

5.1 Chain of Custody Procedures

Chain of Custody records establish an intact, continuous record of the physical possession, storage, and disposal of all samples.

5.1.1 A Chain of Custody form must be completed for samples received by the laboratory and is used as evidence for enforcement purposes. Once a sample is received, the sample custodian or the alternate is notified. All information is then transcribed to the Chain of Custody form and the sampler signs the form to relinquish the samples.

5.1.2 While in the laboratory, samples are stored in a secure area under appropriate environmental conditions to maintain sample integrity. Following the completion of the analysis, the samples are stored until the results are submitted to the Program Manager and permission to discard has been received. A notation of completion is made on the Chain of Custody form, and the document is then filed with the analysis report. Copies of the files are maintained in the DWR archives.

6. Standards and Reagents

Purchased standards and reagents are verified to ensure the quality, purity, and traceability meet the appropriate data quality objectives of the associated analytical procedures. All primary reference standards and standard solutions used by the laboratory are obtained from the National Institute of Standards and Technology or commercial manufacturers. All standards, standard solutions, and reagents are validated prior to being used. Validation procedures range from a check for chromatographic purity to verification of concentration of the standard using standards prepared independently. Certificates of Analysis are kept for all standards. Reagent and standard preparation documentation shall indicate traceability to purchased stock or neat compounds, reference to method of preparation, date of preparation, expiration date, and preparer.

New working standards are compared to the remainder of the current working standards for any concentration differences, formation of precipitates, and any signs of deterioration. Reagents are also examined for purity by subjecting an aliquot to the analytical method for its intended use. Reagent water, organic solvents, or acids are analyzed for possible contamination prior to use.

7. Laboratory Instrumentation

All laboratory instrumentation and testing equipment used by Bryte Chemical Laboratory are maintained and calibrated in accordance with method and SOP criteria to verify proper operation. See Appendix C for an inventory of laboratory instrumentation.

7.1 Calibration Standards and Instruments

7.1.1 Calibration of instruments is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established detection limits. In general, calibration is accomplished by measuring instrument response to standards containing the analytes in known concentrations while being in compliance with manufacturer's recommendations.

7.1.2 Calibration and verification procedures are performed using standards that are traceable to recognized national or international standards.

7.1.3 Prior to use, laboratory instrumentation and testing equipment are calibrated to ensure compliance to laboratory and method requirements.

7.1.4 Instruments that are unable to maintain calibration or not operating properly are taken out of service and will not be placed back into service until they have been repaired and verified to be operating properly.

7.1.5 Records are maintained to document the performance and maintenance of each instrument

7.2 Instrument Maintenance

7.2.1 A bound notebook is assigned to each instrument to log all routine, preventive, and major maintenance performed as well as all daily sensitivity checks and/or calibration results.

7.2.2 Chemists are responsible for the routine daily maintenance of their instruments per the manufacturer's recommendations and for documenting repairs in the equipment maintenance log books. Designated laboratory personnel are trained and responsible for more complex maintenance procedures. All necessary repairs are performed by trained staff or factory service engineers. The Chief of Bryte Chemical Laboratory is informed of the need for, and the performance of, all major maintenance activities that may directly impact sample analysis schedules.

7.2.3 Preventative maintenance is routinely performed on all analytical equipment and instruments to minimize the amount of downtime and to maintain data quality. Equipment manuals, troubleshooting guides, and log books are available for maintenance support. Critical spare parts are kept on hand for laboratory instrumentation that is routinely repaired by

laboratory staff. The inventory is monitored and maintained to avoid extended periods of downtime.

7.2.4 The laboratory maintains service contracts with manufacturers and specialty companies for complex analytical equipment (i.e., GC and ICP/MS).

7.2.5 Maintenance log books are periodically reviewed by the Laboratory QA Officer for completeness and problem areas in the equipment.

8. Data Reduction, Validation, and Reporting

Prior to reporting, the analytical data generated within the laboratory are extensively checked and cross-checked for their accuracy, precision, and completeness. The validation process consists of data generation, reduction review, and finally reporting results.

