QUALITY ASSURANCE PROJECT PLAN

Revised Draft For

LAKE GARDNER BACTERIOLOGICAL STUDY

April 2, 2010

Massachusetts Department of Environmental Protection 604(b) Water Quality Management Planning Grant
Program: Lake Gardner Bacteriological Study (2009-09/ARRA 604)

Prepared By
Comprehensive Environmental, Inc.
21 Depot Street
Merrimack, NH 03054

Prepared For:
EPA New England, Region 1
5 Post Office Square – Suite 100
Boston MA 02109

Project Manager & Grant Recipient	Robert Desmarais, Town of Amesbury rob@amesburyma.gov	4/13/10 Date
MA DEP Project Officer	Gary Gonyea, MA DEP gary.gonyea@state.ma.us	4/22/10 Date
MA DEP QA Officer	Richard Chase, MA DEP richard.f.chase@state.ma.us	4-22-10 Date
U.S. EPA Project Officer	Mary Jo Feuerbach, U.S. EPA, Region 1 feuerbach.maryjo@epamail.epa.gov	4/26/10 Date
U.S. EPA QA Officer	John Smaldone, U.S. EPA, Region 1 smaldone.john@epa.gov	4/26/10 Date
Project Manager & Technical Advisor	Curt Busto, Comprehensive Environmental, Inc. cbusto@ceiengineers.com	4/22/10 Date
QA/QC Officer & Technical Advisor	Nicholas Cristofori, Comprehensive Environmental, Inc. ncristofori@ceiengineers.com	4-22-10 Date
Monitoring Coordinator	Scott Salvucci, Comprehensive Environmental, Inc. ssalvucci@ceiengineers.com	4/22/10 Date
Field Team Leader	Bruce Georgian, Lake Gardner Improvement Association info@lgia.org	4/15/10 Date
Water Chemistry Laboratory QA Officer	Kathleen Noonan, Eastern Analytical Inc. kathn@eailabs.com	04-22-10 Date

1.2. Table of Contents

List of Figures

List of Tables

Appendices

1.3. Distribution List

1. Mr. Robert Desmarais (Project Manager & Grant Recipient)
   Town of Amesbury
   Department of Public Works – Administration Office
   Ordway Building – 9 School Street
   Amesbury, MA 01913
   Phone: 978-388-8116; Fax: 978-388-1769
   Email: rob@amesburyma.gov

2. Mr. Gary Gonyea (MA DEP Project Officer)
   Massachusetts Department of Environmental Protection
   Division of Municipal Services
   1 Winter Street, 6th Floor
   Boston, MA 02108
   Phone: 617-556-1152; Fax: 617-556-1049
   Email: gary.gonyea@state.ma.us

3. Mr. Richard Chase (MA DEP QA Officer)
   Massachusetts Department of Environmental Protection – CERO
   627 Main Street, 2nd Floor
   Worcester, MA 01608
   Phone: 508-767-2859; Fax: 508-791-4131
   Email: richard.f.chase@state.ma.us

4. Ms. Mary Jo Feuerbach (U.S. EPA Project Officer)
   United States Environmental Protection Agency – Region 1
   5 Post Office Square
   Suite 100
   Boston, MA 02109
   Phone: 617-918-1578; Fax: 617-918-0578
   Email: feuerbach.maryjo@epamail.epa.gov

5. Mr. John Smaldone (U.S. EPA QA Officer)
   United States Environmental Protection Agency – Region 1
   11 Technology Drive
   No. Chelmsford, MA 01863
   Phone: 617-918-8312; Fax: 617-918-8397
   Email: smaldone.john@epa.gov

6. Mr. Curt Busto (Project Manager & Technical Advisor)
   Comprehensive Environmental, Inc.
   21 Depot Street
   Merrimack, NH 03054
   Phone: 800-725-2550, x304; Fax: 800-331-0892
   Email: cbusto@ceiengineers.com

7. Mr. Nicholas Cristofori (QA/QC Officer & Technical Advisor)
   Comprehensive Environmental, Inc.
   21 Depot Street
   Merrimack, NH 03054
   Phone: 800-725-2550, x303; Fax: 800-331-0892
   Email: ncristofori@ceiengineers.com

8. Mr. Scott Salvucci (Monitoring Coordinator)
   Comprehensive Environmental, Inc.
   21 Depot Street
   Merrimack, NH 03054
   Phone: 800-725-2550, x314; Fax: 800-331-0892
   Email: ssalvucci@ceiengineers.com

9. Mr. Bruce Georgian (Field Team Leader)
   Lake Gardner Improvement Association (LGIA)
   Post Office Box 253
   Amesbury, MA 01913
   Phone: 978-388-5045
   Email: info@lgia.org

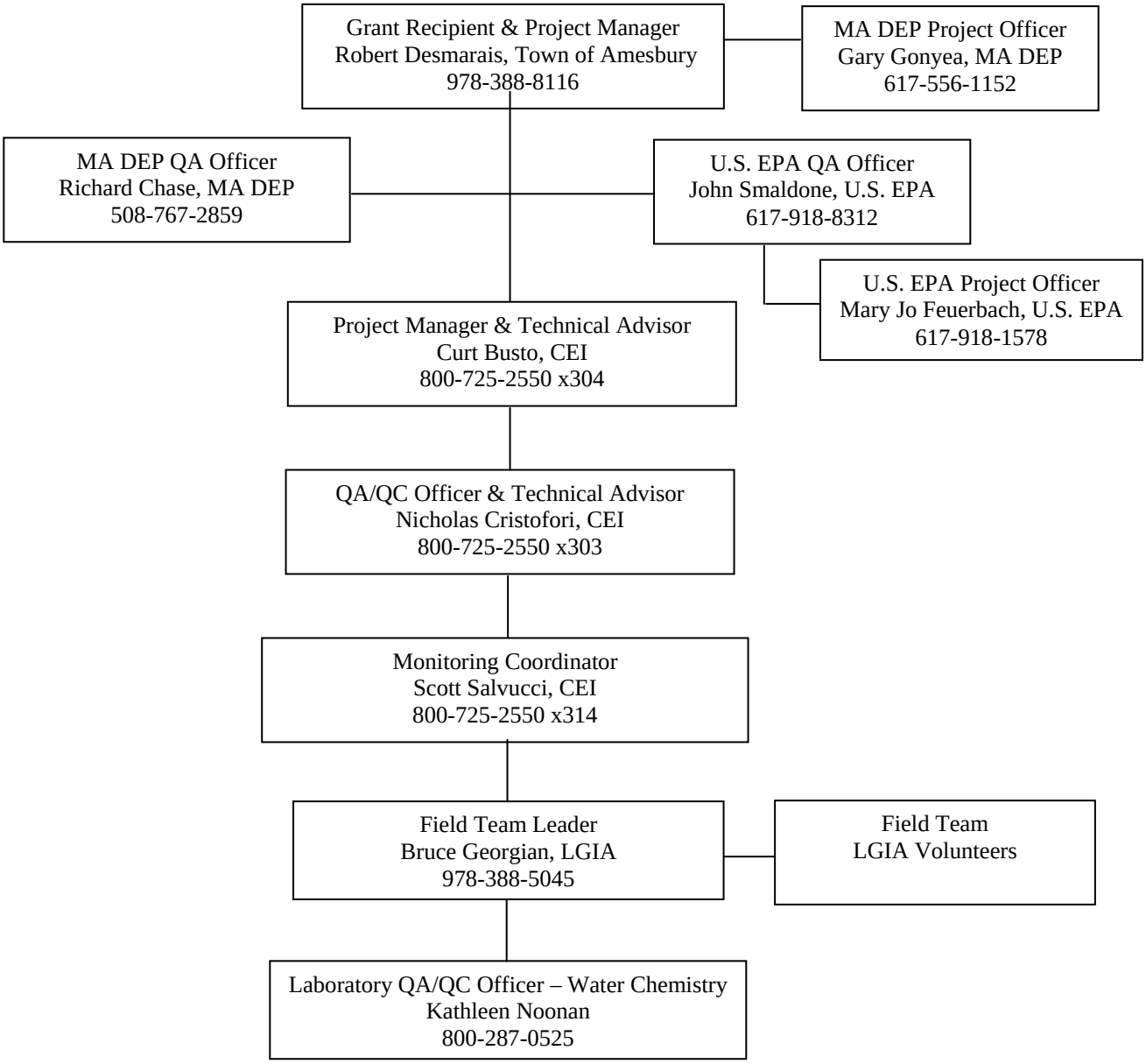
10. Ms. Kathleen Noonan (Laboratory QA Officer)
    Eastern Analytical, Inc.
    25 Chenell Drive
    Concord, NH 03301
    Phone: 800-287-0525; Fax: 603-228-4591
    Email: kathn@eailabs.com

11. Comprehensive Environmental Inc. Staff
    Field Sampling Team (Lake Gardner Improvement Association (LGIA) volunteers)

A project personnel sign-off sheet is included in **Appendix A** and will be completed by the Field Sampling Team prior to each sampling event since field teams may vary based on the availability of project personnel. This will allow the field team leader and project manager to identify sampling teams, if needed, to assist with data review, validation and verification procedures.

1.4. Project / Task Organization

Figure 1.4-1. Project Organization and Coordination



Project Manager & Grant Recipient
Mr. Robert Desmarais is the Project Manager & Grant Recipient and responsible for the overall management of the project. He serves as the Town of Amesbury's primary contact and project manager for the Lake Garner Bacteriological Study, which includes this QAPP. Mr. Desmarais is responsible for overall management of the project and will coordinate and oversee each phase with appropriate project team personnel.

MA DEP Project Officer
Mr. Gary Gonyea is the MA DEP Project Officer. Mr. Gonyea is responsible for overall MA DEP project grant management including technical and administrative supervision and final task review and approval.

MA DEP QA Officer
Mr. Richard Chase is the MA DEP Quality Assurance Officer. Mr. Chase will review and provide comment on the Quality Assurance Project Plan (QAPP). All modifications to the approved QAPP will be documented and submitted to Mr. Chase for approval, including but not limited to changes in sample design, sample collection, and data assessment and reporting.

U.S. EPA Project Officer
Ms. Mary Jo Feuerbach is the EPA Project Officer. Ms. Feuerbach is responsible for overall EPA grant management.

U.S. EPA QA Officer
Mr. John Smaldone is the EPA Quality Assurance Officer. Mr. Smaldone will review and provide comment on the Quality Assurance Project Plan (QAPP). All modifications to the approved QAPP will be documented and submitted to Mr. Smaldone for approval, including but not limited to changes in sample design, sample collection, and data assessment and reporting.

Project Manager & Technical Advisor
The Town of Amesbury has enlisted Comprehensive Environmental, Inc. (CEI) to assist with project development, project management, budget, and technical oversight of the project tasks. Mr. Curst Busto will serve as CEI's project manager for the grant as well as serve in a technical advisory role.

QA/QC Officer and Technical Advisor
Mr. Nicholas Cristofori is the author of this QAPP and is responsible for QAPP revisions and submittals based on comments from the Project and QA Officers. He is the point of contact for QAPP inquiries and will also serve as the Technical Advisor for the QAPP with oversight from the Project Manager and MA DEP and EPA QA Officer. Mr. Cristofori will assist the Monitoring Coordinator with technical and QA/QC components of the QAPP, throughout the sampling project. He will ensure that all elements of the project follow the procedures outlined in the approved QAPP including data quality objectives and reporting.

Monitoring Coordinator
Mr. Scott Salvucci will serve as the Monitoring Coordinator. He will be responsible for coordinating all elements of the field monitoring, provide assistance to LGIA volunteers and help the QA/QC Officer assess field monitoring performance. Mr. Salvucci will be responsible for coordinating all elements of field monitoring with the Field Team Leader, including weather monitoring for storm events, in-lake sampling, stormwater outfall sampling, and laboratory scheduling.

Mr. Salvucci has been involved in the monitoring and water quality sampling of several other Towns within Massachusetts. He will hold a field start-up meeting for LGIA volunteers that will be involved in sampling to review procedures, project goals and objectives and answer any questions regarding the QAPP. Mr. Salvucci will visit each sample location to become familiar with the procedures at each location for training the Field Team Leader and Field Sampling Team. Training will include QAPP review, sample collection and documentation procedures, laboratory requirements (e.g. hold times and preserving samples) and a dry-run of the sampling event. The QAPP and other sampling references will be available prior to and during all sampling events. Mr. Salvucci will be available to assist members of the Field Sampling Team as needed.

Field Team Leader

Mr. Bruce Georgian will serve as the Field Team Leader of the Lake Gardner Improvement Association volunteers. He is familiar with water quality sampling techniques and Standard Operating Procedures (SOPs) through previous work at Lake Gardner. He will coordinate elements of field monitoring with the Monitoring Coordinator. Mr. Georgian will attend a monitoring start-up meeting with CEI to review sampling procedure, project goals, and objectives of the QAPP. Mr. Georgian will visit each sample location with the Monitoring Coordinator to become familiar with the procedures at each location. He will be directly involved in sampling activities during each sampling event for the project and will be available to assist members of the Field Sampling Team as needed. He will oversee the collection, preservation, and transfer of lab samples to Eastern Analytical Inc.

Laboratory QA/QC Officer – Water Chemistry

Ms. Kathleen Noonan is the Laboratory QA/QC Officer for Eastern Analytical, Inc., and will be responsible for all laboratory QA/QC such as conducting internal audits, maintaining certifications, and certifying laboratory support equipment to ensure that the laboratory data quality objectives are achieved. Ms. Noonan will also coordinate lab schedules with the Monitoring Coordinator and Field Team Leader.

Field Team

The project Field Team will consist of volunteers from the Lake Gardner Improvement Association (LGIA). The LGIA is a group of concerned citizens formed to protect and promote Lake Gardner and performs water sampling of public beaches and maintains areas around the lake.

1.5. Problem Definition/Background

Lake Gardner is an 80-acre lake that lies between several reaches of the Powow River in the Merrimack River Watershed (**Figure 1.5-1** in **Appendix B**). It was formed when the Powow River was impounded for industrial mill use in downtown Amesbury in the late 1800s. The Powow River is a Class A waterbody upstream of Lake Gardner and Class B downstream of the lake, with both sections listed as Category 5 impaired waterbodies on the 2008 303(d) list of impaired waters for pathogens, suspended solids, noxious aquatic weeds and turbidity. Lake Gardner flows during part of the year and typically remains stagnant during the summer when flow over the dam ceases.

Lake Gardner has three beaches. The main public beach is located at the southern end of the lake adjacent to the dam. In recent years the Town and local groups committed funds to renovate the beach and associated facilities, and is now a popular recreational spot with parking to accommodate approximately 100 vehicles. This beach is accessed by car from an entrance on High Street or from Battis Farm (part of the Powow Conservation Area) located on South Hampton Road. Pedestrians can also enter on the foot trails at the northern end of the beach area, where there is a narrow strip of land that links the Beach to the trails of the Powow River Conservation Area. The lake is used for swimming, boating and fishing. Canoes, kayaks, small sail craft, and other car top boats can be launched from the northern end of the beach area. Jet skis are prohibited. The Lake Gardner Improvement Association (LGIA) performs water sampling of the several fresh water bathing areas on behalf of the Town of Amesbury, including the Lake Gardner Beach (main beach), Glen Devin Beach and Whitehall Lake Beach. Additionally, each spring LGIA installs a temporary barrier fence on the beach, near the edge of the lake, to discourage Canada Geese from nesting on or near the main beach. The LGIA also sponsors a Summer Fun Festival in early June, which includes activities such as building sand castles, kayak races, a milk jug derby, and ”fun in the sun” education.

Despite the lake activities, public education, and beach facility improvements, periodic beach closures due to elevated bacteria levels, algal blooms, sedimentation and nuisance aquatic weeds plague Lake Gardner. Unfortunately, very little water quality data is available for the lake itself other than the required bacteria sampling for swimming in the summer months. The project’s goal is to develop a more defined sampling program that will result in accurate water quality data to assess impacts of land use activities and begin to identify illicit discharges to the Town’s storm drain system. Areas to focus are the upstream Powow River segment (Tuxbury Pond to Lake Gardner segment of the Powow) and Lake Gardner itself in order to develop a long-term restoration plan to address bacteria issues for these two areas.

According to the 5-year Merrimack River Watershed Action Plan, high bacteria and nutrient levels in the Lake Attitash-Powow River subbasin continue to be a concern. Goals for improved water quality in this area include 1) collecting additional data and 2) reducing nonpoint source pollution impacts on water quality.

1.6. Project / Task Description

The Lake Gardner Bacteriological Study will develop a long-term remediation plan focusing on pathogens and nutrient control for the Powow River (Tuxbury Pond outlet to the inlet of the Lake Gardner segment) through to and including Lake Gardner. With the assistance of the LGIA, collection of the much needed water quality data will allow the Town to prioritize and plan for future water quality improvements to these impacted waterbodies. This effort will also provide baseline data for future water quality efforts, particularly relating to bacteria and nutrients. Project deliverables will position the Town to apply for s.319 Nonpoint Source Grant Funding for the implementation of recommended improvement activities.

The LGIA will be involved throughout the project providing the Town with assistance where needed. The LGIA will also provide project updates and pertinent project information to residents via their website www.lgia.org and periodic meetings that are open to the public.

