CHAPTER I

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SECTION A

INTRODUCTION

1. Purpose of this Document

The purpose of this document is to provide field and laboratory methods and associated quality control (QC) requirements for use in Chesapeake Bay water quality monitoring programs, which will result in the generation of known and comparable data quality. State agency staff or subcontractors (Participants) will conduct field measurements and collect and analyze water and sediment samples for specific physical, chemical, and biological parameters according to the procedures in this document.

Conformance with these procedures provides a solid foundation for a wide variety of scientific and management investigations, e.g., attainment of water quality standards, characterization of the health of the Chesapeake Bay and its tributaries, evaluation of long-term trends, effectiveness of management actions, ecosystem processes and water quality model development and calibration.

2. Organization of this Document

2.1 This document includes the requirements and recommendations for field measurements, field sampling, and laboratory analysis in support of Chesapeake Bay water quality monitoring programs. The first chapters provide general information regarding technical and contractual requirements, and the remaining chapters specify field and laboratory requirements for tidal and nontidal monitoring programs.

2.2 Specifically, this document has been organized as follows:

2.2.1 Chapter I summarizes the technical and contractual requirements established to ensure attainment of Chesapeake Bay Program monitoring objectives.

2.2.2 Chapter II defines the Quality Assurance (QA) protocols and procedures that have been developed for this document including specific requirements for QA procedures.

2.2.3 Chapter III is reserved for reporting requirements, data management procedures and software recommendations. Data deliverables and turnaround times required by the EPA Chesapeake Bay Program Office (CBPO) will be included.

2.2.4 Chapter IV presents specific methods and procedures for monitoring water quality in Chesapeake Bay mainstem and tidal tributaries. The procedures cover sample collection, field measurements, laboratory analyses and the associated QC requirements for each.

2.2.5 Chapter V describes the field protocols and procedures for the Chesapeake Bay Nontidal Water Quality Network. It covers sample collection, field measurements and QC requirements.

2.2.6 Chapter VI contains the laboratory methods used by Chesapeake Bay Program laboratories.

3. Quality Assurance Policies

3.1 State agencies and academic institutions performing monitoring activities under EPA grants and cooperative agreements (i.e. Participants), must ensure the integrity of the data generated so that they are legally defensible.

3.1.1 Data integrity is defined as data that are complete, consistent, and without errors, and maintained with a data management system capable of preventing information corruption and unauthorized data modification.

3.1.2 Field and laboratory actions must be sufficiently documented to permit historical reconstruction of who, what, where, when and how the data was generated.

3.2 Each participant shall develop and operate a comprehensive quality management system that incorporates the applicable methods and quality control requirements contained in this document.

3.2.1 State agencies receiving monitoring funds will establish and maintain Quality Assurance Project Plans (QAPPs) that conform to Chesapeake Bay Program monitoring objectives and protocols.

3.2.2 Participant laboratories will establish a laboratory quality management system and document the policies and standard operational procedures in a Laboratory Quality Manual.

3.3 All procedures shall be carried out by qualified field and laboratory personnel who are trained in the specific analytical and reporting procedures outlined in this document. Additional requirements for maintaining generally acceptable practices and good laboratory practices are provided throughout this document.

3.4 Standard laboratory practices and procedures described herein are derived from authoritative methods recognized by the Environmental Protection Agency. Where Chesapeake Bay Program analytical methods differ from EPA-approved methods, Participant laboratories have demonstrated and documented that the modifications either improve method performance or have a negligible effect. The equivalency studies are fully documented and available on the Analytical Methods and Quality Assurance Workgroup webpage at http://www.chesapeakebay.net/groups/group/analytical_methods_and_quality_assurance_workgroup.

3.5 Laboratory and field SOPs must be consistent with Chesapeake Bay Program methods. If CBP methods fail to provide sufficient detail, Participants shall adhere to methods approved under 40 CFR Part 136 (*Standard Methods* or EPA/600/R-93/100) or EPA Methods for Marine and Estuarine matrices. Nontidal sampling procedures should be consistent with the USGS National Field Manual for water quality data.

3.5.1 *Standard Methods for the Examination of Water and Wastes*, (AWWA) 20th, 21st or 22nd edition.

3.5.2 *Methods for the Determination of Inorganic Substances in Environmental Samples (*Aug. 1993) EPA/600/R-93/100.