8.1 First Tier Review

8.1.1 The analyst performs the first tier review of the data, to ensure the appropriate SOP has been followed, sample preparation is correct and complete, analytical results are correct an complete, QC samples are within established QC limits, and all documentation is complete.

8.1.2 The QC procedures outlined in the analytical SOP are used for the preliminary validation of the results along with any historical data, if available. When applicable, correlation checks are used to validate the data, such as anion-cation balances, specific conductance versus dissolved solids, dissolved solids versus calculated dissolved solids, Biological Oxygen Demand versus suspended solids, Chemical Oxygen Demand or Total Organic Carbon, etc. After data reduction and validation steps are computed, the analyst enters the data into the FLIMS and releases the QC batch.

8.2 Second Tier Review

8.2.1 The data package is the forwarded electronically in the FLIMS to the QA Officer who performs the second tier review and evaluates the data along with all pertinent QC results for compliance to data quality objectives of the method and applicable project. If the data set passes this review, it is released in the FLIMS to the Chief.

8.3 Third Tier Review

8.3.1 A data package containing the required QC batches for each sample submittal is then reviewed by the laboratory Chief for final validation, completeness, and acceptance. The third tier review includes a review of calibration data, appropriate methodology, QC criteria, a comparison of historical data when available, a review of correlation checks, an evaluation of the data set as a whole for comparability, reasonableness, and completeness.

8.4 Reporting

8.4.1 The final report is then released to the end-user either in a hard copy or electronic format. The full data package is then archived for possible future use.

8.4.2 Errors or problems which may occur are documented and transmitted to the appropriate section. The cause of the errors is then addressed either by further training or reevaluation of the analytical method SOPs to ensure quality data is generated at the analyst level.

8.5 Records Management and Storage

8.5.1 The laboratory retains all original observations, calculations and derived data, calibration records and a copy of report for the period required based on project-specific requirements. Records contain adequate information to recreate analytical results.

8.5.2 All records are archived and protected from fire, theft, loss, unauthorized alterations, and environmental deterioration. Computer files are backed up to protect them from loss, damage, or unauthorized personnel.

9. Performance and System Audits

Performance and system audits are an essential part of QA to ensure that the laboratory is statistically generating consistent valid data. A system audit consists of reviewing laboratory conditions, practices, equipment, staff, and procedures used to generate quality data. Performance audits verify the ability of the laboratory to correctly identify and quantitate compounds in blind check samples. The laboratory currently participates in several ongoing auditing programs on a regular basis.

9.1 Performance Testing

9.1.1 The laboratory participates in performance testing or inter-laboratory round robin studies from independent contractors to verify the quality of laboratory data.

9.1.2 The acceptable result for the PT sample is unknown until after the experimental result is reported. All performance testing samples are handled in the same manner as real environmental samples including staff, method, procedures, and equipment.

9.1.3 PT samples are not sent to another laboratory for any analysis and laboratory personnel do not communicate with any individual at another laboratory or the PT provider concerning the PT sample.

9.1.4 The recorded results are reviewed by both the Laboratory QA Officer and senior staff. If deficiencies occur, follow-up corrective action is taken.

9.2 Internal Audits

Regular audits using an in-house blind reference sample are conducted for specific routine procedures. The results of the analyses are evaluated by the Laboratory QA Officer and the Chief of Bryte Chemical Laboratory. System audits are conducted periodically to assess the effectiveness of the quality system in the laboratory. Inspections may include a review of QC charts, analytical procedures, equipment logs, and QA documentation for compliance and any needed operational changes.

In addition, informal audits are conducted by the Laboratory QA Officer as required when accuracy and precision of analyses appear to be drifting out of control. These audits may include the use of QC samples, varied matrices, calibration of instruments, and observation of the analyst to identify additional training of clarification needs, and may require changes in the analytical SOP.

Appropriate corrective action steps are promptly taken to address any deficiencies or areas for improvement identified by the internal audit.

10. Corrective Action

Nonconforming conditions are when any aspect of the quality system or technical operations does not conform to laboratory requirements. Nonconforming conditions have an adverse effect to the quality specifications and are handled in accordance with SOPs. The corrective action process includes determining the root cause of nonconforming conditions, designing and implementing corrective action, and evaluating the effectiveness of the corrective action.