The following is a description of tasks included in the project and associated objectives:

1. **Quality Assurance Project Plan (QAPP)**

   A QAPP will be developed in coordination with the LGIA in accordance with EPA (U.S. Environmental Protection Agency) guidance which will detail protocols for water quality-related monitoring. The QAPP will establish protocols for sampling methodology, processing, analytical methodology, areas to be sampled, sample stations, equipment, sampling frequency, timing, and rainfall event criteria for wet-weather sampling. The QAPP will be submitted to EPA and MA DEP (Massachusetts Department of Environmental Protection) for approval. Deliverables include a draft and approved QAPP.

2. **Data Assessment and Mapping**

   a. **Review of Existing Data**
   This task would include a more detailed review of Lake Gardner existing water quality data, graphing of past bacteriologic and other data and identification of any other data gaps beyond what is discussed in this scope. It would also include collection and review of data from other Amesbury and state sources, including information on soils, groundwater levels and septic systems around the lake (e.g., potential for failure based on anticipated groundwater levels, soil types and Board of Health records). Water quality data may also be obtained from the Merrimack River Watershed 2004 Water Quality Assessment Report and/or the draft Northeast Region Bacteria Source Tracking, 2008 Results as prepared by MADEP.

   All data obtained from state and federal sources is checked for quality to ensure accuracy. Sources such as MassGIS, NRCS, USDA, USGS, and NOAA are assumed to provide data of sufficient quality to be used under this QAPP. Existing water quality data not collected by federal or state agencies is limited to *E.coli* sampling done at Lake Gardner beach areas. The LGIA performs weekly water quality testing of bathing areas on behalf of the Town of Amesbury during warm weather months. Testing is done by Biomarine of Gloucester, a MADEP certified laboratory. As this

data is used by the Massachusetts Department of Public Health to determine safe bacteria levels at bathing beaches, it is assumed that this data is acceptable for state and federal uses. No other existing water quality data is known to exist. Data will be reviewed by the Project Manager and QA/QC Officer. Should existing data be found not to meet QA/QC requirements, it will be excluded.

In addition to collecting any other available data in the area and on the watershed of Lake Gardner, a base map would also be developed using existing MassGIS and Town mapping and overlaying information such as storm drains, sewer lines, land use maps, zoning designations, hazardous waste and other site locations (if any), pedestrian locations and waterfowl concentrations. The infrared aerials available from the state or other aerial photographs will be obtained if possible. This base map may be helpful in identifying potential sources of bacteria or other contaminants. It will also provide a basis for presenting data. A summary of existing data will be included in the final report, as well as a list and map of sites identified with higher pollution potential.

b. Watershed Area Map

The watershed of Lake Gardner beginning at the outlet of Tuxbury Pond/Powow River will be delineated to determine land uses and infrastructure within the watershed that may be contributing bacteria to the lake. The watershed map will include land use obtained through GIS software, as well as drainage subwatershed divides. Land use will depict uses such as high density residential, commercial, open space, etc. and will outline developed areas more likely to contribute to diminished water quality. Drainage divides will show the extent of the watershed and determine which areas are looked at.

The map will be field verified using Town storm drain maps and a site walkover to assure that what is mapped based on apparent topography is found in the field. This is particularly important in urban areas where drainage may have been modified from the natural contours by the storm drain system. During the site walkover, additional sources of bacteriologic inputs will be identified. In some areas this will consist of a windshield survey, while in other areas the site walkover will be done on foot. The shoreline may also be surveyed by boat if useful in getting a closer look in some areas. A watershed map with data from a windshield survey will be produced.

3. Monitoring

Although data has been collected at the beaches for bacterial data, very little in-lake sampling has been done for traditional eutrophication parameters such as phosphorus, nitrogen and for bacteria. While bacteria test results are available for shoreline samples, the overall bacterial picture of the lake may be important in determining the extent of the problem and whether there are groundwater contributions of bacteria.

A field sampling data report will be included in the final report for all monitoring tasks. Water quality samples (Total Phosphorus (TP), ammonia nitrogen, nitrate nitrogen, fecal coliform, *E.coli*, Total Suspended Solids (TSS), and turbidity) will be collected in clean

and/or sterile bottles provided by Eastern Analytical Inc. according to laboratory QC guidelines. Field measurements (temperature, dissolved oxygen, pH, and conductivity) will be collected using a YSI 556 MPS handheld multi-meter or equivalent instrument. Depth will be recorded using a Secchi Disk. Depth of sediment will be estimated using a pole and zip-ties.

a. In-Lake Monitoring Station

The lake has not been assessed for depression of dissolved oxygen at the bottom. This subtask, which would be combined in the field with subtasks 3a and 3b, would include in-lake sampling at the surface and bottom of the "deep hole" of the lake. Field parameters would be monitored including temperature, dissolved oxygen at intervals through the water column, pH, and conductivity. Additionally, laboratory analysis will be performed on samples collected at the bottom and at the surface for Total Phosphorus, ammonia nitrogen, nitrate nitrogen, Total Suspended Solids, and turbidity. Bacteria would also be analyzed using fecal coliform and *E. coli* parameters. This in-lake monitoring will show whether there are significant differences between the bottom and surface of the lake and may indicate strategies that could be effective. We have assumed three rounds of in-lake sampling.

b. Dry Weather Input Sampling

Dry weather events are defined as no rain 72 hours prior to a sampling event. The Powow River is the primary inlet to the lake and will be sampled upstream of the Newton Road culvert, just downstream of Tuxbury Lake, upstream of the Jewell Street culvert, and just prior to entering Lake Gardner. This will be included in the sampling program with analysis for temperature, dissolved oxygen, pH, and conductivity via field measurements, and Total Phosphorus, ammonia nitrogen, nitrate nitrogen, fecal coliform, *E. coli*, Total Suspended Solids, and turbidity submitted for laboratory analysis. Any other dry weather inputs would also be sampled if found discharging to the lake. Additionally, the lake outlet will be sampled downstream of the dam, representing outflow from the surface of the lake. Presence or absence of flow over the dam and/or from the outlet pipe will be documented. Three rounds of dry weather sampling will be performed for the lake inlet, lake outlet, and up to one additional major inlet found during field investigations.

c. Wet Weather Input Sampling

Wet weather events are defined as a storm event greater than 0.5" in a 24-hour period, with first flush occurring ten minutes after flow is observed. There are nine known stormwater outfalls that discharge in close proximity to Lake Gardner. These outfalls will be sampled under wet weather conditions with analysis for temperature, dissolved oxygen, pH, and conductivity via field measurements, and Total Phosphorus, ammonia nitrogen, nitrate nitrogen, fecal coliform, *E. coli*, Total Suspended Solids, and turbidity. This information will be used to determine the need for and benefit of local controls for this outlet to minimize direct bacteria inputs at the beach. Two rounds of sampling will be performed on all nine outfalls. This may be reduced depending on the results of the dry weather sampling (in-lake sampling) and based on the results of the first round of wet weather sampling. Any changes in the

number and frequency of sampling will be submitted to DEP and EPA personnel listed on the Distribution List in Section 1.3 for approval beforehand.

d. **Sediment Depth**
During in-lake sampling, the deep hole will be checked for sediment approximations. At this time, a full sediment depth map for purposes of dredging is not included in this scope. Instead, a check on estimated depth at the in-lake location would be made such that it could be compared annually to determine if and when dredging might be appropriate. The location of the Deep Hole station will be recorded with a GPS unit on the first visit, such that the location can be replicated during subsequent field events.

4. Data Evaluation

a. Water Quality Issues
Based on the information obtained in Tasks 2 and 3, any additional water quality issues and the conclusions on past data will be reviewed and identified. A summary of identified water quality issues will be provided in the final report.

b. Evaluate Effectiveness of Existing Controls
During field reviews and monitoring, an assessment will be made of the existing controls including the geese control program and their apparent effect on water quality will be evaluated using the data generated in previous tasks. A summary of the effectiveness of existing controls will be provided in the final report.

c. Additional Control Identification
Based on the data collected to date, additional controls will be identified and described in a conceptual method. The final report will identify potential controls for future implementation. Criteria that will be used to prioritize areas for future site BMPs or watershed restoration will include the extent of water quality impacts from each tributary, type of pollutant being remediated, will the BMP adequately promote stormwater awareness, area required to construct a BMP that sufficiently treats stormwater, property ownership, cost to implement or construct BMP, maintenance responsibilities and associated costs.

5. Project Recommendations
Based on the above tasks, CEI will prepare a bacteriological investigation report that will outline specific areas of bacterial contribution within the watershed and other sources of nonpoint source pollution identified. Specific BMP recommendations to improve water quality will be provided in a long-term remediation plan with conceptual designs, approximate costs, and an implementation schedule. Conceptual designs will incorporate uses of Low Impact Development (LID) principles and BMPs whenever possible.

A draft and final report will be prepared that presents that findings of tasks 1 through 4 and includes:

- Sampling and analysis protocol
- Watershed maps

- Additional water quality controls needed
- Discussion and recommendations related to options
- Specific stormwater controls
- Prioritization and costs of recommended activities
- Outline of next steps including future funding

6. Reporting

Monthly project status reports will be prepared and submitted to the MA DEP 604b Project Officer per the ARRA reporting requirements. Quarterly invoices and project reports will also be provided. A draft and final report consisting of a summary of project results and recommendations will be submitted to MA DEP for review and approval.

Table 1.6-1 outlines the project schedule.

Table 1.6-1. Project Milestone Schedule

Task Description	Month														
	Jan 2010	**Feb 2010**	**Mar 2010**	**Apr 2010**	**May 2010**	**Jun 2010**	**Jul 2010**	**Aug 2010**	**Sep 2010**	**Oct 2010**	**Nov 2010**	**Dec 2010**	**Jan 2011**	**Feb 2011**	**Mar 2011**
Task 1: QAPP	x	x	x												
Task 2: Data Assessment and Mapping				x	x	x									
Task 3: Monitoring					x	x	x	x	x						
Task 4: Data Evaluation									x	x	x				
Task 5: Project Recommendations												x	x	x	
Task 6: Reporting	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

1.7. Data Quality Objectives for Measurement Data

Data quality objectives and criteria are discussed in **Tables 1.7-1**, **1.7-2**, and **1.7-3**. The objective of this project is to collect water quality data in-lake as well as at stormwater outfalls. Water quality data will also be collected at two locations along the Powow River that are up-stream of Lake Gardner. The extent and quantity of samples collected in-lake, within the Powow River and at outfalls is discussed in Section 1.6. In-lake data will be collected, at the inlet and outlet to Lake Gardner, as well as throughout the water column and bottom at the deepest point of the lake. This in-lake data show whether there are significant differences between the bottom and surface of the lake such as periods of anoxia and may indicate whether strategies would be effective. Data will be used to prioritize and plan for future water quality improvement projects in and around Lake Gardner in an effort to reduce the number of beach closures, algal blooms, sedimentation, and the spread of nuisance aquatic weeds. This effort will also provide baseline data for future water quality efforts, particularly relating to TSS, nutrients and bacteria.

Based on the field and analytical results of the data, appropriate measures will be assessed for follow-up stormwater remediation in terms of the beneficial impact on surface water quality. Water quality impairments such as TSS, turbidity and nutrient levels will be evaluated at each sample location to help determine the cause of excessive sediment and elements contributing to noxious aquatic weeds found in Lake Gardner. The field and analytical results at each sampling location will help determine where to focus improvement efforts and prioritize BMPs that reduce sediment and nutrient inputs to the lake.MA DEP will use the data to assess the performance of projects it funds through their respective grant programs. The data will also be available to other interested parties, such as the LGIA, and for regional reporting purposes. Data quality objectives will include precision, accuracy/bias, representativeness, comparability, and completeness:

Precision is a measure of the reproducibility of repeated measurements and will be determined by analyzing sample duplicates. If sample duplicates fall within a specified critical range for that parameter, the precision will be acceptable. If the duplicate falls outside the critical range, the sample will be run again to determine if there was an error in the analyzer or the lab/field equipment that led to the imprecision. Lab duplicates will be collected twice each sampling event for each parameter analyzed, once at a stormwater outfall and once at an in-lake surface sample.

Accuracy/Bias is an indicator of measurement confidence and will be calculated based on analytical results of lab spiked samples of known concentrations. Lab analysis will include the division of a sample into two aliquots with a known amount of a standard added to one aliquot. Both aliquots are then analyzed and the amount of the spiked material recovered will be compared to the amount added. Spike samples will be analyzed once per analytical batch. Lab spikes will not be performed for parameters measured during multi-meter use or bacteria analysis due to the impracticality of this analysis. Multi-meter parameters will be compared against the manufacturers calibration solution. Percent recoveries are calculated as follows:

$$\% \text{ Recovery} = ((SC - UC) / EV) * 100$$

Where:
SC = Concentration in the spiked sample
UC = Concentration in the unspiked sample
EV = Expected value

Representativeness is the extent to which the sampling design and measurements obtained adequately reflect the true environmental conditions at the location being monitored. This will be evaluated based on the appropriateness of the selected sampling sites for describing specific impacts and general characteristics, the appropriateness of the sample collection points and frequency based on temporal and spatial variations, and the appropriateness of the selected parameters to the type of impact.

Comparability is the degree to which data can be compared directly to similar studies. In-situ data will be appropriately compared through the use of the same field protocol, locations, and frequency. Stormwater data will be compared between sites to assist with development of follow-up stormwater remediation projects at sites with the greatest observed impacts. In-lake and stormwater outfall sample collection will follow this QAPP and will remain as baseline water quality for future sample collection and studies for comparison.

Completeness is the percentage of validated data compared to the total amount of data collected. The data set will be considered complete when 90% of it meets the above established criteria (precision, accuracy/bias, representativeness, and comparability. Completeness may be calculated as follows:

Completeness = (A / B) * 100

Where:
A = Total number of valid data points
B = Total number of data points

Table 1.7-1. Data Quality Indicators

Matrix	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance
Precision-Overall	Relative Percent Difference (RPD) <= 20%	Collecting and performing field duplicate samples.
Precision-Lab	Relative Percent Difference (RPD) <= 20%	Running laboratory duplicate samples. Frequency is determined by the method used (see Section 2.5). Evaluating method QC requirements such as laboratory control samples, calibration standards and internal standards. Deviations in QC are noted and tracked by EAI.
Accuracy/Bias	80-120% Recovery of Spikes; Max 20% RPD for duplicates.	Analyzing matrix spikes and duplicates. Maintaining and following detailed SOPs for storage, preparation and sample analysis.
Representativeness	Current field program was designed to obtain data representativeness through the screening and selection of sample locations. Program includes both in-lake and stormwater samples.	Review of storm event data, watershed, and drainage system characteristics.
Comparability	Data will be compared between sites to identify those with the greatest impact and provide a baseline for comparison with future data.	Data comparison and evaluation by Project Manager and Technical Advisors, as appropriate for this project.
Completeness	90% data will meet all acceptance criteria in Table 1.7-2.	A data completeness check is performed by the Project Manager and Technical Advisors, as appropriate for this project.

Table 1.7-2. Field Indicator Data Quality Objectives

Source Matrix	Indicator	Units	WQ Limit	Reporting Limit	Detection Limit	Accuracy / Bias	Overall Precision	Range
In-Lake Water Column	Temperature	°C	20[1]	N/A	0.01	+/-0.15	0.01	-5-45
In-Lake Water Column	Dissolved Oxygen	mg/L	6.0[1]	N/A	0.01	0 to 20, highest of ± 2% of reading or ±0.2; 20 to 50, ± 6% of reading	0.5	0-50
In-Lake and Stormwater	pH	-	6.5-8.3[1]	N/A	0.01	+/-0.2	0.5	0-14
In-Lake and Stormwater	Conductivity	mS/cm	Back-ground	N/A	0.001	highest of ± 0.5% of reading or ± 0.001	0.001 to 0.1 mS/cm	0-200
In-Lake	Depth to Bottom	ft	N/A	N/A	0.05	+/-0.1	0.1	0-100
In-Lake	Secchi Depth	ft	N/A	N/A	0.05	+/-0.1	0.1	0-100
In-Lake	Depth of Sediment	ft	N/A	N/A	0.01	+/-0.01	0.01	0-100

1. 314 CMR 4.00 Massachusetts Surface Water Quality Standards.

Table 1.7-3. Laboratory Indicator Data Quality Objectives

Source Matrix	Indicator	Units	WQ Limit	Reporting Limit (RL)	Detection Limit	Accuracy / Bias	Overall Precision	Range
In-Lake and Stormwater	Total Phosphorus	mg/L	0.008[1]	0.002	0.002	80-120% recovery for lab fortified matrix	20% relative percent difference (RPD)	0.01-1.2
In-Lake and Stormwater	Ammonia Nitrogen	mg/L	0.254[2]	0.05	0.05	90-110% recovery for QC standards	20% RPD	0.03-1400
In-Lake and Stormwater	Nitrate Nitrogen	mg/L	10[3]	0.05	0.05	90-110% recovery for lab fortified matrix. +/-10% linear calibration range. +/-10% instrument performance check	+/-0.01 mg/L for 0.0-1.0, +/-0.1 mg/L for 1.0-2.0, +/-0.3 mg/L for 2.0-10.0	0.05-10.0
In-Lake and Stormwater	Fecal Coliform	Most Probable Number (MPN)	<20[2]	<1.8	<1.8	TNTC (Too Numerous to Count) on pos. control and 0 or less than RL for neg. control	30% RPD for log 10 transformed duplicate data	0-100,000
In-Lake and Stormwater	*E.coli*	MPN	<235[4]	N/A	0	TNTC on pos. control and 0 or less than RL for neg. control	30% RPD for log 10 transformed duplicate data	0-100000
In-Lake and Stormwater	TSS	mg/L	25[2]	1	1	80-120% recovery for QC standards	20% RPD	0-500
In-Lake and Stormwater	Turbidity	NTU	3.04[2]	1.0 NTU	1	90-110% recovery for QC std. +/-10% check instrument performance	+/-1 NTU	0-40

1. EPA Eco-Region Nutrient Criteria, Eco-Region XIV.
2. MADEP Aquatic Life Use Criteria
3. EPA National Recommended Water Quality Standards
4. 314 CMR 4.00 Massachusetts Surface Water Quality Standards.