3.5.3 *Methods for the Determination of Chemical Substances in Marine and Estuarine Environmental Matrices- 2nd edition* (Sept. 1997). EPA/600/R-97/072.

3.5.4 U.S. Geological Survey, variously dated, *National field manual for the collection of water-quality data*: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9. Available online at http://pubs.water.usgs.gov/twri9A.

4. Participation in CBP Workgroup Meetings

4. 1 Attendance of state representatives at Bay Program workgroup meetings, e.g., Analytical Methods and Quality Assurance Workgroup (AMQAW) and Nontidal Workgroup (NTWG), is recommended by the EPA Chesapeake Bay Program Office (CBPO).

4. 2 AMQAW is a workgroup of the CBP that is concerned with field and analytical methodology and quality assurance

issues. The membership includes laboratory directors, field managers, and State program managers conducting work for the Chesapeake Bay Program. The workgroup's goal is to ensure that analytical and field protocols provide consistent water quality data in Chesapeake Bay tidal areas.

4.3 Data quality and methods issues may originate from AMQAW members or be identified by other workgroups who observe anomalies during data analysis. AMQAW seeks to identify discrepancies among Participants and take measures to improve the situation, frequently by refining and/or aligning procedures among Participants. The forum allows the different organizations to share the way they do things and individuals to present new and innovative ideas, potentially for their use.

4.4 Data comparability issues may also arise from regular AMQAW reviews of inter-laboratory performance samples. As directed by the CBPO and AMQAW, Participants shall conduct follow-up investigations to determine possible causes of inter-organization differences in split sample, blind audit or USGS reference sample results.

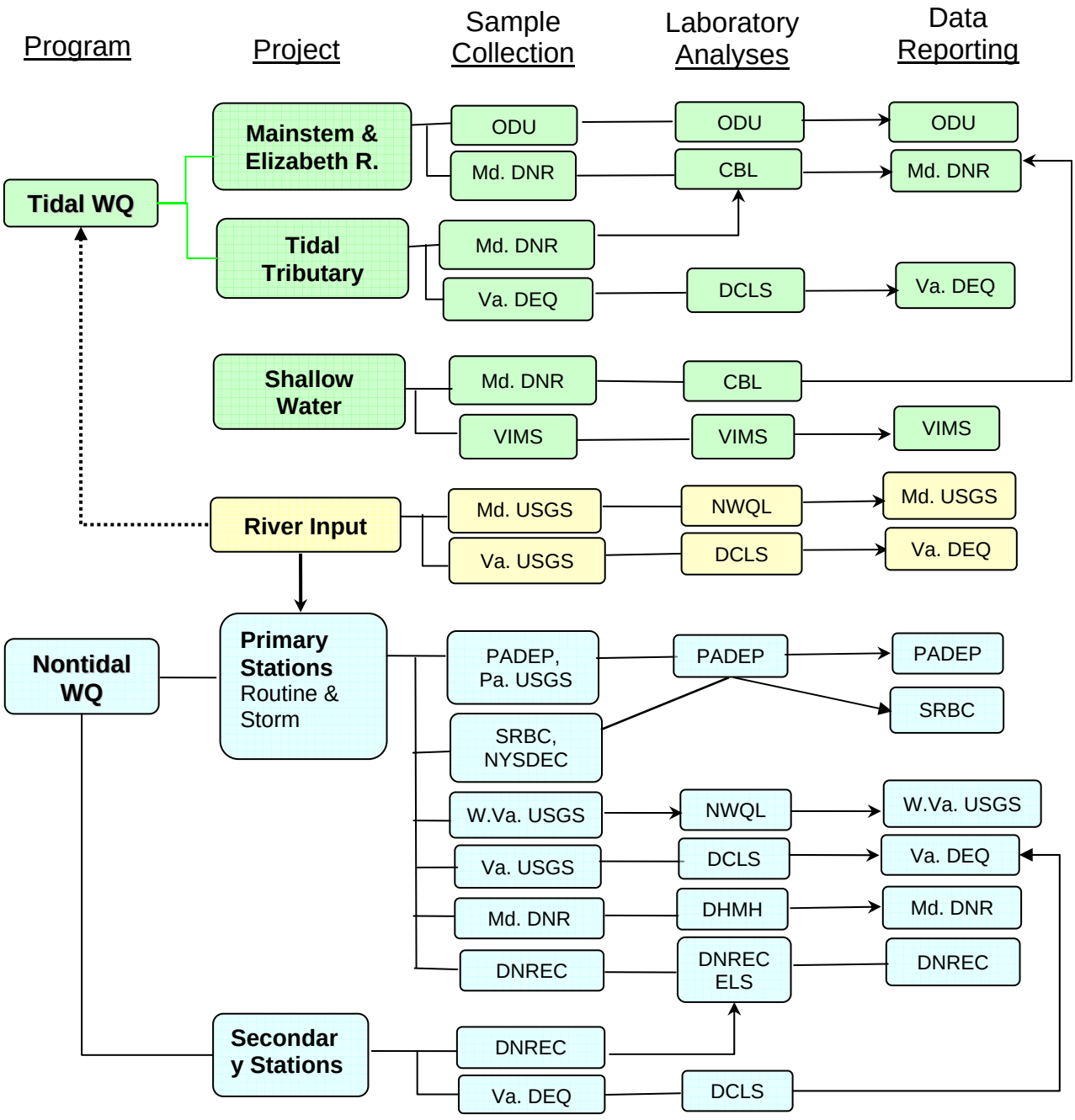
4.5 The Tidal Monitoring and Analysis and the Nontidal Workgroups conduct Bay-wide water quality data analyses and stress the collection and management of comparable environmental data of known quality through continued communication and transfer of technologies among the agencies and institutions involved in the Chesapeake Bay water quality monitoring programs. When needed, these workgroups evaluate the existing monitoring programs to ensure that sampling designs, parameters and methods generate the appropriate data to meet management and monitoring objectives.