10.1 Root Cause Identification

10.1.1 When errors, deficiencies, or out of control conditions are encountered, corrective actions are necessary. The root cause may be identified in any of the following ways:

- QC data outside acceptable limits for a given sample set
- Rising or falling trends that are detected in spike recovery or duplicate control charts
- Unacceptable levels of contamination in blanks and reagents
- Unusual changes in detection limits
- Calibration standards with low sensitivity
- Nonlinear or misshapen calibration curves
- Deficiencies detected by Laboratory QA Officer or senior staff reviewing analytical data
- Deficiencies detected during internal or external audits by Laboratory QA Officer, outside agency, or from performance evaluation studies

10.1.2 Non-conformances are typically managed at the analyst level; however, if the problem persists and cannot be handled by the analyst, the matter is referred to the Laboratory QA Officer. The following corrective action steps may be taken:

- Identification of the problem
- Investigation and determination of the cause of the problem
- Corrective action determined to eliminate the problem
- Assigning responsibility for implementing corrective action
- Evaluation of the effectiveness of the corrective action
- Verification that the corrective action has eliminated the problem
- Documentation of the problem and corrective action needed

10.1.3 All suspect analytical results are evaluated. Data are not released until the corrective action has been completely successful. Corrective action documentation is routinely reviewed by the Laboratory QA Officer and Chief of Bryte Chemical Laboratory for recurring problems which may require changes in analytical procedures, methods, or additional training of analysts.

11. Quality Assurance Reports

Quality Assurance Reports are generated by the Laboratory QA Officer with assistance from senior staff to evaluate its continuing suitability and effectiveness of the quality program and make any necessary changes or improvements.

The review includes the outcome of recent internal audits, assessments by external accrediting authorities, the results of inter-laboratory comparisons or proficiency tests, any changes in the volume and type of work, feedback from end users, corrective actions, and other relevant factors and recommendations. These reports are used in evaluating the overall QA program, identifying problems and trends, and planning for future needs.

QA Reports are routed to specific staff members and the Chief of Bryte Chemical Laboratory.

12. Training

12.1 Initial and Continuing Training

12.1.1 The training requirement of each employee is assessed periodically to ensure the competency of their job responsibilities that career development objectives are being met. The training program is designed to be relevant to the present and anticipated tasks of the laboratory.

12.1.2 Previous training, education, and experience are considered in the evaluation of training needs of each employee.

12.1.3 Manuals, SOPs, journals, and analytical methods are available for all new trainees, with on the job training performed by senior staff. Specified performance criteria must be successfully met while under supervision before personnel are made responsible for activities that affect the quality objectives of the laboratory.

12.2 Training Documentation

12.2.1 Training records of education, professional qualifications, training, and experience of all technical personnel are maintained to ensure they have demonstrated capability prior to performing activities for which they are responsible. Employees are responsible for keeping their training file up-to-date.

12.2.2 Files are maintained to demonstrate each employee has read and understood the current version of applicable quality documents.

13. Subcontracting

Bryte Chemical Laboratory may subcontract particular analyses to outside laboratories. Subcontracted laboratories are held responsible for the implementation of their own Quality Manual and meeting their data quality objectives. Reports and data received from a subcontracted laboratory are clearly identified and included with the final report.

14. Data Integrity and Ethics

Bryte Chemical Laboratory expects employee compliance with all laboratory SOPs and applicable regulatory guidelines and standards.

Bryte Chemical Laboratory does not condone and will not tolerate the fraudulent manipulation or falsification of data, intentional non-compliance, gross negligence, or any other unethical conduct. Employees who are aware of, or reasonably suspicious of, any case fraudulent or unethical conduct must notify the QA Officer, laboratory supervisor, or the Chief of Bryte Chemical Laboratory. Allegations of unethical conduct may be reported anonymously and will be fully investigated.