1.8. Training Requirements / Certification

Lake Gardner Improvement Association (LGIA). staff will complete the project monitoring and sampling. The LGIA have conducted water sampling at the several freshwater swimming areas in Lake Gardner on behalf of the Town of Amesbury.

The Monitoring Coordinator will meet with the Project Manager and QA/QC Officer to review the sampling sites, sampling procedures, project goals and objectives to answer any questions regarding the QAPP. The Monitoring Coordinator is familiar and trained in field sampling and handling and has conducted field sampling in dry and wet weather conditions in several Towns in the past. The Monitoring Coordinator has coordinated other training and field sampling projects and has extensive expertise in working with volunteers.

The Monitoring Coordinator will visit each sampling location prior to holding the monitoring/sampling start-up meeting for the sampling staff. He will train the sampling staff, as appropriate for the sampling project based on prior water quality and stormwater sampling experience. At a minimum, training will include relevant safety issues, sample collection and documentation, QAPP review, and a dry run of the sampling event. Volunteers will be trained to operate all sampling equipment as well as instructed on how to properly calibrate the multi-meter for field measurements.

The QAPP and other sampling references will be available prior to and during all sampling events. The Monitoring Coordinator will be available to assist members of the Field Sampling Team as needed. **Appendix C** includes a copy of the training record that will be completed and maintained on file with the Town of Amesbury and the LGIA, and included as part of the final project report.

1.9. Documentation and Records

Documentation accompanying samples from field collection and monitoring through laboratory analysis include field data sheets, sample labeling, chain of custody forms and lab data sheets.

Field Data Sheets
Field data sheets will be completed on-site at the time of sampling and monitoring and will be provided to each field team. Field sheets will include the following information:

- Site name and location
- Names of field team personnel
- Sample date/time collection
- Weather conditions
- Site observations
- Station location

Paper records will be stored with the LGIA. Paper copies will be scanned into Adobe Reader format (.pdf files) and stored electronically on servers at Comprehensive Environmental, Inc. for a minimum of five years and backed up several times each week. **Appendix D** contains a sampling and monitoring data sheet.

Sample Labeling
Sample labeling will include a label for each sample bottle collected in the field and filled out with an indelible writing instrument. A sample label is included in **Appendix E** and will include the following information.

- Name of sample collected
- Sample identification
- Location of sample
- Date of collection
- Time of collection
- Initials of person collecting the sample
- Preservative
- Analysis

Records will be maintained at Eastern Analytical laboratories in a central lab archival location for several years.

Chain of Custody
A chain of custody will be used to track the samples from the collection point through analysis and data management. Chain of Custody records will be signed by the appropriate Field Sampling Team member before samples are relinquished to the laboratory. The records will also be signed by the receiving laboratory. The Field Team Leader, Monitoring Coordinator and the laboratory analyzing the sample will maintain copies of the Chain of Custody. **Appendix F** contains the appropriate sample Chain of Custody form. The Chain of Custody will contain the following information:

- General project information
- Sample identification

- Date of collection
- Time of collection
- Sample matrix
- Sample analysis
- Additional comments as appropriate

Records will be maintained at Eastern Analytical laboratories in a central lab archival location for several years. Paper copies will be scanned into Adobe Reader format (.pdf files) and stored electronically on servers at Comprehensive Environmental, Inc. for a minimum of five years and backed up several times each week.

Lab Data Sheets
Lab data sheets will be used by the laboratory to document sample processing and analysis. Lab data sheets will be kept for each parameter analyzed and will include:

- Name of lab
- Analysis date
- Time of sample arrival at lab
- Time samples were analyzed
- Sample ID # and site #
- Raw results, calculated results
- Name of lab analyst
- Internal QC procedures.

Bacteria lab data sheets will also include:

- Volume filtered
- Number of colonies counted
- Result in colonies per 100 mL.

Records will be maintained at Eastern Analytical laboratories in a central lab archival location for several years. Paper copies will be scanned into Adobe Reader format (.pdf files) and stored electronically on servers at Comprehensive Environmental, Inc. for a minimum of five years and backed up several times each week.

Data Presentation
Data will be tabulated into various tables and graphs and presented in the draft and final reports to be submitted to EPA and MA DEP for approval. Reports will include both a summary of all data as well as copies of the raw data obtained during sampling events. Summaries will be presented in tables within the report body with raw data included in an appendix. Monthly and quarterly reports will document data obtained in the most recent sampling round.

Approved QAPP
Upon approval by MA DEP and EPA, the approved QAPP will be distributed to those specified on the Distribution List as outlined in Section 1.3. Distribution will be done via email, with hardcopies available to CEI staff and the Field Team prior to the first sampling event. Any updates will be sent via email.

2.0. DATA GENERATION AND ACQUISITION

2.1. Sampling Process Design

The goal of this project is to collect surface water quality data in-lake and at stormwater outfalls to prioritize and plan for future water quality improvement projects in an effort to reduce the number of beach closures, algal blooms, sedimentation, and the spread of nuisance aquatic weeds. Sampling sites were selected to provide a water quality profile at different locations in and around the lake. The combination of outfall and in-stream sample locations will best quantify the magnitude and type of stormwater impacts in Lake Gardner.

Sample Site Selection
Sample sites were selected to evaluate the water quality of natural and constructed tributaries to Lake Gardner, as well as impacts on downstream water quality. Figures 2.1-1 and 2.1-2 in Appendix B show the location of all sample stations. All samples will be analyzed for temperature, dissolved oxygen, pH, conductivity, Total Phosphorus, ammonia nitrogen, nitrate nitrogen, fecal coliform, *E.coli*, Total Suspended Solids, and turbidity. Finally, the depth to bottom at the Deep Hole (Deep) location will be recorded.

The Newton Road station is located just downstream from the Tuxbury Pond outlet on the upstream side of the bridge. This station was selected to determine water quality exiting the pond. The Jewell Street station is located between the Newton Road and Lake Inlet stations upstream of the bridge, and will be used to further bracket water quality impacts along the Powow River, particularly to identity potential impacts from the nearby farm and wetland areas. The lake inlet station is located just prior to where the Powow River widens into Lake Gardner. This station was selected to determine pollutant loads carried into the lake from upstream sources. The lake outlet station is located just downstream of the Lake Gardner dam. This station was selected to determine pollutant loads leaving the lake and impacting the downstream Powow River. Data at this station will be compared to the inlet station to determine the effects of the impoundment on water quality. The deep hole station is located towards the southern end of the lake. Samples will be taken both at the surface and bottom. Temperature and dissolved oxygen readings will be taken throughout the water column. The LGIA will also determine an approximate sediment depth. Data will be compared to the lake inlet and outlet to understand water quality variations within the lake.

Nine stormwater outfalls previously located around Lake Gardner will be sampled to determine pollutant load contributions. Each outfall will be prioritized according to the impact on the lake for future water quality improvement, such as the design and construction of stormwater BMPs.

Sample Collection Description
Three rounds of dry weather sampling will be conducted at the Newton Road, Jewell Street, lake inlet, lake outlet, and deep hole station. A minimum of two rounds of sampling at each of nine stormwater outfalls will be collected during wet weather events. Dry weather events are defined as no rain 72 hours prior to a sampling event. Wet weather events are defined as a storm event greater than 0.5” in a 24-hour period with first flush occurring ten minutes after flow is observed. As discussed in the Standard Operating Procedures, wet weather conditions will be monitored

through the NOAA: National Weather Service website at http://weather.noaa.gov/weather/MA_cc_us.html under the Essex County forecast section. Sample collection procedures are outlined in SOPs located in **Appendix G**.

Sampling is expected to begin in May 2010. Refer to Table 1.6-1 for a project schedule. **Table 2.1-1** outlines the sampling and monitoring program.

Table 2.1-1. Sampling/Monitoring Design

Indicator	Sites[1]	Sample Location
Wet Weather: Two sampling rounds with storm events that generate >0.5" of precipitation in a 24-hr period and no rain 72 hrs prior to sampling. Weather reporting will be obtained from the NOAA: National Weather Service website.		
1. Temperature 2. Dissolved Oxygen 3. pH 4. Conductivity 5. Ammonia Nitrogen 6. Nitrate Nitrogen 7. Fecal Coliform 8. *E.coli* 9. Turbidity 10. Total Suspended Solids 11. Total Phosphorus	Stormwater 4-2	Orchard Court
	Stormwater 4-4	Unicorn Circle near Barbara Drive intersection
	Stormwater 4-5	Unicorn Circle
	Stormwater 4-7	Nancy Drive
	Stormwater 4-8	Nancy Drive
	Stormwater 4-9	Nancy Drive
	Stormwater 4-12	Whitehall Road
	Stormwater 4-13	Whitehall Road
	Stormwater 4-15	End of Whitehall Lake Drive
Dry Weather: Three sampling rounds with no rain 72 hrs prior to sampling. Weather reporting will be obtained from the NOAA: National Weather Service website.		
1. Temperature 2. Dissolved Oxygen 3. pH 4. Conductivity 5. Ammonia Nitrogen 6. Nitrate Nitrogen 7. Fecal Coliform 8. *E.coli* 9. Total Suspended Solids 10. Turbidity 11. Total Phosphorus	Newton Road	Powow River upstream of the Newton Road culvert
	Jewell Street	Powow River upstream of the Jewell Street culvert
	Lake Inlet	Powow River at discharge point to Lake Gardner
	Lake Outlet	Powow River at the just below Lake Gardner dam
	Deep Hole (Shallow)	Approximate center of Lake Gardner, at surface
	Deep Hole (Deep)	Approximate center of Lake Gardner, at bottom
Depth to Bottom	Deep Hole (Deep)	Approximate center of Lake Gardner, at bottom
Depth of Sediment	Deep Hole (Deep)	Approximate center of Lake Gardner, at bottom
Secchi Reading	Deep Hole (Deep)	Approximate center of Lake Gardner, at bottom
1. Temperature 2. Dissolved Oxygen (DO)	Deep Hole (Shallow and Deep)	Throughout water column at Deep Hole station

1. See Figures 2.1-1 and 2.1-2 in Appendix B for sampling locations.

In addition to sampling outlined above, two duplicate samples will be collected for each indicator per sampling round, one at a stormwater outfall and one at an in-lake surface location. Additionally, one blank filled with distilled water will be collected to verify that proper rinse water was used on sampling equipment at the Deep Hole (Deep) station. Sample collection SOPs are located in Appendix G.

Sample collection will be during daylight hours generally between 7 AM and 5 PM, 7 days a week. Eastern Analytical accepts samples 8 AM to 5 PM Monday through Friday and outside of office hours with advanced notice. The Monitoring Coordinator will coordinate sample dates and times with Eastern Analytical Inc. in advance and immediately preceding the sampling event. All samples will be grab samples.

Both the Monitoring Coordinator and Field Team Leader will monitor expected weather conditions, including anticipated rainfall from appropriate weather locations such as www.weatherunderground.com or local weather station throughout the sampling period. Should appropriate weather conditions be expected, the Field Team Leader will contact all appropriate field personnel in advance. This will be done up to one day ahead of time so that Field Team members are on standby and the laboratory may be notified. Approximately one hour prior to the start of the storm, final weather conditions will be reviewed, and the Field Team Leader will give a go or no go to the Field Team. The Field Team will then meet at the main public beach where the Team Leader will distribute bottles to each team and review final assignments.

Dry Weather Sampling
Should dry weather conditions be expected, sampling teams will be deployed to collect water quality samples from each location. One crew with a minimum of two people will collect samples from the Lake Inlet and Deep Hole stations via a boat during dry weather. A second crew will collect samples from the Newton Road, Jewell Street, Lake Outlet and other inlets found discharging to the lake during the dry weather sampling event.

Wet Weather Sampling
Should a storm greater than 0.5” be expected, sampling teams will be dispatched to their first stormwater location to begin sampling after meeting at the public beach. Sampling will commence ten minutes after the start of flow is observed to approximately capture the first flush as per the sampling SOPs provided in Appendix G.

During wet weather, the nine stormwater outfalls will be sampled by a minimum of three crews. After coordination with the Monitoring Coordinator and Field Team Leader, crews will be stationed at their first sampling location at the start of the storm. Crews will be broken up according to the following stations:

Crew 1: Stormwater 4-4, 4-5, and 4-15
Crew 2: Stormwater 4-7, 4-8, and 4-9
Crew 3: Stormwater 4-12, 4-13, and 4-2

2.2. Sampling Method Requirements

Sampling at the Lake Inlet and Deep Hole stations will be done from a kayak, canoe, or similar vessel. A boat launching area is available at the northern end of the main public beach. Sampling at Newton Road, Jewell Street, Lake Outlet and the nine stormwater outfalls will be done on foot using either a surface sampler or extendable swing sampler. Samples at the Deep Hole (Deep) station will be collected using a Wisconsin Sampler. Samples will be collected directly with containers supplied by the lab with the exception of the Deep Hole (Deep) station. Site maps (Figures 2.1-2 and 2.2-2) are provided to assist sampling teams in finding each location. Collection methods are summarized in **Tables 2.2-1** and **2.2-2**. Laboratory QA/QC procedures are provided in **Appendix H**. Sample collection SOPs are provided in Appendix G.

Table 2.2-1. Container, Sample Size, Type, Preservation and Storage

Indicator	Container Type	Minimum Sample Quantity (mL)	Sample Type	Preservation[1]	Maximum Holding Time
Total Phosphorus (TP)	HDPE	100	Grab	Sulfuric Acid / Ice	28 days
Ammonia Nitrogen	Plastic/Glass	200	Grab	Sulfuric Acid / Ice	28 days
Nitrate Nitrogen	Plastic	50	Grab	Ice	48 hours
Fecal Coliform	Plastic Sterile Container	100	Grab	Sterile / Ice	4 hours
E.coli	Plastic Sterile Container	100	Grab	Sterile / Ice	4 hours
Total Suspended Solids	Plastic	300	Grab	Ice	7 days
Turbidity	Plastic	100	Grab	Ice	48 hours

1. All samples initially stored in a cooler at 4° C. TP and ammonia sample bottles will be pre-preserved by the lab prior to the sampling event. Bacteria bottles will be sterilized by the lab prior to the sampling event.

Table 2.2-2. Sampling Methods

Indicator	What Will Be Sampled	Sampling Equipment	Sampling Method
Total Phosphorus (TP)	In-Lake and Stormwater	Surface sampler, extendable swing sampler, or Wisconsin Sampler.	Refer to Appendix G for sampling SOP.
Ammonia Nitrogen	In-Lake and Stormwater	Surface sampler, extendable swing sampler, or Wisconsin Sampler.	
Nitrate Nitrogen	In-Lake and Stormwater	Surface sampler, extendable swing sampler, or Wisconsin Sampler.	
Fecal Coliform	In-Lake and Stormwater	Surface sampler, extendable swing sampler, or Wisconsin Sampler.	
E.coli	In-Lake and Stormwater	Surface sampler, extendable swing sampler, or Wisconsin Sampler.	
Total Suspended Solids	In-Lake and Stormwater	Surface sampler, extendable swing sampler, or Wisconsin Sampler.	
Turbidity	In-Lake and Stormwater	Surface sampler, extendable swing sampler, or Wisconsin Sampler.	
Depth	In-Lake (Deep Hole)	Secchi Disk.	

Two duplicate samples will be collected for each indicator per sampling round, one at a stormwater outfall and one at an in-lake surface location. One blank filled with distilled water will be collected to verify that proper rinse water was used on sampling equipment.

2.3. Sample Handling and Custody Requirements

Detailed sampling and handling procedures are outlined in the Standard Operating Procedures provided in Appendix G. The five steps to sample handling and custody are described below.

Completion of Field Data Sheets
Field data sheets will be completed at the sample site during sampling activities and will include the following general information: site name and location, names of field team personnel, sample date/time collection, weather conditions, and comments. The Field Team will record values of temperature, pH, dissolved oxygen, and conductivity measured with a properly calibrated multi-meter instrument. Upon filling each bottle for laboratory analysis, the team member will place a check mark in the appropriate box for Total Phosphorus, ammonia, nitrate, fecal coliform, *E.coli*, Total Suspended Solids, and turbidity to keep track of laboratory samples. If performing sampling at the Deep Hole (Deep) station, field team will record the depth, temperature and dissolved oxygen readings at two-foot intervals throughout the water column, as well as the final depth to sediment using a multi-meter and Secchi Disk. Estimated sediment depth will be estimated at the bottom with a pole and zip-ties. A sample field data sheet is provided in Appendix D.

Sample Labeling
Sample labels will be placed on dry bottles in advance of sampling. The laboratory will provide sample labels. An example label is provided in Appendix E. Each sample label will contain the following information once sampling is complete: sample name (e.g., Stormwater 4-5), location (e.g. Unicorn Circle), sampler's initials, date and time, preservation (e.g., sulfuric acid), and lab analysis to be performed (e.g., TP).