5. State, Federal and Academic Participants

Figure I-A, Chesapeake Bay WQ Monitoring Program Participants, represent State and Federal Agencies participating in various Chesapeake Bay Program water quality monitoring activities.

Abbreviation	**Participant**
CBL	Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science
CBPO	U.S. EPA Chesapeake Bay Program Office
DCLS	Virginia Division of Consolidated Laboratory Services
DNREC (ELS)	Delaware Department of Natural Resources and Environmental Control (Environmental Lab Services)
MDNR	Maryland Department of Natural Resources
ODU	Old Dominion University Water Quality Laboratory
PADEP	Pennsylvania Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
USGS	United States Geological Survey (Md., Pa., Va. & WVa. Water Science Centers)
SRBC	Susquehanna River Basin Commission
VDEQ	Virginia Department of Environmental Quality
VIMS	Virginia Institute of Marine Science
WVDEP	West Virginia Department of Environmental Protection

Figure I-A. Chesapeake Bay WQ Monitoring Program Participants



SECTION B

SUMMARY OF REQUIREMENTS

1. Task Areas

1.1 For each monitoring program component, the Participant will perform certain tasks. These tasks include: (1) development of a sampling schedule; (2) performance of field measurements; (3) collection, preparation and transport of field samples; (4) laboratory receipt and preparation of field samples; (5) chemical analyses of field samples; (6) adherence to QA/QC procedures outlined in this document; and (7) maintaining records, managing data and reporting results.

All efforts must be made to produce data that are comparable to data collected previously and currently by other Chesapeake Bay Program grant recipients and participants.

1.2 These tasks are specifically outlined as follows.

1.2.1 Task 1. Development of sampling schedules

1.2.1.1 The Participant will develop a sampling schedule that complies with the frequency and location requirements established in this document. The mainstem and tidal tributary sampling schedules shall be developed in close coordination among Virginia DEQ, CBPO, and Maryland DNR.

1.2.1.2 The Participant will ensure compliance with the sampling schedule through the development and use of contingency plans.

1.2.1.3 The Participant will visit each sampling station as specified in Chapters IV and V; verify and record site location according to procedures specified in each Chapter.

1.2.1.4 The Participant will transport the sampling crew and all necessary sampling and field measurement equipment and ensure that they are capable of meeting the specified data quality objectives.