15. References

_ Federal Register Volume 49, No. 209, Friday, March 26, 1984, EPA, 40 Code of Federal Regulations, Part 136

_ Handbook for Sampling and Sample Preservation of Water and Wastewater, EPA 600/4-82-029, September 1982

_ Handbook for Analytical Quality Control in Water and Wastewater Laboratories (EPA 600/4-79-019, March 1979)

_ Quality Assurance Practices for the Chemical and Biological Analyses of Water and Fluvial Sediments, Techniques of Water Resources Investigations, USGS, Book 5, Chapter A6, 1982

- Manual of Analytical Quality Control for Pesticides and Related Compounds in Human and Environmental Samples (EPA-600/1-79-008, January 1979)
- Methods for Chemical Analyses of Water and Wastes, EPA-600/4-79-020 (revised March 1983) (Not used for drinking water.)
- Standard Methods for the Examination of Water and Wastewater, 19th Edition or later, APHA, American Water Works Association, Water Pollution Control Federation, Washington, D.C. (1992)
- Methods for Determination of Inorganic Substances in Water and Fluvial Sediments, Techniques of Water Resources Investigations, USGS, Book 5, Washington, D.C. (1985)
- Annual Book of American Society for Testing and Material Standards, Volumes 11.01 and 11.02, ASTM, Philadelphia, Pennsylvania (1988)
- Official Methods of Analysis, 14th Edition, AOAC International, Arlington, Virginia (1984)
- Methods for Organic Chemical Analysis and Municipal and Industrial Wastes, EPA 600/4-82-057, (1982)
- Guidelines Establishing Test Procedures for the Analysis of Pollutants Under Clean Water Act, Federal Register, EPA, 40 CFR, Part 136, (1984)
- Biological Field and Laboratory Methods, EPA-670/4-73-001, (1973)
- Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, EPA, SW846, Volumes 1A, 1B, 1C, and II, (1986)

Appendix A

Sample Collection, Preservation, and Holding Times

Method	Analyte	Container	Sample Prep	Sample Size	Preservative	Holding Time
SM 2320B, EPA 310.1	Alkalinity	Polyethylene	Filtered	500 mL	0 - 6°C	14 days
SM 10200H	Chlorophyll	Manila Envelope	Filtered	500 mL	-20°C	28 days
SM 2510B EPA 120.1	Electrical Conductivity (EC)	Polyethylene	Filtered	500 mL	0 - 6°C	28 days
EPA 200.7	Hardness, Total by Calculation	Polyethylene	Unfiltered	250 mL	pH<2 HNO_3	6 months
EPA 200.7	ICP Cations, Dissolved	Polyethylene	Filtered	250 mL	pH<2 HNO_3	6 months
EPA 200.7	ICP Cations, Total	Polyethylene	Unfiltered	250 mL	pH<2 HNO_3	6 months
EPA 200.8	ICP/MS Trace Metals, Dissolved	Polyethylene	Filtered	500 mL	pH<2 HNO_3	6 months
EPA 200.8	ICP/MS Trace Metals, Total	Polyethylene	Unfiltered	500 mL	pH<2 HNO_3	6 months
EPA 200.8	Mercury by ICP/MS	Polyethylene	Filtered	500 mL	0 - 6°C, pH<2 HNO_3	28 days
EPA 1631	Low Level Mercury	Glass	Filt/Unfilt	250 mL	5 mL/L BrCl	90 days
EPA 1638	ICP/MS Trace Metals, Dissolved	Polyethylene	Filtered	500 mL	pH<2 HNO_3	6 months
EPA 1638	ICP/MS Trace Metals, Total	Polyethylene	Unfiltered	500 mL	pH<2 HNO_3	6 months
EPA 300.0	IC Anions	Polyethylene	Filtered	500 mL	0 - 6°C	28 days