Sample Transport and Chain of Custody
The Total Phosphorus, ammonia nitrogen, nitrate nitrogen, fecal coliform, *E.coli*, and samples will be placed in coolers on ice and transported to Eastern Analytical subsequent to sample collection and within the sample holding times by laboratory courier. Once sampling is completed, the Field Team Leader will meet with each sampling team to compile data sheets and samples that will be submitted for laboratory analysis. The containers will be inspected to ensure they are sealed and labeled appropriately. A chain of custody will be used to track the samples from the collection point through analysis and data management. The Field Team Leader will sign Chain of Custody records before samples are relinquished to the laboratory courier. The receiving laboratory will also sign the records. The Field Team Leader, Monitoring Coordinator and the laboratory analyzing the sample will maintain copies of the Chain of Custody. Appendix F contains the sample Chain of Custody form which contains the following information: general project information, sample identification, date of collection, time of collection, sample matrix, sample type, sample analysis, and additional comments as appropriate.

Sample Disposal
The samples analyzed in the laboratory will be disposed in accordance with Massachusetts Law and the Standard Operating Procedures (SOP) of Eastern Analytical Inc.

Sample Storage
No samples will be stored for later use in this project.

2.4. Analytical Methods Requirements

Field measurements will be performed in accordance with the SOPs provided in Appendix G. Temperature, DO, pH, and conductivity indicators will be measured with a YSI 556MPS Multi-meter or equivalent instrument. The operating manual is provided in **Appendix I**. Depth to bottom and Secchi Depth will be measured with a Secchi Disk with an attached line marked at $1/10^{th}$ of a foot intervals. Sediment depth will be approximated with a pole and zip-ties. **Table 2.4-1** provides a summary of field measurements indicators and methods.

Table 2.4-1. Field Measurements Methods

Indicator	Responsible Organization	Method	Reporting Units	Modifications or options
Temperature	LGIA	YSI 556MPS Multi-meter or equivalent.	^{o}C	None
Dissolved Oxygen (DO)	LGIA	YSI 556MPS Multi-meter or equivalent.	mg/L	None
pH	LGIA	YSI 556MPS Multi-meter or equivalent.	-	None
Conductivity	LGIA	YSI 556MPS Multi-meter or equivalent.	mS/cm	None
Depth to Bottom	LGIA	Secchi Disk	ft	None
Secchi Depth	LGIA	Secchi Disk	ft	None
Depth of Sediment	LGIA	Pole and zip-ties	ft	None

Laboratory analyses will be performed in accordance with Eastern Analytical QA/QC procedures, provided in Appendix H. **Table 2.4-2** provides a summary of laboratory analytical indicators and methods.

Table 2.4-2. Laboratory Analyses Methods

Indicator	Responsible Organization	Method	Reporting Units	Modifications or options
Total Phosphorus (TP)	Eastern Analytical, Inc.	EPA 365.3	mg/L	None
Ammonia Nitrogen	Eastern Analytical, Inc.	EPA 350.3	mg/L	None
Nitrate Nitrogen	Eastern Analytical, Inc.	EPA 353.2	mg/L	None
Fecal Coliform	Eastern Analytical, Inc.	SM 9221E 19th Edition	# colonies / 100 mL	None
E.coli	Eastern Analytical, Inc.	SM 9221F 19th edition	# colonies / 100 mL	None
Total Suspended Solids	Eastern Analytical, Inc.	EPA 160.2	mg/L	None
Turbidity	Eastern Analytical, Inc	EPA 180.1	NTU	None

2.5. Quality Control Requirements

Tables 2.5-1 and **2.5-2** contain all field and laboratory QC tests and samples for each indicator.

Table 2.5-1. Field Quality Control Checks for Field Parameters[1]

Indicator	Field Quality Control Checks	Calibration
Temperature	Instrument is clean and calibrated. All readings recorded on field data sheet.	YSI calibrated just prior to use
Dissolved Oxygen (DO)	Instrument is clean and calibrated. All readings recorded on field data sheet.	YSI calibrated just prior to use
pH	Instrument is clean and calibrated. All readings recorded on field data sheet.	YSI calibrated just prior to use
Conductivity	Instrument is clean and calibrated. All readings recorded on field data sheet.	YSI calibrated just prior to use
Depth to Bottom	Instrument is in working order. All readings recorded on field data sheet.	Secchi Disk calibrated at beginning of sampling season
Secchi Depth	Instrument is in working order. All readings recorded on field data sheet.	Secchi Disk calibrated at beginning of sampling season
Depth of Sediment	Instrument is in working order. All readings recorded on field data sheet.	NA

1. The QA/QC Officer and Field Team Leader will evaluate the field data when available to determine if the QC samples reveal any sampling or analytical problems.

Table 2.5-2. Field Quality Control Checks for Laboratory Parameters[1]

Indicator	Field Quality Control Checks	EPA Method	Calibration	EAI SOP #
Total Phosphorus (TP)	Sampler is clean, sample is transferred immediately from sampler to sample container, container is properly sealed and immediately placed on ice.	EPA 365.3	4 standards and a blank every 4 months.	QA142002 PhosT
Ammonia Nitrogen	Sampler is clean, sample is transferred immediately from sampler to sample container, container is properly sealed and immediately placed on ice.	EPA 350.3	3 standards and a blank every 4 months.	QA138002 NH3
Nitrate Nitrogen	Sampler is clean, sample is transferred immediately from sampler to sample container, container is properly sealed and immediately placed on ice.	EPA 353.2	3 standards and a blank, daily.	QA117001 Lachat
Fecal Coliform	Sample container is intact and sterile (sealed), no foreign objects enter the container, gloves are worn to prevent sample contamination, and container is properly sealed and immediately placed on ice.	SM 9221E 19th Edition	NA	QA196001 FC
E.coli	Sample container is intact and sterile (sealed), no foreign objects enter the container, gloves are worn to prevent sample contamination, and container is properly sealed and immediately placed on ice.	SM 9221F 19th edition	NA	QA193001 EC
Total Suspended Solids	Sampler is clean, sample is transferred immediately from sampler to sample container, container is properly sealed and immediately placed on ice.	EPA 160.2	N/A	QA102001 TSS
Turbidity	Sampler is clean, sample is transferred immediately from sampler to sample container, container is properly sealed and immediately placed on ice.	EPA 180.1	Instrument calibration checked.	QA170001 Turb

1. The QA/QC Officer and Field Team Leader will evaluate lab data when available to determine if the QC samples reveal any sampling or analytical problems.

Tables 2.5-3 and **2.5-4** contain all field and laboratory QC frequency for each indicator.

Table 2.5-3. QA/QC Frequency for Field Parameters

Indicator	QA/QC Checks
Temperature	Parameter stabilizes prior to recording final reading.
Dissolved Oxygen (DO)	Parameter stabilizes prior to recording final reading.
pH	Parameter stabilizes prior to recording final reading.
Conductivity	Parameter stabilizes prior to recording final reading.
Depth to Bottom	Two readings are within 0.1 foot of each other.
Secchi Depth	Two readings are within 0.1 foot of each other.
Depth of Sediment	Two readings are within 0.1 foot of each other.

Table 2.5-4. QA/QC Frequency for Laboratory Parameters[1]

Indicator	Blanks	Duplicates	Matrix Spikes	Matrix Spikes Duplicates	Continuing Calibration Checks	Lab Control Samples	Performance Check Samples
Total Phosphorus (TP)	one per batch	N/A	one per batch	one per batch	two per digestion	one per digestion batch	semiannual batch
Ammonia Nitrogen	one per analytical batch	N/A	10%	10%	one every four hours	one per batch	semiannual
Nitrate Nitrogen	10%	N/A	10%	10%	10%	10%	once per quarter
Fecal Coliform	NA	5% of positive samples	N/A	N/A	N/A	N/A	semiannual
E.coli	NA	5% of positive samples	N/A	N/A	N/A	N/A	semiannual
Total Suspended Solids	one per batch	10%	N/A	N/A	N/A	one per batch	once per quarter
Turbidity	one per batch	10%	N/A	N/A	see calibration	one per batch	semiannual

1. Quality control protocols and laboratory SOPs are provided in Appendix H.

2.6. Equipment Testing, Inspection, and Maintenance Requirements

Tables 2.6-1 and **2.6-2** contain field and laboratory QC inspection and maintenance procedures.

Table 2.6-1. Field Equipment Inspection and Maintenance

Equipment Type	Inspection Frequency	Type of Inspection	Available Parts	Maintenance Frequency
YSI 556MPS Multi-meter	Prior to each sampling event	Working order, integrity, cleanliness, and properly calibrated according to manufacturer specifications.	Spare batteries.	Annually or as needed.
Surface Sampler	Prior to each sampling event	Instrument is clean.	Spare sampler.	Annually or as needed.
Extendable Swing Sampler	Prior to each sampling event	Instrument is clean; extension mechanism is working correctly.	Spare sampler.	Annually or as needed.
Wisconsin Sampler	Prior to each sampling event	Instrument is clean; mechanism is working correctly.	Spare sampler.	Annually or as needed.
Secchi Disk	Prior to each sampling event	Working order, integrity, cleanliness, and properly calibrated according to manufacturer specifications.	Spare sampler.	Annually or as needed.
Pole and zip ties	Prior to each sampling event	Instrument is clean.	None necessary.	Annually or as needed.
GPS Unit	Prior to each sampling event	Working order, integrity, and cleanliness	None necessary	Annually or as needed.
Cooler	Prior to each sampling event	Cooler is clean; ice packs.	None necessary.	Annually or as needed.
Boat, motor, life vests, gas, oars.	Prior to each sampling event	Boat is seaworthy, motor in working order, emergency equipment present.	Gasoline for motor	Annually or as needed.

Table 2.6-2. Laboratory Equipment Inspection and Maintenance

Equipment Type	Inspection Frequency	Type of Inspection	Available Parts	Maintenance Frequency & Recordkeeping
Lab Benches	Each day of use	Cleanliness, chips, cracks.	Patch or filler kit	Clean and disinfect before each analysis date.
Drying Oven	Each day of use	Proper operation, cleanliness.	Per manufacturer	Semi-annually or as needed Logbook notation.
Filtration Apparatus	Each day of use	Calibration verified at range of use.	Extra filters and hand pumps	Annually or as needed Logbook notation.
Spectro-photometer	Each day of use	Calibration verified at range of use.	Per manufacturer (Genesys 2)	Alignment is checked quarterly. Lamps and tubing replaced as necessary. Logbook notation .
Analytical Balance	Each day of use	Calibration verified at range of use.	Per manufacturer (Ohaus Adventurer)	Semi-annually or as needed. Logbook notation.
Ammonia Analyzer	Each day of use	Calibration verified at range of use.	Per manufacturer (Alletch 380, Timberline TL201)	Semi-annually or as needed. Logbook notation.
Turbidimeter	Each day of use	Calibration verified at range of use.	Per manufacturer (Hach 2100A)	Semi-annually or as needed. Logbook notation.

2.7. Instrument Calibration and Frequency Requirements

Tables 2.7-1 and **2.7-2** outlines field and laboratory calibration procedures. The laboratory QA/QC manual is included in Appendix H of this QAPP. A quick guide to YSI calibration is provided in **Appendix J**.

Table 2.7-1. Field Calibration Procedures

Equipment Type	Inspection and Calibration Frequency	Standard of Calibration Instrument Used	Logbook Notation	Corrective Action	Responsible Party
YSI 556MPS Multi-meter	Prior to each sampling event.	Manufacturers' standards	No	Replace / calibrate	LGIA
Secchi Disk	At beginning of sampling season	Manufacturers' standards	No	Replace / calibrate	LGIA

Table 2.7-2. Laboratory Calibration Procedures

Equipment Type	Inspection and Calibration Frequency	Standard of Calibration Instrument Used	Logbook Notation	Corrective Action	Responsible Party
Spectro-photometer	Alignment checked quarterly, lamps changed as necessary and alignment performed, pump tubing replaced as necessary, service required when calibration curves out of line with historical data.	Manufacturers' standards	Yes	Replace / calibrate	Eastern Analytical, Inc.
Filtration Apparatus	Operation of vacuum pump, cleanness and completeness of equipment, sufficient filters, sterility (bacteria samples).	Manufacturers' standards	Yes	Replace / calibrate	Eastern Analytical, Inc.
Analytical Balance	Checked daily with three class S weights to verify accuracy over working range. Preventative maintenance and verification of calibration performed annually using NIST calibration rates.	Manufacturers' standards	Yes	Replace / calibrate	Eastern Analytical, Inc.
Ammonia Analyzer	Calibrated with three standards and a blank every three months. Continuing calibration checks once every four hours	Manufacturers' standards	Yes	Replace / calibrate	Eastern Analytical, Inc.
Turbidimeter	Calibrated with high and low standards every three months.	Manufacturers' standards	Yes	Replace / calibrate	Eastern Analytical, Inc.

2.8 Inspection / Acceptance Requirements of Supplies and Consumables

Table 2.8-1 outlines field supplies and recommended inspections. Field SOPs are contained in Appendix G. Procedures for calibrating the YSI Multi-meter as provided in Appendix J.

Table 2.8-1. Recommended Inspection for Supplies

Supplies	Inspection Frequency	Type of Inspection	Available Parts	Maintenance	Responsible Party
Field and lab sheets	Prior to each sampling event	Visual	Additional copies.	None necessary.	LGIA / Eastern Analytical
Sample bottles	Prior to each sampling event	Integrity, cleanliness and seal for nutrient bottles, verified sterility of bacterial sample bottles.	One set of spare bottles.	None necessary.	LGIA / Eastern Analytical
YSI 556MPS Multi-meter	Prior to each sampling event	Working order, integrity, cleanliness, and properly calibrated according to manufacturer specifications.	Spare sampler, spare batteries.	Clean and calibrate prior to each sampling event.	LGIA
Surface sampler	Prior to each sampling event	Instrument is clean.	Spare sampler.	Clean prior to each sampling event.	LGIA
Extended stormwater sampler	Prior to each sampling event	Instrument is clean; extension mechanism is working correctly.	Spare sampler.	Clean prior to each sampling event.	LGIA
Wisconsin Sampler	Prior to each sampling event	Instrument is clean; mechanism is working correctly.	Spare sampler.	Clean prior to each sampling event.	LGIA
Secchi Disk	Prior to each sampling event	Instrument is clean; mechanism is working correctly.	Spare sampler.	Clean prior to each sampling event.	LGIA
Pole and zip-ties	Prior to each sampling event	Instrument is clean.	None necessary.	Clean prior to each sampling event.	LGIA
GPS Unit	Prior to each sampling event	Working order, integrity, and cleanliness	None necessary.	None necessary.	LGIA
Cooler	Prior to each sampling event	Cooler is clean; ice packs.	None necessary.	Clean prior to each sampling event.	LGIA / Eastern Analytical

2.9. Data Acquisition Requirements

Maps will be prepared using MassGIS data layers to help to identify monitoring locations and the general land features in the area. Additional data, such as aerial photographs, groundwater information, and soils information will be obtained from the United States Geological Survey (USGS), United States Department of Agriculture (USDA), and/or the National Resources Conservation Services (NRCS) as available. Rainfall information for each sampling date will be obtained from the NOAA National Weather Service website and used for data evaluation at the completion of sampling events. Water quality data may also be compared to the Merrimack River Watershed 2004 Water Quality Assessment Report and the draft Northeast Region Bacteria Source Tracking, 2008 Results as prepared by MADEP.

The above-referenced sources provide state or federal databases or studies with accurate information suitable for this study. Data collected during this project will be used to prioritize future water quality improvements and used for comparison with future water quality monitoring efforts.

Additional field reconnaissance efforts will be performed by CEI staff familiar with the area and experienced in conducting a watershed assessment. Watershed data such as land use types, storm drain locations, additional sources of pollutant inputs, and sites with a higher pollution potential will be compared to existing MassGIS data and incorporated into the report.

2.10. Data Management

The field and laboratory data collected during this project will be managed according to the following stages:

Raw Data
Field and lab data sheets will be signed and checked for completeness by the Field Team Leader and Laboratory QA Officer. Any omissions or apparent errors will be verified with the Field Team. Chain of Custody forms will follow the samples and the Laboratory QA Officer will inspect data sheets as soon as they are received. All sample receipt and/or analytical anomalies will be identified in the Narrative Section of the final summary report. Final summary reports are reviewed by Laboratory QA Officer or approved signatory prior to final submission. If any problem is suspected at this time, the Field Team Leader and/or samplers will be contacted. Lab analysts will flag data and comment on any samples that did not arrive cool or have questionable characteristics. Data sheets and Chain of Custody forms will be sent to the Project Manager, QA/QC Officer, Monitoring Coordinator, and Field Team Leader as soon as the results are in.

Data Entry and Validation
The field and laboratory data will be entered into a spreadsheet (MS Excel). Final results may be displayed in part by using ArcGIS maps if appropriate. The Field Team Leader and Monitoring Coordinator will check the tabulated data against the field and lab sheets to assure that all data has been entered correctly. The data will be critically reviewed by the Project Manager and QA/QC Officer for reasonableness, correspondence with data quality objectives, and appropriate qualification or censoring of suspect data.

Data Storage
Original field data sheets will be maintained with the Lake Gardner Improvement Association. Laboratory data sheets and Chain of Custody forms will be maintained with Eastern Analytical, Inc. Copies of all original documents will be provided to MA DEP and Comprehensive Environmental Inc. for inclusion in the final report. Electronic files associated with the final report including sampling results will be stored with CEI for distribution as appropriate. Electronic files are stored on secure servers which are backed up several times each week.