1.2.2 Task 2. Performance of field measurements

1.2.2.1 The Participant will measure physical and chemical parameters as defined in Chapters IV and V.

1.2.3 Task 3. Collection, preparation, and transport of field samples

1.2.3.1 The Participant will develop and implement field handling and custody procedures as described in Chapter II.

1.2.3.2 The Participant will collect samples as described in Chapter IV and V.

1.2.3.3 The Participant will prepare and preserve samples as described in Chapter IV and V.

1.2.3.4 The Participant will transport samples as described in Chapter IV and V.

1.2.4 Task 4. Laboratory receipt and preparation of field samples

1.2.4.1 The Participant will develop and implement laboratory handling and custody procedures as described in Chapter II.

1.2.4.2 All CBP monitoring samples shall be received and logged by the sample custodian.

1.2.4.3 The Participant will provide adequate storage for CBP samples awaiting analysis.

1.2.4.4 The Participant will follow the applicable sample preparation procedures outlined in this document.

1.2.5 Task 5. Chemical analysis of field samples

1.2.5.1 Samples shall be analyzed by the techniques described in the methodologies given in Chapters VI.

1.2.5.2 Samples must be analyzed within the maximum specified holding times.

1.2.6 Task 6. Adherence to QA/QC procedures outlined in this document

1.2.6.1 The Participant will adhere to all QA procedures described in Chapter II and all specific QC procedures described in Chapters IV, V and VI. Records documenting the use of the specified QC protocols shall be maintained in accordance with the document control procedures described in Chapter II.

1.2.6.2 The Participant will establish a Quality Assurance Project Plan (QAPP) with the objectives consistent with Chesapeake Bay Program monitoring objectives. The QAPP shall incorporate the QC procedures, any necessary corrective action, and all documentation required during data collection, as well as the quality assessment measures performed by management to ensure acceptable data production.

1.2.6.3 Participant laboratories will establish a comprehensive quality management system and document the policies and operational procedures in a Laboratory Quality Manual. The Quality Manual will address the components contained in Chapter II.

1.2.6.3 Participant laboratories will analyze Chesapeake Bay Coordinated Split Samples, CBP Blind Audit and USGS Standard Reference Samples for the parameters and sample types analyzed for the CBP. The results of these laboratory intercomparison samples may be used for evaluating laboratory performance.

1.2.6.4 "Compliant performance" is defined as that which yields correct compound identification and concentration values as determined by the CBPO, as well as meeting the method requirements for analysis, quality assurance/quality control, data reporting and other deliverables; including sample custody, sample documentation, and SOP documentation.

1.2.7 Task 7. Records, Data Management and Reporting

1.2.7.1 The laboratory shall establish a record keeping system that allows the history of the sample and associated data to be readily understood through the documentation. This system shall produce unequivocal, accurate records that document all laboratory activities associated with the testing such as equipment, personnel, methods, analytical standards, calibration, sample receipt, data verification, etc.

1.2.7.2 Samples will be analyzed and the data reported to EPA or the State Agency within the time specified in the cooperative agreement. The Participant will prepare electronic and hardcopy data according to the procedures outlined in Chapter III and will report electronic and hardcopy data according to the formats, order, and turnaround times according to this document.

2. Personnel Requirements

2.1 Participants will provide technical expertise for the EPA grant or State/EPA cooperative agreement.

2.2 Participants will designate and use key personnel to perform the functions described below. The CBPO reserves the right to review personnel qualifications and experience, and take action as appropriate.

2.3 Participants should have an organization with well-defined responsibilities for each individual in the management system to ensure sufficient resources are available to meet the conditions of the grant or cooperative agreement, and to

maintain a successful operation. To establish this capability, the Participant will designate personnel to carry out the following responsibilities. Functions include, but are not limited to, the following:

2.3.1 Project Manager

The project manager is employed by the State agency. S/he is responsible for all aspects of the grant or assistance agreement, from sample collection through data delivery, and shall be the primary contact for the Participants and CBPO. The project manager shall be responsible for the technical and management aspects of the agreement and shall ensure that all requirements are met.

The minimum qualifications for Project Manager are: a) College degree in chemistry, biology, or other scientific/engineering discipline and b) Two years of field experience, two years of laboratory experience, and one year of project management experience.

2.3.2 Field Supervisor

The field supervisor is responsible for all field activities performed on behalf of the State agency. The minimum qualifications are: a) Bachelor's degree in chemistry, biology or other scientific/engineering discipline and b) Four years of field experience, including at least one year of supervisory experience.