Sample Collection, Preservation, and Holding Times

Method	Analyte	Container	Sample Prep	Sample Size	Preservative	Holding Time
EPA 300.0	Nitrate, Nitrite	Polyethylene	Filtered	500 mL	0 - 6°C	48 hours
EPA 300.0	Nitrate, Nitrite (DWR mod)	Polyethylene	Filtered	500 mL	0 - 6°C	28 days
SM 4500-NO_3-F EPA 353.2	Nitrate, Nitrite (Nutrient)	Polyethylene	Filtered	250 mL	0 - 6°C	48 hours
SM 4500-NO_3-F EPA 353.2	Nitrate, Nitrite (DWR mod)	Polyethylene	Filtered	250 mL	-20°C	28 days
SM 4500-P-F EPA 365.1	Orthophosphate	Polyethylene	Filtered	250 mL	0 - 6°C	48 hours
SM 4500-P-F EPA 365.1	Orthophosphate (DWR mod)	Polyethylene	Filtered	250 mL	-20°C	28 days
SM 4500-NH_3 B, H EPA 350.1	Nitrogen, Ammonia (DWR mod)	Polyethylene	Filtered	250 mL	-20°C	28 days
EPA 351.2	Nitrogen, Kjeldahl, Total (TKN) (DWR mod)	Polyethylene	Unfiltered	250 mL	-20°C	28 days
EPA 415.3 (D)	Organic Carbon Dissolved (DOC)	Amber, VOA	Filtered	40 mL	0 - 6°C pH<2 ,H_3PO_4	28 days
EPA 415.3 (T)	Organic Carbon Total (TOC)	Amber, VOA	Unfiltered	40 mL	0 - 6°C pH<2 ,H_3PO_4	28 days
EPA 365.4	Phosphorus Total (DWR mod)	Polyethylene	Unfiltered	250 mL	-20°C	28 days
EPA 552.2	Haloacetic Acids Formation Potential	Amber, VOA	Filtered	3-40 mL VOAs no headspace	0 - 6°C	14 days
SM 2540C EPA 160.1	Solids, Total Dissolved (TDS)	Polyethylene	Filtered	500 mL	0 - 6°C	7 days
EPA 160.2	Solids, Total Suspended (TSS)	Polyethylene	Unfiltered	500 mL	0 - 6°C	7 days
SM 5710B/ EPA 524.2	THM Formation Potential (THMFP)	Amber, VOA	Filtered	3-40 mL VOAs no headspace	0 - 6°C	14 days

Sample Collection, Preservation, and Holding Times

Method	Analyte	Container	Sample Prep	Sample Size	Preservative	Holding Time
SM 2310B EPA 180.1	Turbidity	Polyethylene	Unfiltered	500 mL	0 - 6°C	48 hours
SM 5910B	UVA (DWR mod)	Polyethylene	Filtered	250 mL	0 - 6°C	14 days*
SM 5210B	BOD/CBOD	Polyethylene	Unfiltered	500 mL	0 - 6°C	48 hours

* *Method modification*

Appendix B

Quality Control Acceptance Criteria

Method	Title	Analyte	RL	Units	LCS % Rec	MS/MSD % Rec	LCS/D RPD	MS/D RPD
SM 2310B, EPA 180.1	Turbidity	Turbidity	1.0	N.T.U.	85 - 115		15	
EPA 300.0	Inorganic Anions (DWR mod)	Bromide	0.05	mg/L	90 – 110	90 - 110	10	10
		Chloride	1.0	mg/L	90 – 110	90 - 110	10	10
		Nitrate	0.1	mg/L	90 – 110	90 - 110	10	10
		Sulfate	1.0	mg/L	90 - 110	90 - 110	10	10
SM 4500-NO3-F, EPA 353.2	Nitrite, Nitrate (DWR mod) (Diss.)	Nitrate + Nitrite	0.01	mg/L as N	90 - 110	80 - 120	20	20
SM 4500-NH3 B, H, EPA 350.1	Ammonia, Nitrogen (DWR mod)(Diss.)	Ammonia	0.01	mg/L as N	90 - 110	80 - 120	20	20
EPA 351.2	Total Kjeldahl Nitrogen (DWR mod)	TKN	0.1	mg/L as N	90 - 110	80 - 120	20	20
SM 4500-P-F, EPA 365.1	Ortho-Phosphate (DWR mod) (Diss.)	Ortho-phosphate	0.01	mg/L as P	90 – 110	90 - 110	10	10
EPA 365.4	Phosphorus (Total)	Phosphorus	0.01	mg/L	90 - 110	80 - 120	20	20
EPA 415.3 (D)	Organic Carbon (Diss.) by Wet Oxidation	Organic Carbon	0.5	mg/L as C	80 - 120	70 - 130	20	20
EPA 415.3 (T)	Organic Carbon (Total) by Wet Oxidation	Organic Carbon	0.5	mg/L as C	80 - 120	70 - 130	20	20
SM 2320B, EPA 310.1	Alkalinity	Alkalinity	1.0	mg/L	80 - 120	80 - 120	20	20
SM 2510B, EPA 120.1	Electrical Conductivity (EC)	Electrical Conductivity (EC)	1.0	µS/cm	85 - 115		15	
SM2540C, EPA 160.1	Total Dissolved Solids (TDS)	Solids	1.0	mg/L	85 - 115		15	
SM2540D, EPA 160.2	Total Suspended Solids (TSS)	Solids	1.0	mg/L			25	
SM2540D, EPA 160.4	Volatile Suspended Solids (VSS)	Solids	1.0	mg/L			25	
SM 5910B/EPA 415.3	UVA @254nm (DWR mod)	UV Absorbance	0.01	abs/cm	90 - 110		10	
EPA 200.7 (D)	ICP Metals and Trace Elements (Diss.)	Boron	0.1	mg/L	85 - 115	70 - 130	20	20
		Calcium	1.0	mg/L	85 - 115	70 - 130	20	20
		Magnesium	1.0	mg/L	85 - 115	70 - 130	20	20
		Sodium	1.0	mg/L	85 - 115	70 - 130	20	20
		Potassium	0.5	mg/L	85 - 115	70 - 130	20	20