3.0. ASSESSMENT AND OVERSIGHT

3.1. Assessment and Response Actions

The Field Team Leader will observe the sampling teams to assess their understanding of the written procedures both after the training session and after each sampling round. If any deviations from the procedures are observed, they will be corrected and an assessment made as to whether any previously collected data is suspect.

The Monitoring Coordinator will be responsible for overseeing data collection activities and handling corrective actions that pertain to data collection and data entry. The Monitoring Coordinator will be in contact with the Field Team Leader throughout the project, particularly immediately before and after each sampling round. The Monitoring Coordinator will inform the Project Manager with the results of corrective actions.

The QA/QC Officer will be responsible for reviewing the field data sheets and tabulated laboratory data for information that pertains to data quality objectives throughout the project, particularly immediately after each sampling round and when laboratory data results are available.

The Project Manager will be responsible for oversight and follow-up on corrective actions reported by the Field Team Leader, Monitoring Coordinator, and QA/QC Officer throughout the project.

The Laboratory QA/QC Officer will provide the laboratory assessment procedures after each sampling round and during data analysis. The Laboratory QA/QC Officer will discuss any sampling issues with the Field Team Leader and Monitoring Coordinator as necessary.

The Technical Advisors will assist with these tasks throughout the project as appropriate.

3.2. Reports

A summary memo will be prepared after the completion of each sampling event, once data results are received but at a minimum at least prior to the next sampling event. The memo, prepared by the Monitoring Coordinator with input from the Field Leader, QA/QC Officer and Project Manager will summarize the sampling/monitoring event and note any problems that occurred with recommendations for improvement prior to the next sampling event.

Monthly and/or quarterly reports will be distributed to the Town of Amesbury, LGIA, MA DEP and EPA for comment and information purposes as part of the 604(b) reporting requirements. As appropriate, the project quality assurance information will be included.

Final sampling/monitoring results will be incorporated into the final project report required by the MA DEP 604(b) Grant Program at the completion of the project. This report will contain the following:

- Executive Summary
- Project Description
- Existing Data Assessment
- Environmental Monitoring
- QA/QC Issues (field and laboratory)
- Evaluation of Data
- Recommendations and Conclusions
- Data Gaps
- References and Further Reading

Comprehensive Environmental Inc. will be responsible for interpreting the water quality results, compiling monitoring data sheets, and completing a final report encompassing the above sections. Draft copies will be distributed to the Town of Amesbury, LGIA, MA DEP and EPA for review and comment prior to finalization and approval.

4.0. DATA VALIDATION AND USABILITY

4.1. Data Review, Verification, and Validation Requirements

All data will be reviewed by the Monitoring Coordinator, Project Manager, and QA/QC Officer as well as the MA DEP Project Officer to determine if they meet the QAPP objectives. The Field Team Leader will initially review field data for completeness as soon as possible after collection. If data review indicates a problem with a particular sample, it is possible that another sample round will be collected at the site. The Project Manager, QA/QC Officer, Monitoring Coordinator and Field Team Leader will determine the appropriateness and need for such an action.

The Project Manager and QA/QC Officer will review laboratory data for completeness as soon as possible after analysis. Data on field duplicates, lab duplicates, and other quality control measures should accompany the sample data. If discrepancies that exceed the data quality objectives are observed, re-analysis may be possible, as long as additional sample material is available and holding times have not been exceeded.

The Project Manager and QA/QC Officer using all available QC data will review the combined data set after the field collection data. Deviations will be flagged, incomplete data will be noted, and sampling staff and volunteers will be reminded that complete data logs are necessary. Calculations will be spot-checked. QC results that deviate from the data quality objectives will call the validity of the individual data or all related data into question. The final decision on whether to include or reject the data will be made by the Project Manager and QA/QC Officer and the MA DEP Project Officer.

4.2. Validation and Verification Methods

Each verifying group will examine all data for logical consistency, as presented in **Table 4.3-1**. If inconsistencies are found, an attempt will be made to determine whether the data is in error. For example, field notes taken at the time of the sampling event might indicate possible reasons for any inconsistency. Any apparent problems will be noted in the final reports as appropriate.

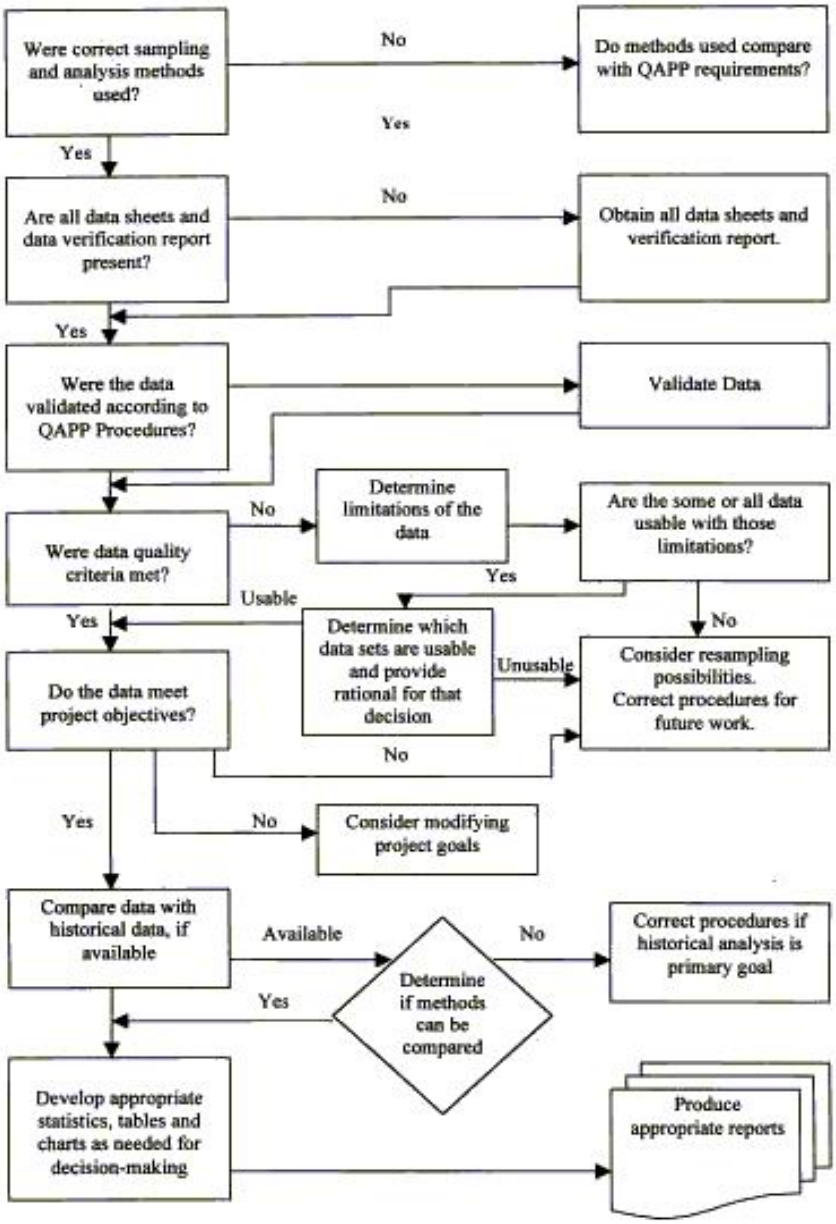
Table 4.2-1. Validation and Verification Procedures

Verifying Group	When	Activity	Possible Corrective Measures and Notification
Field Team Leader	Sampling day – when samplers turn in their data sheets, chains of custody.	Collect, review field staff field sheets for outliers, illegible data entries, missing data, etc.	Discuss with field staff. Flag problems that are not correctable. Fill in missing data.
Laboratory Project Manager	Sampling day – when samples are submitted, chains of custody, laboratory report.	Same as above for chain of custody. Check for samples that exceeded holding time, arrived in improper condition (i.e., too warm, improperly sealed).	All analytical issues will be identified and addressed by the Laboratory Area Supervisors. All sample receipt and/or analytical anomalies will be identified in the Narrative Section of the final summary report.
Monitoring Coordinator	As soon as possible after each sampling date.	Review data/ observation, field sheets, and chain of custody sheets.	Discuss any outliers or errors with other team members and correct those found.
Project Manager / QA/QC Officer	Shortly after each sampling date. When data compilation has been completed. When QC data are reported.	Compare # of QC tests performed vs. # outlined in QAPP. Compare QC test results with targets or expected values. Spot-check calculations. Check for transcription errors. Check again for outliers.	Check to see if any QC results sheets are missing. Discuss any outliers or errors with other team members and correct those found. Re-run calculations. Re-run QC tests, if possible. Flag any problems that are not correctable.

4.3. Reconciliation with Data Quality Objectives

The Project Manager and QA/QC Officer will compare the data with the objectives for precision, completeness, and accuracy provided in Section 1.7. The following data review decision tree (**Figure 4.3-1**) from the Massachusetts Volunteer Monitor's Guidebook to Quality Assurance Project Plans (October 1, 2001) will serve as the basis for evaluating the quality of project data. Necessary corrective actions will be implemented, documented and initiated by the Project Manager and QA/QC Officer. Data quality objective failures due to equipment issues will result in the reassessment of calibration and maintenance procedures, with affected data so noted.

Figure 4.3-1. Data Review Decision Tree



Appendix A

Field Team Sign-off Sheet

PROJECT PERSONNEL SIGN-OFF SHEET FOR FIELD TEAM

QUALITY ASSURANCE PROJECT PLAN
LAKE GARDNER BACTERIOLOGICAL STUDY

Name	Sampling Performed	Date

Appendix B
Figures

GENERAL NOTES

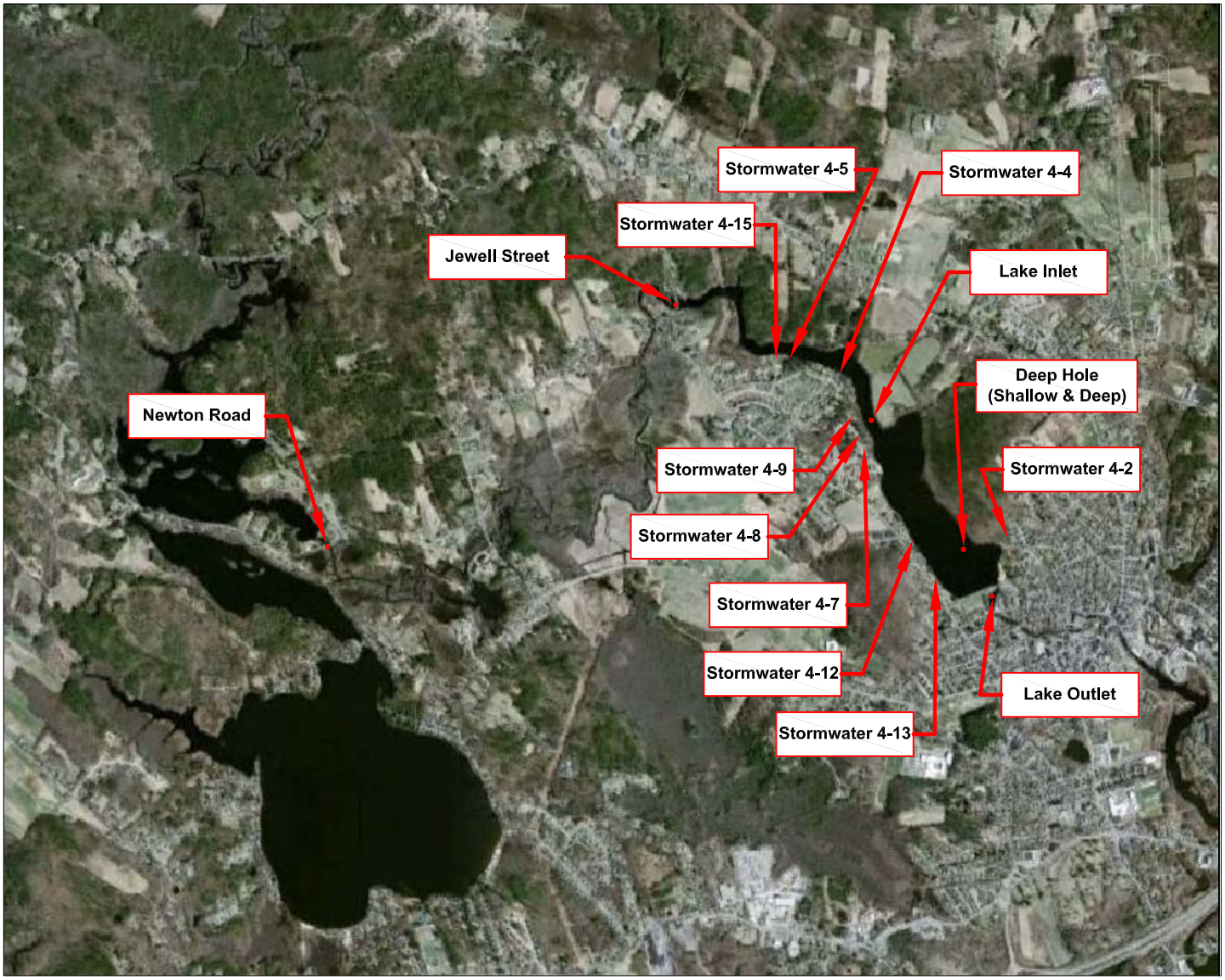
1. LOCUS MAP BASED ON USGS TOPOGRAPHY IMAGE GENERATED IN 1981 PREPARED BY THE U.S. DEPARTMENT OF THE INTERIOR AND THE U.S. GEOLOGICAL SURVEY

2. LOCUS SCALE IS APPROXIMATE

LAKE GARDNER BACTERIOLOGICAL STUDY

Figure 1.5-1:
Site Locus Map for Lake Gardner

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
21 Depot Street
Merrimack, NH 03054



3000 0 1500 3000 6000

1" = 3000'

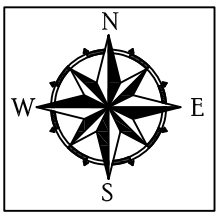
GENERAL NOTES

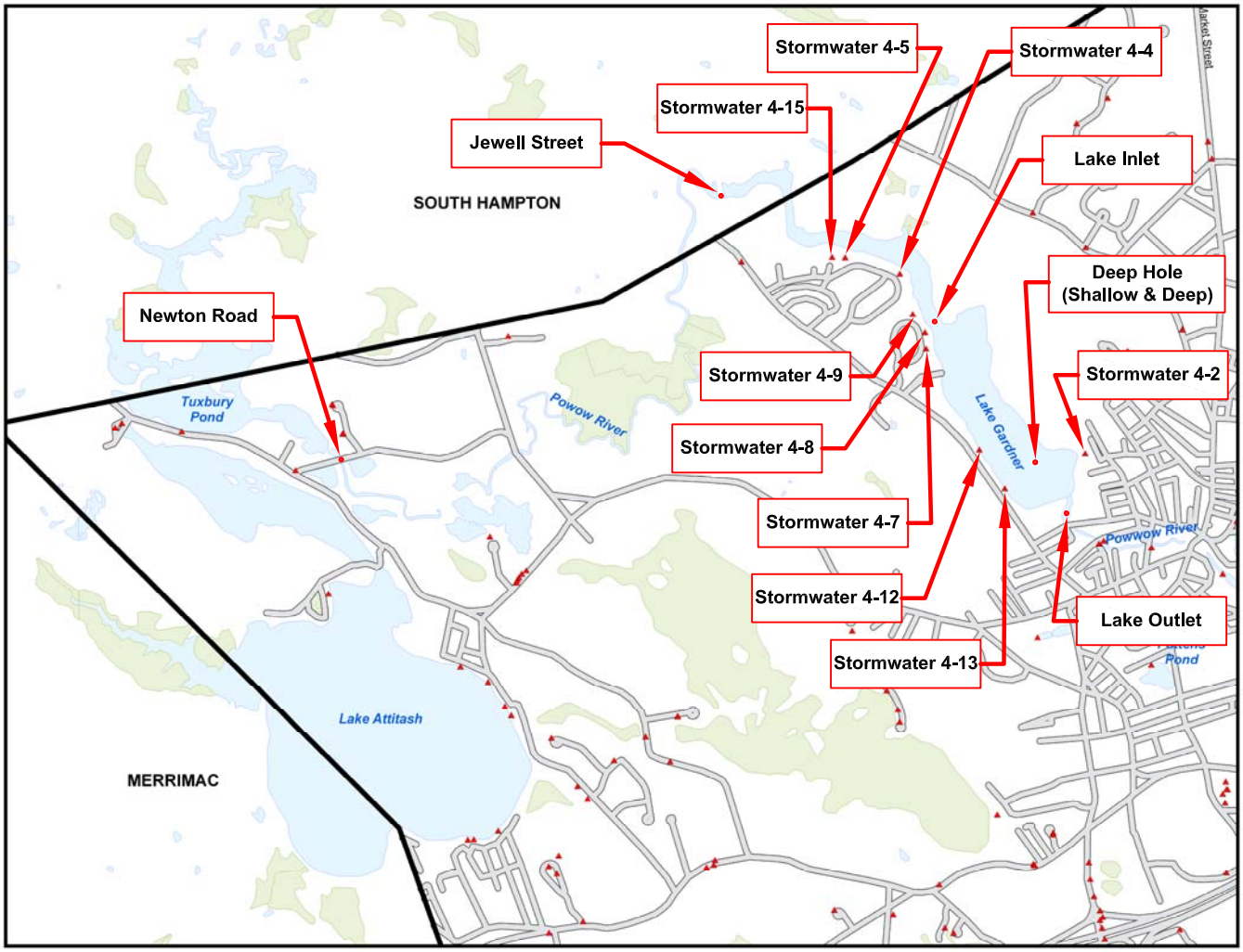
LAKE GARDNER BACTERIOLOGICAL STUDY

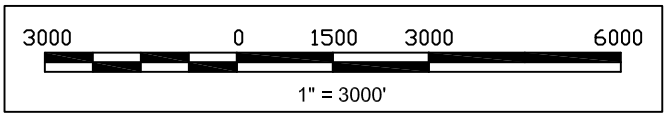
Figure 2.1-1:
Lake Gardner Sampling Locations