2.3.3 Water Quality Laboratory Supervisor

The Water Quality Laboratory Supervisor is responsible for all technical efforts of the laboratory performed on behalf of the State agency. The minimum qualifications are: a) Bachelor's degree in chemistry or other scientific/engineering discipline and b) Four years of water quality laboratory experience, including at least one year of supervisory experience.

2.3.4 Quality Assurance Officer

The State Agency Quality Assurance Officer is responsible for overseeing the quality assurance aspects of contract data and reporting directly to upper management to meet all terms and conditions of the State/EPA cooperative agreement.

The minimum qualifications are: a) Bachelor's degree in chemistry or any scientific/engineering discipline and b) Three years of field and laboratory experience, including at least one year of applied experience with QA principles and practices in sampling and analytical procedures.

2.3.4 Sample Custodian

The Laboratory Sample Custodian is responsible for receiving the water quality samples (logging, handling, and storage). The Field Office Sample Custodian is responsible for handling and temporary storage of samples in the field office.

The minimum qualifications are: a) High School Diploma with four or more science courses and b) Two years experience receiving and logging scientific samples. Additional education and/or experience may be substituted for these requirements.

2.3.5 Data Systems Manager

The Data Systems Manager is responsible for the management and quality control of all computing systems (hardware, software, documentation, and procedures), generating, updating, and quality controlling automated deliverables to meet all terms and conditions to meet all terms and conditions of the State/EPA cooperative agreement.

The minimum qualifications are: a) Bachelor's degree with four or more intermediate courses in programming, information management, database management systems, or systems requirements analysis and b) Three years experience in data or systems management or programming including one year of experience with software utilized for data management and generation of data deliverables.

2.3.6 Field personnel

Field personnel are responsible for field measurements and collection of monitoring samples in accordance with this document. The minimum qualifications for field personnel are: a) Bachelor's degree in chemistry or any scientific/engineering discipline and b) One year of experience sampling surface waters and collecting in-situ measurements using the field instrumentation and sampling devices cited in this document. Additional suggestions are given in the document *Knowledge and Skill Guidelines for Marine Technicians Who Work Aboard Research Vessels (2001)*, available on the world-wide web at: http://www.marinetech.org/files/marine/files/Workforce/Marine%20Technicians.pdf

2.3.7 Water Quality Laboratory personnel

Water quality laboratory personnel are responsible for the analysis of samples in accordance with this document. The minimum qualifications consist of: a) Bachelor's degree in chemistry or any scientific/engineering discipline (or equivalent experience) and b) One year of experience analyzing nutrients and water quality parameters, specifically, with the instrumentation and methods cited in this document. (The experience requirement may be waived if a person works under close supervision of experienced staff.)

2.3.8 Database Manager

The database manager is responsible for the operation and maintenance of software and programs generating, updating and quality controlling analytical databases and automated deliverables to meet all terms and conditions of the EPA grant or State/EPA cooperative agreement. The minimum qualifications are: a) Bachelor's degree with four or more intermediate courses in information management, information systems, database management systems, or systems requirements analysis and b) Two years experience in data systems or including one year of experience with the software being utilized for data management and generation of data deliverables.

3. Facilities

3.1 The adequacy of the facilities is of equal importance as the technical staff to accomplish the required work as specified by this contract. Therefore, the Participant will provide the field and laboratory facilities described in this Section.

3.2 Field Facilities

3.2.1 An adequate cruise vessel to safely traverse the waterways and carry the field crew, field instrumentation, sampling equipment, sample preparation equipment and materials, freezers and refrigerators for cold-storage.

3.2.2 Source of de-ionized (DI) organic-free water to prepare reagent-grade de-ionized water for calibration standards, field blanks and rinsing equipment.

3.3 Laboratory facilities

3.3.1 Sample Receipt Area

Adequate, contamination-free, well ventilated work space provided with chemical resistant bench top for receipt and safe handling of CBP samples.

3.3.2 Storage Area

Sufficient refrigerator space is necessary to maintain unused CBP sample volume for at least 60 days after data submission. NOTE: Samples or extracts and standards shall each be stored separately. Samples shall be stored in an atmosphere demonstrated to be free from all potential contaminants.