Method	Title	Analyte	RL	Units	LCS % Rec	MS/MSD % Rec	LCS/D RPD	MS/D RPD
		Silica (SiO2)	0.1	mg/L	85 - 115	70 - 130	20	20
EPA 200.7 (T)	ICP Metals and Trace Elements (Total)	Calcium	1.0	mg/L	85 - 115	70 - 130	20	20
		Magnesium	1.0	mg/L	85 - 115	70 - 130	20	20
		Potassium	0.5	mg/L	85 - 115	70 - 130	20	20
		Silica (SiO2)	0.1	mg/L	85 - 115	70 - 130	20	20
EPA 200.8 (D)	ICP/MS Trace Elements (Diss.)	Aluminum	0.01	mg/L	85 - 115	70 - 130	20	20
		Antimony	0.001	mg/L	85 - 115	70 - 130	20	20
		Arsenic	0.001	mg/L	85 - 115	70 - 130	20	20
		Barium	0.005	mg/L	85 - 115	70 - 130	20	20
		Beryllium	0.001	mg/L	85 - 115	70 - 130	20	20
		Cadmium	0.001	mg/L	85 - 115	70 - 130	20	20
		Chromium	0.001	mg/L	85 - 115	70 - 130	20	20
		Cobalt	0.005	mg/L	85 - 115	70 - 130	20	20
		Copper	0.001	mg/L	85 - 115	70 - 130	20	20
		Iron	0.005	mg/L	85 - 115	70 - 130	20	20
		Lead	0.001	mg/L	85 - 115	70 - 130	20	20
		Lithium	0.005	mg/L	85 - 115	70 - 130	25	20
		Manganese	0.005	mg/L	85 - 115	70 - 130	20	20
		Mercury	0.0002	mg/L	85 - 115	70 - 130	20	20
		Molybdenum	0.005	mg/L	85 - 115	70 - 130	20	20
		Nickel	0.001	mg/L	85 - 115	70 - 130	20	20
		Selenium	0.001	mg/L	85 - 115	70 - 130	20	20
		Silver	0.001	mg/L	85 - 115	70 - 130	20	20
		Strontium	0.005	mg/L	85 - 115	70 - 130	25	20
		Thallium	0.001	mg/L	85 - 115	70 - 130	20	20
		Vanadium	0.005	mg/L	85 - 115	70 - 130	20	20
		Zinc	0.005	mg/L	85 - 115	70 - 130	20	20
EPA 200.8 (T)	ICP/MS Trace Elements (Total)	Aluminum	0.01	mg/L	85 - 115	70 - 130	20	20