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

21 Depot Street
Merrimack, NH 03054







GENERAL NOTES

LAKE GARDNER BACTERIOLOGICAL STUDY

Figure 2.1-2:
Lake Gardner Sampling Locations

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
21 Depot Street
Merrimack, NH 03054

Appendix C

Field Team Training Record

FIELD TEAM TRAINING RECORD

QUALITY ASSURANCE PROJECT PLAN
LAKE GARDNER BACTERIOLOGICAL STUDY

Name	Topic or Activity(ies)	Instructor	Date	Hours

Appendix D
Field Data Sheet

Lake Gardner Field Data Sheet

Date (m/d/y):_____ Weather Today:_____ Weather over past 72 hours:_____

	Sample Name	Time of Sample	Observer Initials	Field Samples (Record the appropriate value off of the multi-meter once values have stabilized) Temperature (˚C)	pH	Dissolved Oxygen (DO) (mg/L)	Conductivity (µS/cm)	Laboratory Samples (Place a check mark in each box once the sample has been collected) T.P.	Amm.	Nitr.	Fecal	E.coli	TSS	Trbdty	Comments (record duplicate samples, GPS coordinates, unusual site conditions, issues, or other observations)
Stormwater Outfall Pipes (use multi-meter)	Stormwater 4-2														
	Stormwater 4-4														
	Stormwater 4-5														
	Stormwater 4-7														
	Stormwater 4-8														
	Stormwater 4-9														
	Stormwater 4-12														
	Stormwater 4-13														
	Stormwater 4-15														
In-lake (use multi-meter)	Deep Hole (Shallow)														
	Deep Hole (Deep)														
	Newton Road														
	Jewell Street														
	Lake Inlet														
	Lake Outlet														

Lake Outlet Flow at Dam	Flow Over Spillway?	Flow from Outlet Pipe>	Secchi Disk Reading at Deep Hole	Reading 1 (ft)	Reading 2 (ft)	Average (ft)
Flow Present at Lake Gardner Dam (observation, yes or no)			**Secchi Disk Reading** (use Secchi Disk)			

Depth to Bottom at Deep Hole	Reading 1 (ft)	Reading 2 (ft)	Average (ft)	Sediment Depth at Deep Hole	Reading 1 (ft)	Reading 2 (ft)	Average (ft)
Depth to Bottom of Lake (use Secchi Disk)				**Sediment Depth at Deep Hole** (use pole and zip ties)			

Water Column at Deep Hole	Depth 1 (ft)	Temp. (˚C)	DO (mg/L)	Depth 2 (ft)	Temp. (˚C)	DO (mg/L)	Depth 3 (ft)	Temp. (˚C)	DO (mg/L)	Depth 4 (ft)	Temp. (˚C)	DO (mg/L)	Depth 5 (ft)	Temp. (˚C)	DO (mg/L)	Comments
Depth, Temperature, and Dissolved Oxygen (use multi-meter)																

Appendix E

Sample Laboratory Label

eastern analytical, inc.
professional laboratory services

25 Chenell Drive | Concord NH 03301 | Tel: 603.228.0525 | Fax: 603.228.4591

Client Comprehensive Environmental, Inc.

Sample Name_____

Location_____

Initials_____ **Date**_____ **Time**_____

Preservative_____ **Analysis**_____

Appendix F

Chain of Custody Form

Page 1 of 2

Chain-of-Custody Record

Bold Fields Required. Please Circle Requested Analysis.

For Lab Use Only

Sample I.D.	Sampling Date/Time *If Composite, Indicate Start Date/Time	Matrix (see below)	Grab/*Composite	VOC: NH524.2 Full List / 524.2 BTEX / 524.2 / 524.2 MTBE only	VOC: NH8260B Full List / 8021B / 8260B / VTICs / 624	VOC: 8021B / BTEX / HALOS	VOC: 8015B GRO / MEGRO / MAVPH	SVOC: 8270C / ABN / 625 / A / BN / SVTICs / PAH	SVOC: TPH8100 / LI / L2	SVOC: 8015B DRO / MEDRO / MAEPH	SVOC: 608 PEST/PCB / PEST 8081A / PCB 8082	SVOC: Oil & Grease 1664 / TPH 1664	TCLP: TCLP 1311 / VOC / ABN / PEST / Metals / Herb	Metals: Dissolved Metals (List Below)	Metals: Total Metals (List Below)	Inorganics: TS / **TSS** (circled) / TDS / Spec. Con.	Inorganics: Br / NO_2 / Cl / F / **NO_3** (circled) / SO_4 / NO_2/NO_3	Inorganics: BOD / CBOD / T. Alk.	Inorganics: TKN / **NH_3** (circled) / **T. Phos.** (circled)	Inorganics: pH / T. Res. Chlorine	Inorganics: COD / Phenols / TOC	Inorganics: Total Cyanide / Total Sulfide	Inorganics: Reactive Cyanide / Flashpoint / Reactive Sulfide / Ignitability	Micro: T. Coliform / **E. Coli** (circled) / **F. Coliform** (circled)	Micro: Enterococci / Heterotrophic Plate Count	Other: **Turbidity** (circled)	Other	Other	# of Containers	Notes MeOH Vial #
Newton Road		SW	G													X	X		X X					X X		X				
Jewell Street		SW	G													X	X		X X					X X		X				
Lake Inlet		SW	G													X	X		X X					X X		X				
Lake Outlet		SW	G													X	X		X X					X X		X				
Deep Hole (Shallow)		SW	G													X	X		X X					X X		X				
Deep Hole (Deep)		SW	G													X	X		X X					X X		X				
Stormwater 4-15		SW	G													X	X		X X					X X		X				
Stormwater 4-5		SW	G													X	X		X X					X X		X				
Stormwater 4-4		SW	G													X	X		X X					X X		X				
Stormwater 4-9		SW	G													X	X		X X					X X		X				
Matrix: A-Air; S-Soil; GW-Ground Water; SW-Surface Water; DW-Drinking Water; WW-Waste water. Preservative: H-HCL; N-HNO_3; S-H_2SO_4; Na-NaOH; M-MEOH																N/A	N/A		N/A H2SO4					Na2S2O3 Na2S2O3		N/A				

Project Manager: Curt Busto

Company: Comprehensive Environmental Inc.

Address: 21 Depot Street

City: Merrimack State: NH Zip: 03054

Phone: 800-725-2550 Ext.: 304

Fax: 800-331-0892

E-Mail: cbusto@ceiengineers.com

Site Name: Lake Gardner

Project #: 175-7

State: NH **MA** (circled) ME VT Other:

Is Your Project **RGP**? Y / N

Quote #: 1007664 PO #:

Date Needed:

QA/QC Reporting Level

A **B** (circled) C

OR

MA MCP Presumptive Certainty

Reporting Options

Prelims: **Yes** (circled) or No

If Yes: Fax or **PDF** (circled)

Electronic Options

No Fax **E-Mail** (circled) PDF Equis

Temp. 4 °C

Ice? **Yes** (circled) No

Metals: 8 RCRA 13 PP Fe, Mn Pb, Cu

Other Metals:

Dissolved Metals Field Filtered? Yes No

Notes: (ie: Special Detection Limits, Billing Info, If Different)

Sampler(s):

Relinquished By: Date: Time: Received By:

Relinquished By: Date: Time: Received By:

Relinquished By: Date: Time: Received By:

Page 2 of 2

Chain-of-Custody Record

Bold Fields Required. Please Circle Requested Analysis.

For Lab Use Only

Sample I.D.	Sampling Date/Time *If Composite, Indicate Start Date/Time	Matrix (see below)	Grab/*Composite	VOC: NH524.2 Full List 524.2 / 524.2 BTEX 524.2 MTBE only	VOC: NH8260B Full List 8260B / 8021B VTICs 624	VOC: 8021B BTEX HALOS	VOC: 8015B GRO MEGRO MAVPH	SVOC: 8270C 625 SVTICs / ABN A BN PAH	SVOC: TPH8100 LI L2	SVOC: 8015B DRO MEDRO MAEPH	SVOC: 608 PEST/PCB PEST 8081A PCB 8082	SVOC: Oil & Grease 1664 TPH 1664	TCLP: TCLP 1311 ABN / VOC PEST Herb Metals	Metals: Dissolved Metals (List Below)	Metals: Total Metals (List Below)	Inorganics: TDS Spec. Con. / TS TSS	Inorganics: Br Cl F SO_4 NO_2/NO_3 / Br NO_2 NO_3	Inorganics: BOD CBOD T. Alk.	Inorganics: TKN T. Phos. / TKN NH_3	Inorganics: pH T. Res. Chlorine	Inorganics: COD Phenols TOC	Inorganics: Total Cyanide Total Sulfide	Inorganics: Reactive Cyanide Reactive Sulfide Ignitability Flashpoint	Micro: T. Coliform E. Coli / T. Coliform E. Coliform	Micro: Enterococci Heterotrophic Plate Count	Other: Turbidity			# of Containers	Notes MeOH Vial #
Stormwater 4-8		SW	G													X	X		X X					X X			X					
Stormwater 4-7		SW	G													X	X		X X					X X			X					
Stormwater 4-12		SW	G													X	X		X X					X X			X					
Stormwater 4-13		SW	G													X	X		X X					X X			X					
Stormwater 4-2		SW	G													X	X		X X					X X			X					
Matrix: A-Air; S-Soil; GW-Ground Water; SW-Surface Water; DW-Drinking Water; WW-Waste water Preservative: H-HCL; N-HNO_3; S-H_2SO_4; Na-NaOH; M-MEOH																N/A	N/A		N/A H2SO4					Na2S2O3 Na2S2O3		N/A					

Project Manager: Curt Busto
Company: Comprehensive Environmental Inc.
Address: 21 Depot Street
City: Merrimack State: NH Zip: 03054
Phone: 800-725-2550 Ext.: 304
Fax: 800-331-0892
E-Mail: cbusto@ceiengineers.com
Site Name: Lake Gardner
Project #: 175-7
State: NH (MA) ME VT Other:
Is Your Project **RGP**? Y / N
Quote #: 1007664 PO #:

Date Needed:

QA/QC Reporting Level
A (B) C
OR
MA MCP
Presumptive Certainty

Reporting Options
Prelims: (Yes) or No
If Yes: Fax or (PDF)

Electronic Options
No Fax (E-Mail) PDF Equis

Temp. 4 °C
Ice? (Yes) No

Sampler(s):

Relinquished By:	Date:	Time:	Received By:
Relinquished By:	Date:	Time:	Received By:
Relinquished By:	Date:	Time:	Received By:

Metals: 8 RCRA 13 PP Fe, Mn Pb, Cu

Other Metals:

Dissolved Metals Field Filtered? Yes No

Notes: (ie: Special Detection Limits, Billing Info, If Different)

eastern analytical, inc.
professional laboratory services
25 Chenell Drive | Concord, NH 03301 | Tel: 603.228.0525 | 1.800.287.0525 | Fax: 603.228.4591 | E-Mail: customer_service@eailabs.com | www.eailabs.com

(White: Original Green: Project Manager)

Appendix G

Field Standard Operating Procedures (SOPs)

Sampling Standard Operating Procedure (SOP)

Sampling / Monitoring Procedures for

Observations and Field Records
In-Lake Surface Sample Collection
Secchi Disk Reading
Lake Depth Determination
In-Lake Bottom Sample Collection
In-Lake YSI Multi-meter Monitoring
In-Lake Sediment Depth Estimation
Storm Drain Outfall Sample Collection
Storm Drain Outfall YSI Multi-meter Monitoring
Sample Event Completion
Sample Delivery

Project Contacts

Comprehensive Environmental – Phone: 800-725-2550
Curt Busto (Project Manager & Technical Advisor), x304
Nicholas Cristofori (QA/QC Officer & Technical Advisor), x303
Scott Salvucci (Monitoring Coordinator), x314

Lake Gardner Improvement Association – Phone: 978-388-5045
Bruce Georgian (Field Team Leader)

Eastern Analytical Inc. – Phone: 800-287-0525
Kathleen Noonan (Laboratory QA Officer)

Town of Amesbury – Phone: 978-388-8100
Robert Desmarais (Project Manager & Grant Recipient)

MA DEP – Phone: 617-292-5500
Gary Gonyea (MA DEP Project Officer) 617-556-1152
Richard Chase (MA DEP QA Officer) 508-767-2859

EPA – 617-918-8312
Mary Jo Feuerbach (U.S. EPA Project Officer)
John Smaldone (U.S. EPA QA Officer)

Emergency Contacts

Amesbury Police – Phone: 978-388-1217

Amesbury Fire Department – Phone: 978 388 1333

Anna Jaques Hospital – Phone: 978-463-1000

Sampling Process

The goal of this project is to collect water quality data in-lake and at storm drain outfalls to help identify pollution sources, prioritize efforts, and plan for future water quality improvement projects in an effort to reduce the number of beach closures, algal blooms, sedimentation, and the spread of nuisance aquatic weeds.

Several in-lake and storm drain outfall sampling locations were selected to provide a water quality profile in the Lake Gardner watershed between the outlet of Tuxbury Pond and the outlet of Lake Gardner. The combination of sample locations will best quantify the magnitude and type of stormwater impacts in Lake Gardner.

This Standard Operating Procedures (SOP) will be used as a guide for proper procedures when making field observations, sampling and handling, managing data, and completing quality control measures. The Field Sampling Team will complete all fieldwork and sampling of the twelve sampling locations identified in Figures 2.1-1 and 2.1-2 in the QAPP.

Dry weather samples will only be collected when the following conditions are met:

- Sampling must be preceded by 72 hours of dry weather. The NOAA: National Weather Service Website will be used current weather conditions and forecasts.
- Field Sampling Team has reviewed all relevant safety issues.
- Field Sampling Team has reviewed proper procedures when completing field data sheets.
- Field Sampling Team has reviewed how to operate field equipment.
- Field Sampling Team has reviewed sampling techniques and procedures when transferring samples to the laboratory.

Wet weather samples will only be collected when the following conditions are met:

- Sampling must be preceded by 72 hours of dry weather. The NOAA: National Weather Service Website will be used current weather conditions and forecasts.
- Storm events that are anticipated to generate >0.5” of precipitation in a 24-hr period.
- Field Sampling Team has reviewed all relevant safety issues.
- Field Sampling Team has reviewed proper procedures when completing field data sheets.
- Field Sampling Team has reviewed how to operate field equipment.
- Field Sampling Team has reviewed sampling techniques and procedures when transferring samples to the laboratory.

Field Activities

Field sampling activities will include boating or walking to the sampling location, depth measurements (if applicable), multi-meter monitoring, sample collection, sample preservation and transport. Sample collection will be during daylight hours generally between 7 AM and 5 PM, 7 days a week. Eastern Analytical accepts samples 8 AM to 5 PM Monday through Friday and outside of office hours with advanced notice. The Monitoring Coordinator will coordinate sample dates and times with Eastern Analytical Inc. in advance and immediately preceding the sampling event. All samples will be grab samples.

The following field sampling will take place:

Indicator	Sites[1]	Sample Location
Wet Weather: Two sampling rounds with storm events that generate >0.5" of precipitation in a 24-hr period and no rain 72 hrs prior to sampling. Weather reporting will be obtained from the NOAA: National Weather Service website.		
1. Temperature 2. Dissolved Oxygen 3. pH 4. Conductivity 5. Ammonia Nitrogen 6. Nitrate Nitrogen 7. Fecal Coliform 8. *E.coli* 9. Total Suspended Solids 10. Turbidity 11. Total Phosphorus	Stormwater 4-2	Orchard Court
	Stormwater 4-4	Unicorn Circle near Barbara Drive intersection
	Stormwater 4-5	Unicorn Circle
	Stormwater 4-7	Nancy Drive
	Stormwater 4-8	Nancy Drive
	Stormwater 4-9	Nancy Drive
	Stormwater 4-12	Whitehall Road
	Stormwater 4-13	Whitehall Road
	Stormwater 4-15	End of Whitehall Lake Drive
Dry Weather: Three sampling rounds with no rain 72 hrs prior to sampling. Weather reporting will be obtained from the NOAA: National Weather Service website.		
1. Temperature 2. Dissolved Oxygen 3. pH 4. Conductivity 5. Ammonia Nitrogen 6. Nitrate Nitrogen 7. Fecal Coliform 8. *E.coli* 9. Total Suspended Solids 10. Turbidity 11. Total Phosphorus	Newton Road	Powow River upstream of the Newton Road culvert
	Jewell Street	Powow River upstream of the Jewell Street culvert
	Lake Inlet	Powow River at discharge point to Lake Gardner
	Lake Outlet	Powow River at the just below Lake Gardner dam
	Deep Hole (Shallow)	Approximate center of Lake Gardner, at surface
	Deep Hole (Deep)	Approximate center of Lake Gardner, at bottom
Depth to Bottom	Deep Hole (Deep)	Approximate center of Lake Gardner, at bottom
Depth of Sediment	Deep Hole (Deep)	Approximate center of Lake Gardner, at bottom
Secchi Reading	Deep Hole (Deep)	Approximate center of Lake Gardner, at bottom
1. Temperature 2. Dissolved Oxygen (DO)	Deep Hole (Shallow and Deep)	Throughout water column at Deep Hole station

1. See Figures 2.1-1 and 2.1-2 in Appendix B for sampling locations.

In addition to sampling outlined above, two duplicate samples will be collected for each indicator per sampling round, one at a stormwater outfall and one at an in-lake surface location. Additionally, one blank filled with distilled water will be collected to verify that proper rinse water was used on sampling equipment. The following procedures were developed to ensure that data collection remains consistent and accurate throughout the project.