3.3.3 Sample and Reagent Preparation Areas

Adequate, contamination-free, well-ventilated work space provided with:

3.3.3.1 Benches with chemical resistant tops, exhaust hoods.

3.3.3.2 Source of de-ionized (DI) organic-free water.

3.3.3.3 Analytical balance(s) located away from drafts and rapid changes in temperature.

3.3.4 Standards and reagents

The Participant will have in-house appropriate standards and reagents to perform all procedures.

4. Instrumentation and Equipment

4.1 The Participant will have the field and laboratory instrumentation and equipment described in this Section.

4.2 All equipment and instrumentation specified in this document should be in the possession of the Participant and maintained in good condition at all times. The Participant will ensure that, in the event of instrument or equipment failure, backup instrumentation or equipment in good condition are available to perform field measurements, and sample collection, preparation, and analysis. It is recommended that surge protectors and a temporary backup power supply source are installed in order to protect analytical instruments, PCs, and other equipment in the event of a temporary electrical disruption or power surge.

4.3 In addition, the Participant should have an in-house stock of instrument parts to ensure continuous operation to meet contract-specified holding and turnaround times.

4.4 At a minimum, the Participant should have the following instruments and equipment operative.

4.4.1 Field Instrumentation and equipment

4.4.1.1 Secchi disk: 20 cm. diameter

4.4.1.2 Multi-parameter sonde, equipped with calibrated probes to measure *in-situ* apecific conductance, temperature, pH and DO. Depth sensor or calibrated line to measure sampling depth.

4.4.1.3 Licor light attenuation sensors: Flat Cosine Underwater Quantum Sensor LI-192SA, air (deck) reference sensor LI-190SA, and Data Logger (LI-1000 or LI-1400)

4.4.1.4 Sample collection bottles.

4.4.1.5 System to collect below-surface samples (e.g., submersible pump or rosette).

4.4.2 Analytical instrumentation

4.4.2.1 Automated nutrient analysis system equipped with an autosampler, manifold, proportional pump, heating bath, colorimeter, photomultiplier and computer-based data system.

4.4.2.2 Particulate Carbon and Nitrogen Analyzer (CNH) equipped with a combustion tube, reduction tube, water trap, and nitrogen and carbon dioxide detectors.

4.4.2.3 TOC Analyzer which employs high temperature combustion, platinum catalyst, and a non-dispersive infrared detector.

4.4.2.4 Analytical balance located away from drafts and rapid changes in temperature.

4.4.2.5 Centrifuge.

4.4.2.6 Dual beam spectrophotometer with matched cuvettes.

4.4.2.7 Drying oven capable of maintaining 103 – 105 °C.

4.4.2.8 Muffle furnace capable of maintaining 550°C.

4.4.2.9 pH meter and probe.

5. Health and Safety Considerations

5. 1 Participants should be aware of the potential hazards associated with the handling and analyses of surface water samples as they may contain hazardous materials which could present a risk to human health and a hazard to field and laboratory instrumentation/equipment. It is the Participants' responsibility to take all necessary measures to ensure the health and safety of its employees, and to maintain its analytical instruments in good working condition.

5. 2 The Participant will comply with all applicable Occupational Safety and Health Administration (OSHA) requirements.

5. 3 Participant must comply with nationally-recognized safety protocols for the operation of research vessels. One set of protocols, Research Vessel Safety Standards of the University-National Oceanographic Laboratory System (UNOLS), may be found on the world-wide web at: UNOLS Research Vessel Safety Standards - Revised March 2009

5. 4 All vessels used to collect samples from the Chesapeake Bay mainstem monitoring stations will be in full compliance with state and federal regulations regarding the use of tributyl-tin (TBT) anti-fouling paints. Regulations ban the use of paint containing TBT to marine contractors and boatyards.

5. 5 All vessels used to collect samples will be in compliance with Section 312 of the Water Quality Act of 1987 which requires the installation of marine sanitation device (MSD) on all vessels with installed toilets operating in the navigable waters of the United States. Type III MSDs, which are designed to prevent the discharge of human waste from boats in any form, will be used.

6. Other Federal and State Requirements

6. 1 The Participant will comply with all relevant State and Federal laws and regulations, including the Resource Conservation Recovery Act (RCRA) and the Clean Water Act (CWA).

6. 4 For hazardous substances used in the sample preparation and analysis procedures described in this document (e.g., acetone and inorganic acids), appropriate state and federal regulations must be followed for their handling and disposal both in the laboratory and in the field.