Method	Title	Analyte	RL	Units	LCS % Rec	MS/MSD % Rec	LCS/D RPD	MS/D RPD
		Antimony	0.001	mg/L	85 - 115	70 - 130	20	20
		Arsenic	0.001	mg/L	85 - 115	70 - 130	20	20
		Barium	0.005	mg/L	85 - 115	70 - 130	20	20
		Beryllium	0.001	mg/L	85 - 115	70 - 130	20	20
		Cadmium	0.001	mg/L	85 - 115	70 - 130	20	20
		Chromium	0.001	mg/L	85 - 115	70 - 130	20	20
		Copper	0.001	mg/L	85 - 115	70 - 130	20	20
		Iron	0.005	mg/L	85 - 115	70 - 130	20	20
		Lead	0.001	mg/L	85 - 115	70 - 130	20	20
		Manganese	0.005	mg/L	85 - 115	70 - 130	20	20
		Nickel	0.001	mg/L	85 - 115	70 - 130	20	20
		Selenium	0.001	mg/L	85 - 115	70 - 130	20	20
		Silver	0.001	mg/L	85 - 115	70 - 130	20	20
		Strontium	0.005	mg/L	85 - 115	70 - 130	20	20
		Zinc	0.005	mg/L	85 - 115	70 - 130	20	20
EPA 1638 (D)	ICP/MS Trace Elements (Diss.)	Aluminum	0.1	mg/L	75 - 125	75 - 125	20	20
		Arsenic	0.1	mg/L	75 - 125	75 - 125	20	20
		Cadmium	0.1	mg/L	75 - 125	75 - 125	20	20
		Chromium	0.05	mg/L	75 - 125	75 - 125	20	20
		Copper	0.05	mg/L	75 - 125	75 - 125	20	20
		Iron	0.1	mg/L	75 - 125	75 - 125	20	20
		Lead	0.04	mg/L	75 - 125	75 - 125	20	20
		Manganese	0.05	mg/L	75 - 125	75 - 125	20	20
		Nickel	0.1	mg/L	75 - 125	75 - 125	20	20
		Selenium	0.2	mg/L	75 - 125	75 - 125	20	20
		Silver	0.03	mg/L	75 - 125	75 - 125	20	20
		Zinc	0.1	mg/L	75 - 125	75 - 125	20	20
EPA 1638 (T)	ICP/MS Trace Elements (Total)	Aluminum	0.1	mg/L	75 - 125	75 - 125	20	20

Method	Title	Analyte	RL	Units	LCS % Rec	MS/MSD % Rec	LCS/D RPD	MS/D RPD
		Arsenic	0.1	mg/L	75 - 125	75 - 125	20	20
		Cadmium	0.1	mg/L	75 - 125	75 - 125	20	20
		Chromium	0.05	mg/L	75 - 125	75 - 125	20	20
		Copper	0.05	mg/L	75 - 125	75 - 125	20	20
		Iron	0.1	mg/L	75 - 125	75 - 125	20	20
		Lead	0.04	mg/L	75 - 125	75 - 125	20	20
		Manganese	0.05	mg/L	75 - 125	75 - 125	20	20
		Nickel	0.1	mg/L	75 - 125	75 - 125	20	20
		Selenium	0.2	mg/L	75 - 125	75 - 125	20	20
		Silver	0.03	mg/L	75 - 125	75 - 125	20	20
		Zinc	0.1	mg/L	75 - 125	75 - 125	20	20
EPA 1631	Low Level Mercury	Mercury	0.5	ng/L	71 - 125	71 - 125	25	25
SM 10200H	Chlorophyll	Chlorophyll & Pheophytin	0.5	µg/L	70 - 130			
EPA 552.2 *	HAA-FP	Bromochloroacetic Acid	1.0	µg/L	70 - 130	70 - 130	30	30
		Dibromoacetic Acid	1.0	µg/L	70 - 130	70 - 130	30	30
		Dichloroacetic Acid	1.0	µg/L	70 - 130	70 - 130	30	30
		Monobromoacetic Acid	1.0	µg/L	70 - 130	70 - 130	30	30
		Monochloroacetic Acid	2.0	µg/L	70 - 130	70 - 130	30	30
		Trichloroacetic Acid	1.0	µg/L	70 - 130	70 - 130	30	30
SM 5710B/EPA 524.2 *	THM-FP	Bromodichloromethane	0.5	µg/L	70 - 130	70 - 130	30	30
		Bromoform	0.5	µg/L	70 - 130	70 - 130	30	30
		Chloroform	5.0	µg/L	70 - 130	70 - 130	30	30
		Dibromochloromethane	0.5	µg/L	70 - 130	70 - 130	30	30
SM 5210B *	BOD	Biochemical Oxygen Demand	2.0	mg/L	85 - 115			
SM 5210B *	CBOD	BOD, Carbonaceous	2.0	mg/L	80 - 130			