Communications and Sampling Initiation

The Monitoring Coordinator is designated to determine when proper weather conditions have been met before sampling takes place. If weather conditions are met, the following procedures will take place:

1. The Field Team Leader and Monitoring Coordinator will monitor expected weather conditions from appropriate sources, including anticipated rainfall throughout the sampling period.
2. Should appropriate wet or dry weather conditions be expected, the Field Team Leader will contact each member of the Field Sampling Team to confirm availability and arrange for a meeting prior (e.g., main beach) to beginning any fieldwork.
3. The Sampling Coordinator will contact Eastern Analytical, Inc. to inform them when the sampling event will take place and when to pick-up/drop off the samples.
4. The Field Sampling Team will meet, if necessary, to discuss last minute instructions.
5. The Field Sampling Team will be assigned predetermined locations to conduct sampling activities; however, this may vary by sampling event based on the availability of team members.
6. The Field Team Leader will distribute all necessary equipment to sampling teams including sampling maps, field data sheets, sample containers, distilled water, coolers, ice, sampling equipment, and safety equipment (see attached field supply and equipment checklist).

Special Training Requirements

The Monitoring Coordinator will provide appropriate training to the Field Team Leader and Field Sampling Team prior to the first sampling event and assess field monitoring performance during sampling events. The Monitoring Coordinator will visit each sample location to become familiar with the procedures at each location for training the field sampling team.

Training will include sample collection and documentation, QAPP review, and a dry run of the sampling event. The QAPP and other sampling references will be available prior to and during all sampling events. The Field Team Leader will be directly involved in sampling activities during each sampling event for the project and will be available to assist members of the Field Sampling Team as needed.

Field Equipment Preparation

Preparation of field equipment necessary for collecting stormwater samples will occur prior to the sampling event. All maintenance and repairs to the equipment will be completed at this time to prevent any impediment of the fieldwork. Field preparation is as follows:

Equipment Type	Inspection Frequency	Type of Inspection	Available Parts	Maintenance Frequency
YSI 556MPS Multi-meter	Prior to each sampling event	Working order, integrity, cleanliness, and properly calibrated according to manufacturer specifications.	Spare batteries.	Annually or as needed.
Surface Sampler	Prior to each sampling event	Instrument is clean.	Spare sampler.	Annually or as needed.
Extendable Swing Sampler	Prior to each sampling event	Instrument is clean; extension mechanism is working correctly.	Spare sampler.	Annually or as needed.

Equipment Type	Inspection Frequency	Type of Inspection	Available Parts	Maintenance Frequency
Wisconsin Sampler	Prior to each sampling event	Instrument is clean; mechanism is working correctly.	Spare sampler.	Annually or as needed.
Secchi Disk	Prior to each sampling event	Working order, integrity, cleanliness, and properly calibrated according to manufacturer specifications.	Spare sampler.	Annually or as needed.
Pole and zip ties	Prior to each sampling event	Instrument is clean.	None necessary.	Annually or as needed.
GPS Unit	Prior to each sampling event	Working order, integrity, and cleanliness	None necessary	Annually or as needed.
Cooler	Prior to each sampling event	Cooler is clean; ice packs.	None necessary.	Annually or as needed.
Boat, motor, life vests, gas, oars.	Prior to each sampling event	Boat is seaworthy, motor in working order, emergency equipment present.	Gasoline for motor	Annually or as needed.

Field Equipment Calibration

Procedures for calibrating the YSI Multi-meter are included in the QAPP as Appendix J. Calibration of the YSI meter and Secchi Disk will be performed at the beginning of the sampling season to check for line shrinkage or stretching as described below:

1. Attach a cloth tape measure to the bottom of the line
2. Lower the Secchi Disk off of an elevated platform such as a deck
3. Feed the tape measure so that it is taunt
4. Compare the reading on the tape measure with the line reading
5. If they do not agree, Secchi Disk readings may have to be adjusted accordingly, or the unit replaced

Inspection / Acceptance Requirements for Supplies and Consumables

Field Sampling Team members will inspect field supplies and consumables prior to use. The Field Team Leader will obtain sample bottles from the laboratory prepared with the appropriate preservations prior to the sampling event. Sample bottles will be needed for each of the twelve sampling locations, sample duplicate, plus extras. Sample bottles will be checked prior to use for cracks, leaks, and potential contamination. Should any bottle be deemed inadequate, it will be appropriately discarded. Back-up sample containers will be available during each sampling event. Distilled water will be obtained from a source of known quality and stored in appropriately labeled containers. Distilled water containers will be inspected in the same manner as the sample bottles and discarded if contamination occurs.

Observations and Field Records

Field Data Sheets will be completed on-site at the time of sampling and monitoring and will be provided to each field team. The Field Team Leader will collect field sheets at the sample drop-off location and will include the following information:

- Site name and location
- Names of field team personnel
- Sample date/time collection
- Weather conditions
- Site observations
- QA/QC issues

Field data sheets are included in Appendix D of the QAPP.

Initial Sampling/Monitoring Procedures

Field Teams will proceed to assigned locations and begin the following procedures. The following information should be recorded on the field sheet for each sampling location:

- Date
- Weather conditions.
- Any observations according to field sheet footnote instructions.

If assigned to in-lake stations, proceed to Dry Weather Sampling/Monitoring Procedures, In-Lake Surface Sample Collection instructions. If assigned to stormwater outfall stations, proceed to Wet Weather Sampling/Monitoring Procedures, Storm Drain Outfall Sample Collection instructions.

Dry Weather Sampling/Monitoring Procedures

Sampling crews will be deployed to collect water quality samples from each location. One crew will collect samples from the Lake Inlet and Deep Hole stations via a boat during dry weather. A second crew will collect samples from the Newton Road, Jewell Street, and Lake Outlet from land during dry weather. This crew will also sample any other dry weather inputs found discharging to the lake.

In-Lake Surface Sample Collection

Samples will be collected for Total Phosphorus (TP), ammonia nitrogen, nitrate nitrogen, fecal coliform, *E.coli*, Total Suspended Solids, and turbidity. Surface sample collection will take place with the use of a surface sampler. One set of duplicate samples will be collected during each sampling event at one of the surface locations. The following protocol will be followed for collecting in-lake surface samples at stations Newton Road, Jewell Street, Lake Inlet, Lake Outlet, and Deep Hole (Shallow) using a surface sampler:

1. If performing sampling at the Lake Outlet, note presence or absence of flows from dam spillway and/or dam outlet pipe.
2. If performing sampling at the Deep Hole station for the first time, record GPS coordinates on the field sheet. If returning for subsequent visits, maneuver the boat until the location matches the GPS coordinates.
3. Put on disposable/sterile gloves.
4. Attach bottle to surface sampler.
5. Insert sampler into water at an approximate depth of 8 inches (slightly below surface).
6. Fill sampling container to shoulder of bottle and remove, taking care not to spill any preservatives contained in the bottle. Do not fill and empty containers as some contain preservative (pre-preserved from laboratory); do not fill bottles to top of neck.
7. Close lid tightly.
8. Record the required information for the collected sample onto the laboratory bottle label and the field data sheet.

9. Place laboratory bottle in cooler containing ice and keep cooler lid closed to maintain cool temperature and darkness.
10. Record any additional observations or deviations in the sampling procedures while collecting the sample.
11. Repeat steps 2 through 8 for the remaining bottles.
12. If collecting a duplicate, collect the sample from the same location in the same manner as outlined in steps 2 through 8. Record the word "duplicate" on the sample bottle and make note of this duplicate location on your sample sheet.

Note that all sample containers are laboratory pre-preserved and/or sterilized by Eastern Analytical, Inc. If at Deep Hole (Shallow) station, proceed to Secchi Disk Reading. Otherwise, proceed to In-Lake YSI Multi-meter Monitoring.

Secchi Disk Reading

A Secchi Disk reading will be taken at the Deep Hole station to estimate water clarity. The following protocol will be followed:

1. Check to make sure that the Secchi Disk is securely attached to the measured l ine
2. Lower the Secchi Disk into the water on the shady side of the boat
3. Lower the disk until it disappears from view, then slowly raise the disk until it juse reappears.
4. Move the disk up and down until the exact vanishing point is found
5. Note the point where the line enters the water. Record the measurement on the data sheet.
6. Repeat steps 1 through 5.
7. Readings must be within 0.1 foot of each other. Average of two readings is final reading.

Proceed to Lake Depth Determination instructions.

Lake Depth Determination

Depth will be determined through the use of the calibrated Secchi Disk. The following protocol will be followed:

1. Lower Secchi Disk until disk hits the bottom and the line goes slack.
2. Retrieve line until all slack is removed.
3. Read depth on line at lake surface.
4. Record depth on field sheet.
5. Repeat steps 1 through 4.
6. Readings must be within 0.1 foot of each other. Average of two readings is final reading.

Proceed to In-Lake Bottom Sample Collection instructions.

In-Lake Bottom Sample Collection

Samples will be collected for Total Phosphorus (TP), ammonia nitrogen, nitrate nitrogen, fecal coliform, *E.coli*, Total Suspended Solids, and turbidity. Bottom depth samples should be taken approximately six to eight inches above the bottom to avoid collecting a sample with sediment present. Bottom sample collection at station Deep Hole (Deep) will take place with the use of a Wisconsin Sampler. The following protocol will be followed:

1. Put on disposable/sterile gloves.
2. Thoroughly rinse the inside of the Wisconsin Sampler (WS) 3 times with distilled water, taking care to cover all surfaces. When done, empty all distilled water from inside the sampler.
3. Wait approximately three minutes to allow bottom sediment to settle. Prepare WS for deployment.
4. Lower WS to desired depth using the calibrated line on the WS being careful not to hit the bottom.
5. Once this depth has been reached, send messenger/weight down to activate mechanism for WS closure.
6. Slowly retrieve sampler and place in vessel.
7. Fill all bottom sample containers to shoulder of bottle from the WS starting with the bacteria bottles to minimize contamination potential (same aliquot) , taking care not to spill any preservatives contained in the bottle. Do not fill and empty containers as some contain preservative (pre-preserved from laboratory); do not fill bottles to top of neck.
8. If there is not enough to fill all sample bottles, repeat steps 2 through 6 for non-bacteria bottles.
9. Fill a bottle marked “blank” with distilled water.
10. Close all lids tightly.
11. Record the required information for the collected sample onto the laboratory bottle label and the field data sheets.
12. Place laboratory bottle in cooler containing ice and keep cooler lid closed to maintain cool temperature and darkness.
13. Record any additional observations or deviations in the sampling procedures while collecting the sample.
14. Thoroughly rinse the inside of the Wisconsin Sampler (WS) 3 times with distilled water, taking care to cover all surfaces. When done, empty all distilled water from inside the sampler.

Note that all sample containers are laboratory pre-preserved and/or sterilized by Eastern Analytical, Inc. Proceed to In-Lake YSI Multi-meter Monitoring.

In-Lake YSI Multi-meter Monitoring

The YSI Multi-meter will be used to measure temperature, pH, dissolved oxygen (DO), and conductivity. In-lake stations will be sampled at the surface and at two-foot intervals throughout the water column (if applicable). Field measurements will take place with the use of a YSI 556MPS Multi-meter. The following protocol will be followed:

1. Remove multi-meter from case. Thoroughly rinse probe end with distilled water.
2. Turn unit on by pressing ON/OFF KEY or select Run from the main menu to display the run screen.
3. Make sure the probe sensor guard is installed.
4. Place the probe module in the water, at surface so that all sensors are submerged (approximately 8 inches into water).
5. Watch the readings on the display until they are stable.
6. In the event that the YSI meter is unable to obtain a stable reading due to excessive turbulence, etc., rinse the inside of the Wisconsin Sampler 3 times with distilled water, taking care to cover all surfaces. When done, empty all distilled water from inside the sampler. Fill the sampler with sample water and immediately record all YSI data once readings have settled.
7. Record time, temperature, pH, dissolved oxygen, and conductivity on the field sheet until all parameter readings have been recorded at this water level.
8. If performing readings of temperature and dissolved oxygen throughout the water column at the "deep hole" station, lower multi-meter to two feet deep and repeat above steps 4 through 6 for temperature and DO. Continue to lower multi-meter at two-foot intervals until bottom location is reached. Otherwise proceed to Step 9.
9. Take bottom reading approximately six to eight inches above bottom sediment. Do not let multi-meter touch the bottom to avoid sediment being disturbed.
10. Rinse probe end three times with distilled water.
11. Return unit to case.

Proceed to In-Lake Sediment Depth Estimation.

In-Lake Sediment Depth Estimation

LGIA volunteers will make an estimate of the depth to sediment at the bottom of the Deep Hole station. The depth estimate will be made utilizing a thin metal or plastic pole with zip-ties that fits snugly around the pole. The following protocol will be followed:

1. Lower the rod until the assembly just hits the bottom.
2. Upon reaching the bottom, secure a zip-tie around the pole at the water surface. This zip-tie will mark the surface of the depth to the top of sediment (i.e. depth of water).
3. Firmly push on the top of the rod, thereby driving the rod downward into the sediment. Note that the zip-tie will now be submerged.
4. Secure a second zip-tie at the water surface.
5. Slowly withdraw the rod assembly up through the water column, taking care not to move either zip-tie.
6. Upon reaching the surface, measure the distance between each zip-tie with a measuring tape.
7. Record this distance on the field sheet. This distance is the thickness of sediment at the bottom of the lake.
8. Repeat steps 1 through 7.

9. Readings must be within 0.01 foot of each other. Average of two readings is final reading.
10. Record any additional observations or deviations in the sampling procedures while collecting the sample.
11. Securely stow the assembly in the boat.

Proceed to Sample Event Completion.

Wet Weather Sampling/Monitoring Procedures

The nine stormwater outfalls will be sampled by a total of three crews during wet weather. After coordination with the Monitoring Coordinator and Field Team Leader, crews will be stationed at their first location at the start of the storm. Sampling will commence ten minutes after the start of flow is observed to approximately capture the first flush. Crews will be broken up according to the following stations:

Crew 1: Stormwater 4-4, 4-5, and 4-15
Crew 2: Stormwater 4-7, 4-8, and 4-9
Crew 3: Stormwater 4-12, 4-13, and 4-2

Storm Drain Outfall Sample Collection

Samples will be collected for ammonia nitrogen, nitrate nitrogen, fecal coliform, *E.coli*, Total Suspended Solids, and turbidity. Outfall sample collection will take place by hand or with the use of a surface sampler or extendable swing sampler. The following protocol will be followed:

1. Place road safety cone on either side of sampling locations if necessary.
2. Put on disposable/sterile gloves.
3. If necessary, attach bottle to surface sampler.
4. Hold sample bottle below outlet pipe; place in the center of stormwater flow. Do not allow sample bottle to contact pipe.
5. Fill sampling container to shoulder of bottle and remove, taking care not to spill any preservatives contained in the bottle. Do not fill and empty containers as some contain preservative (pre-preserved from laboratory); do not fill bottles to top of neck.
6. Close all lids tightly.
7. Record the required information for the collected sample onto the laboratory bottle label and the field data sheet.
8. Place laboratory bottle in cooler containing ice and keep cooler lid closed to maintain cool temperature and darkness.
9. Record any additional observations or deviations in the sampling procedures while collecting the sample.
10. Repeat steps 2 through 8 for the remaining bottles.
11. If collecting a duplicate, collect the sample from the same location in the same manner as outlined in steps 2 through 8. Record the word “duplicate” on the sample bottle and make note of this duplicate location on your sample sheet.

Proceed to Storm Drain Outfall YSI Multi-meter Monitoring

Storm Drain Outfall YSI Multi-meter Monitoring

The YSI Multi-meter will be used to measure temperature, pH, dissolved oxygen (DO), and conductivity. Stormwater stations will be sampled in the center of stormwater flow. Field measurements will take place with the use of a YSI 556MPS Multi-meter. The following protocol will be followed:

1. Remove multi-meter from case. Thoroughly rinse probe end with distilled water.
2. Turn unit on by pressing ON/OFF KEY or select Run from the main menu to display the run screen.
3. Make sure the probe sensor guard is installed.
4. Place the probe module in the center of stormwater flow so that sensors are submerged.
5. Watch the readings on the display until they are stable.
6. In the event that the YSI meter is unable to obtain a stable reading due to excessive turbulence, etc., rinse the inside of the Wisconsin Sampler 3 times with distilled water, taking care to cover all surfaces. When done, empty all distilled water from inside the sampler. Fill the sampler with sample water and immediately record all YSI data once readings have settled.
7. Record time, temperature, pH, dissolved oxygen, and conductivity on the field sheet until all parameter readings have been recorded at this water level.
8. Rinse probe end three times with distilled water.
9. Return unit to case.