* *subcontracted*

Appendix C

Laboratory Equipment

Organic Section	*Quantity*
Agilent 5973 GCMS with a PTV/LVI injector and split/splitless injector	1
Agilent 5975 GCMS with purge and trap and split/splitless capability	1
Varian 2200 Saturn Ion Trap GCMS with a Combipal SPME/PTV/LVI autosampler	1
Varian 2100 Saturn Ion Trap GCMS with purge and trap capability	1
Varian 8100 GC with dual ECD detectors	1
HP 5890 GC with dual ECD detectors	1
HP 5890 GC with dual ELCD detectors	1
HP 5890 GC with dual PID/ELCD detectors	1
Tekmar LSC 2000 purge and trap with an ALS 2016 autosampler	1
Tekmar LSC 3000 purge and trap with an ALS 2016 autosampler	1
Agilent 1100 HPLC with diode array and fluorescence detectors	1
Pickering Labs PCX 5200 post column derivatizer	1
Horizon 4970 SPE automated liquid solid phase extractor	1
OIC 1010 persulfate wet oxidation TOC analyzer with an OIC 1051 autosampler	1
OIC 1020A combustion TOC analyzer with an OIC 1051 autosampler	1
OIC 1030D wet oxidation/combustion TOC analyzer with an OIC 1051 autosampler	2

Inorganic Section	*Quantity*
Perkin Elmer ELAN 6000 ICP/MS DRC-e with a PE AS-91 autosampler	1
Perkin Elmer Optima 8300 ICP with a PE AS-90 autosampler	1
Perkin Elmer 5000 AA spectrophotometer with a AS-91 autosampler	1
Varian Spectra 55 AA spectrophotometer with a SPS-5 sample prep station	1
Perkin Elmer Lambda 11 UV/VIS spectrophotometer with an autosampler	1
Technicon Auto Analyzer II segmented flow system with an autosampler	6
Lachat 8500 flow injection analyzer (FIA) with an XYZ autosampler	1

Thermo Konelab Aqua20 discrete analyzer with an autosampler	1
Bran & Luebbe Traccs 800 continuous flow system with an autosampler	1
Brinkmann Metrohm autotitrilyzer with a 712 conductometer, 719 titrator, and 745 autosampler	2
Fisher Scientific Model 400 computer aided autotitrimeter with a multisampler	1
Dionex DX500 ion chromatograph (IC) with an A540 autosampler	2
Dionex ICS2000 ion chromatograph (IC) with an AS autosampler	2
Dionex ICS2100 ion chromatograph (IC) with an AS autosampler	2
Dionex DX4 ion chromatograph (IC) with a BioRad AS48 autosampler	1
Thermo Separation Products 3200 mercury analyzer with an autosampler	1
Bausch and Lomb Spectronic 88 UV/VIS spectrophotometer	1
Hach DR/4000U spectrophotometer	1
Hach 2100N turbidimeter	1
CEM Mars 5 microwave digestion unit	1
Thermo Orion 4 Star electroconductivity meter	1
Beckman sigma 63 pH meter	1
Fisher Scientific Accumet 25 pH/ion meter	2
Cetac M-8000 Low Level Mercury Analyzer	1
Analytik Jena Mercury Analyzer	1

Biological Section	*Quantity*
Perkin Elmer Lambda UV/VIS spectrophotometer	1
Colilert total and fecal coliform testing equipment	1
Wild Heerbrugg inverted microscope with a Nikon camera attachment	1

Additional copies of this report may be obtained at:

Department of Water Resources
Bryte Chemical Laboratory
1450 Riverbank Road
West Sacramento, CA 95605

(916) 375-6008