Proceed to Sample Event Completion.

Sample Event Completion

At the completion of the above sampling activities, the following steps should take place to complete the sampling/monitoring event.

1. Report back to the Field Team Leader at the designated meeting point.
2. Turn over all coolers containing samples, sampling equipment, data sheets/notes, safety equipment etc. to Field Team Leader.
3. Discuss any QA/QC issues and other extraordinary events that may have taken place during the sampling/monitoring event.

Field Team Leader proceed to Sample Delivery.

Sample Delivery

The following will take place to ensure proper sample delivery within the required holding time:

1. Fill out Chain of Custody (COC) form for Eastern Analytical, Inc.
2. Prepare cooler with total phosphorous, ammonia nitrogen, nitrate nitrogen, fecal coliform, *E.coli*, Total Suspended Solids, and turbidity for Eastern Analytical Inc. for courier pick-up; sign COC when courier arrives and surrender coolers; keep copy of COC for final report.

3. Finally, note any QA/QC issues or modifications to the QAPP for discussion with QA/QC Officer and technical advisory team.

Appendix H

Analytical Laboratory Supporting Documentation

eastern analytical, inc.

professional laboratory services

Eastern Analytical, Inc.
25 Chenell Drive
Concord, NH 03301
(603) 228-0525

Quality Assurance Quality Control Manual
For Laboratory Operations

Revision 6
Effective Date: March 21, 2006
Replaces Manual Effective February 2, 2004

Approved By:	Title	Date
Lorraine Olashaw	Lorraine Olashaw, Laboratory Director	3.13.06
Kathleen E. Noonan	Kathleen Noonan, QA Coordinator	3-13-06
Michael Serard	Michael Serard, Operations Manager	3-13-06
Vangie Giotas	Vangie Giotas, VOC Manager	3/14/06
Timothy Schaper	Timothy Schaper, IT/SVOC Manager	3/13/06
Katharine G. Lane	Katharine Lane, Microbiology Manager	3.13.06

Table of Contents
Eastern Analytical, Inc.
Quality Assurance/Quality Control Manual

1 Introduction

1.1 Overview

Eastern Analytical, Inc. (EAI), located in Concord, New Hampshire, is a professional organization offering the following technical services:

- Chemical, microbiological and physical analysis of environmental and industrial samples
- Sample collection
- Technical consultation
- Field services including soil and groundwater sampling
- Soil vapor surveys
- Mini well installations
- Geoprobe
- Field equipment rentals

1.2 Clientele and Scope

The majority of EAI's work is generated by industries, engineering companies, municipalities, public water supplies and state agencies. Analyses provided by EAI include microbiology, metals, inorganic analytes and anions, volatile organic compounds, gasoline range organics (GRO), solvents, phenols, PCBs, TPH, diesel range organics (DRO) and acid and base/neutral compounds. Sample matrices include drinking water, wastewater, industrial waste, soil, sludge, soil vapor, oil, hazardous waste, air, and biological materials. EAI's field service department provides a variety of sample collection procedures, gas monitoring, field data and equipment rentals.

1.3 Quality Philosophy

Eastern Analytical, Inc. is a 100% employee owned company. As stakeholders, each employee strives to provide the highest level of service and quality to the client and is committed to continuous improvement in all areas of our business. As our company values state, EAI operates with the philosophy that the safety of our employees, the quality of our service and the commitment to the needs of our clients are our primary objectives. EAI provides customers accurate and reliable results in a timely and professional manner. To accomplish our objectives, the personnel at EAI are dedicated to increasing and improving their skills and knowledge. By integrating innovative, dedicated and integrity driven personnel with advanced technology and systems, EAI operates within our values and continues to meet our commitment of providing quality services to our customers. We remain committed to customer success for our success comes only after each of our customers succeeds.

1.4 Facility

EAI was incorporated in December of 1980 and since March of 1995 has been located in a 12,000 square foot facility located at 25 Chenell Drive, Concord, NH. The modern laboratory facility has a functional and efficient layout. The current facility includes an inorganics lab, an extractions lab, a segregated volatiles lab, a receiving lab, a waste room and office areas. This facility is large enough to accommodate future growth with an additional 8,000 square feet of expansion

potential. Also on the grounds is a garage with office space which houses our Field Services department. The first floor of the garage consists of approximately 800 sq. ft. of heated garage/workshop space and 400 sq. ft. of furnished office space. The second floor has approximately 600 sq. ft. of cold storage and serves as a storage area for EAI's records.

1.5 Certification

One of EAI's primary goals is to acquire and maintain certification for all analytes for which we offer testing.

1.5.1 NELAC Accreditation

EAI is a NELAC accredited laboratory. EAI holds primary accreditation status from NH ELAP. Requirements are as follows:

1.5.1.1 Once every two years, the NHELAP accreditation staff performs an on-site visit, inspection and evaluation of EAI's facilities, personnel and procedures. The results of this audit may be used by other state agencies to grant certification.

1.5.1.2 Twice per year, successful analysis of blind performance evaluation samples is required. An approved Proficiency Test (PT) Provider supplies the samples, per program, for the analyses for which EAI maintains accreditation.

1.5.1.3 Copies of NELAC Accreditation are posted in the front office.

1.5.1.4 Methods certified under NELAC are listed in Appendix A. Copies of our accreditation can also be found online at our website at www.eailabs.com.

1.5.2 In-State Certification

Through NELAC, EAI maintains certification in the State of New Hampshire. A list of methods performed by EAI is included in Appendix A. The specific methods for which EAI maintains accreditation are noted in Appendix A.

1.5.3 Out-of-State Certification

For work that EAI performs outside of New Hampshire certification is acquired and maintained through reciprocity. Other states in which EAI has earned certification or approval are Massachusetts, Connecticut, Maine, Vermont, and Rhode Island.

1.5.4 Ohio VAP

1.5.4.1 EAI is in the process of attaining certification through the state of Ohio. Our website will be updated to include this certification once the certification process has been successfully completed.

1.6 Objectives of the QA/QC Program

EAI operates a QA/QC program that is overseen by the QA Coordinator. The main objective of this program is to support the data and quality objectives of all work performed at EAI. The program is designed to ensure the following:

1.6.1 The analytical data produced by EAI is in compliance with our approved QA Manual and SOPs.

1.6.2 The analytical data produced by EAI meets the requests and requirements of our customers.

1.6.3 The analytical data produced by EAI meets the requirements of EAI's certifying agencies.

1.6.4 The employees of EAI are trained in the objectives of the QA/QC Program and are free to perform their responsibilities in accordance with the Program.

1.6.5 The employees of EAI understand that when the policies and procedures as outlined in the QA/QC Program cannot be met, their Supervisor, QA Coordinator, Lab Director or the President must be informed. Under no conditions are the policies and procedures to be violated without the written approval from the Supervisor, QA Coordinator, Lab Director or President. Exceptions to procedures will only be granted with full customer knowledge and complete documentation regarding the quality objectives that were met.

1.7 The QA Manual

The objective of the QA Manual is to provide standards and guidance for all aspects of the Quality Assurance program at EAI.

1.7.1 The QA Manual will be reviewed annually by the QA Coordinator and the QA committee.

1.7.2 If changes are necessary then the document will be updated and saved under a name that includes the year of revision. All revisions will include an effective date and documentation of the manual that is being replaced.

1.7.2.1 Revisions of the Appendices are independent of QA Manual revisions. An Appendix revision will include a revision date on all pages. This type of revision will not necessitate a new revision number of the QA Manual.

1.7.3 The QA committee will review and comment on all changes.

1.7.4 When the revision is complete an original will be printed and signed by the Lab Director, the QA Coordinator and the Department Managers. Copies will be prepared and distributed to the staff. Past revisions will be collected and discarded.

1.7.5 Staff members are required to complete the sign-off form (Appendix C) after reading the revised QA Manual. The QA Coordinator keeps these forms on file.

1.7.6 The QA Coordinator will keep one hard copy and one electronic copy of all revisions on file.

2 Personnel

2.1 The employees at EAI are committed to performing their responsibilities in accordance with the standard operating procedures and quality assurance program. Each employee at EAI has responsibility for insuring consistent performance and compliance with the SOPs and QA Manual. All employees also take responsibility for insuring that the QA Manual continues to balance the needs of all stakeholders of EAI.

2.2 Roles and Responsibilities

2.2.1 The President is ultimately responsible for the quality and performance of EAI. The President provides the necessary leadership to assure that the standards within the Quality Assurance Program are met. The President is responsible for assuring that any employee who feels undue pressure in performing their work in accordance with this Program is free to discuss those issues. The President implements the formal QA Program through the QA Coordinator and the Lab Director.

2.2.2 The Laboratory Director(s) is responsible for the overall management of laboratory operations. The Laboratory Director along with the QA Coordinator insures that the QA manual is updated on an annual basis and is revised as necessary to accurately reflect operations. It is the responsibility of the Lab Director to work with the QA Coordinator and department managers to ensure that the objectives of the QA program are met along with client specific QAPPs (Quality Assurance Project Plan). The Laboratory Director has responsibility for insuring that the laboratory is current with approved methodologies and regulations. The Laboratory Director has final sign off authority for the release of analytical data to customers, and approves and signs off on all QA Manual revisions. The Laboratory Director also performs customer service as necessary. In case of absence, the Laboratory Director will nominate a qualified representative to handle responsibilities.

2.2.3 Department Managers/Supervisors (also known as Technical Directors) have primary responsibility for assuring that the daily operations of their departments are performed in compliance with the QA Manual and SOPs. Department Managers insure that approved SOPs reflect current operations, document deviations from the referenced method, and are available to all employees. In addition, the Department Managers actively participate in lab wide QA/QC activities, request support in implementing the QA Manual, meet the requirements of certifying agencies to maintain certification, and perform customer management as needed. The Department Manager is responsible for insuring that the data released from the department is final, is an accurate representation of the testing done and meets EAI's quality standards. Department Managers make sure that the staff has the appropriate education and experience to perform their tasks and that a current certification of capability is on file. The Department Managers have overall responsibility for the technical operation of the area supervised. In case of absence, the Department Manager will nominate another Department Manager, Laboratory Director or Analyst to handle responsibilities.

2.2.4 The Quality Assurance (QA) Coordinator is responsible for the overall implementation of the QA Program and compliance of the daily operations with the QA Manual and SOPs. The QA Coordinator is independent from all laboratory operations for which they have QA oversight. The QA Coordinator along with the Laboratory Director insures

that the manual is updated on an annual basis and revised as necessary to accurately reflect operations. The QA Coordinator serves as the focal point for a periodic review of QA/QC. The QA Coordinator is responsible for conducting periodic internal audits, maintaining certifications, organizing PT studies and certifying laboratory support equipment. The QA Coordinator will work with the Lab Director and department managers to ensure that objectives of client specific QAPPs are met. The QA Coordinator has direct access to the President and Lab Director for any issues that are not resolvable through standard corrective action procedures. In case of absence, the QA Coordinator will nominate a Department Manager, Laboratory Director or Analyst to handle responsibilities.

2.2.5 Each employee has the responsibility of performing their daily tasks in accordance with the QA Manual and SOPs. Employees are responsible for being familiar with the most current approved method reference for the methods performed. Employees are also responsible for participating in the development and maintenance of SOPs. In the event of undue pressure to perform job responsibilities not in accordance with the Quality Assurance Program, the employee is responsible to speak with his/her supervisor, Laboratory Director or President prior to completing any further work.

2.2.6 Marketing/Customer Service personnel, or any employee that interfaces with the customer has the responsibility of insuring that sufficient information regarding the customer's needs is gathered and communicated. Personnel are responsible to be familiar with the QA/QC Manual, applicable regulations and certifications.

2.3 Personnel Qualifications and Training

2.3.1 All employees receive general training within their first 10 days of employment. This training includes review of the QA Manual, Safety Manual, general laboratory processes, data system and other applicable SOPs, with trained personnel. Each employee completes a sign off of the understanding of the QA Manual, Safety Manual, Confidentiality and Quality Philosophy during this 10-day period. Records are kept in the personnel file.

2.3.2 Prior to performing a new method or procedure, the employee reads the SOP and receives training from an experienced employee. A trainee may be asked to complete a questionnaire as they review the SOP. Each department has a checklist of skills the need to be demonstrated before training is considered complete. The department manager or training chemist will sign off on the checklist and SOP review.

2.3.3 After training and before analyzing client samples without a supervising chemist an analyst will complete an IDC (Initial Demonstration of Capability) to prove proficiency and understanding of the procedure. Once an analyst has completed an IDC a continuing demonstration of capability (CDC) will be performed annually. Initial and ongoing demonstrations of proficiency are required for all methods performed. Documentation of this proficiency is required on an annual basis and is kept on file by the department manager. See Section 4.6 and Appendix C for the required form.

2.3.4 All work performed by a new employee or for a new method is reviewed by a trained employee for a minimum of 30 days.

2.3.5 Onsite and offsite training for specific instrument operation, general techniques, or employee development are available to employees on an

ongoing basis. Records of all training are kept in the employee's personnel file.

2.3.6 The minimum education, experience and qualifications for all positions are outlined in the Job Descriptions. A copy of the employee's resume and transcripts, where applicable, are kept on file for all employees. Transcripts are required for the Laboratory Director(s), Quality Assurance Coordinator and Department Managers(s).

2.4 Data Integrity Policy and Penalties

2.4.1 Each and every employee of EAI is professionally and morally obligated to perform their duties, including reporting of analytical results, in the most honest, truthful and accurate manner possible.

2.4.2 Altering, falsifying, forging, or fabricating test results clearly violates professional integrity and is justification for immediate termination of employment.

2.4.3 EAI's Data Integrity Training includes the following:

2.4.3.1 On an ongoing basis, EAI conducts refresher-training exercises regarding ethics in the environmental laboratory. These exercises may include but are not limited to group discussion and or review of pertinent articles or videos. Employees sign off on the training and this documentation will be kept on file.

2.4.3.2 At the time of employment, each employee signs a document from the President of EAI that commits the employee to act in a legal, ethical and responsible manner. Employees also agree to report any incident of unethical actions to their Supervisors, Lab Director or President of EAI.

2.4.3.2.1 This letter serves as formal notification that the President will offer strict confidentiality.

2.4.3.3 Manual Integration Training and Review

2.4.3.4 Detection of unethical actions is achieved through auditing of laboratory activities, reviewing of QC data, holding daily meetings to discuss work in progress, open communication with management and encouraging employees to report unethical actions.

2.5 Approved Signatories

2.5.1 The QA Coordinator, the Lab Director and the Department Managers sign the Quality Assurance Manual for approval.

2.5.2 External communication regarding data quality issues are reviewed and signed by the QA Coordinator, the Lab Director or a Department Manager.

2.5.3 The Lab Director or their designee signs off on all final report packages.

2.5.4 Department Managers or their designees initial all final data produced in their departments.

2.5.5 Analysts sign off (manually or electronically) on their work product at the bench level.

2.5.6 The CEO signs off on all legal, contract and business documents along with the secretary of the Board of Directors when necessary.

3 Sample Receipt, Tracking, and Custody

3.1 General Philosophy

The accurate documentation of the chain of custody of each sample is imperative. It is also critical to identify and document any irregularities or violations of protocol for sample preservation, shipment and handling, which may influence the integrity and analyses of the sample.

3.2 Chain of Custody

A chain of custody (COC) document accompanies all samples. The COC is initiated at the time of sample bottle preparation, during sample collection, or at the time of receipt in the lab. If the client does not supply a COC at the time of sample delivery, the office personnel at EAI supply one. Upon receipt of samples in the laboratory, the transfer of custody is noted by signatures and dates on the COC, in the absence of a COC personnel sign the sample conditions page. The original COC remains with the samples and a copy of the COC is returned to the customer at the time the samples are relinquished to the lab. For samples that are received via non-EAI courier, the customer retains a copy of the COC prior to shipment of samples. The COC is filed with the final report and a copy of the COC, amended with inconsistencies, is mailed with the report to the customer.

3.2.1 The COC form includes space to provide the following information:

- Project Name and Number
- Client's Name and Address
- Purchase Order Number
- Sampler's Name
- Miscellaneous Sample Notes
- Sample Identification
- Collection Date and Time
- Matrix
- # of Containers
- Analyses Required
- Sample Preservation
- Temperature of cooler/samples
- Turn around Requirements
- Reporting options
- Received/Relinquished signature lines

3.2.2 Documentation of COC Discrepancies

3.2.2.1 The sample receiving personnel carefully check the COC against the samples received. Any significant inconsistencies between the COC and the samples are noted on the COC or on the Sample Conditions Page.

3.2.2.2 Inconsistencies observed by the chemist in the lab are noted on the work orders or analysis sheets.

3.2.2.3 When discrepancies pose direct impact to data quality, the customer is notified and is responsible for authorizing EAI to proceed with the requested analysis. If the customer decides to collect new samples, the samples in question are cancelled and disposed of appropriately.

3.2.3 Subcontracting

3.2.3.1 A new COC is generated at EAI for samples that need to be subcontracted due to customer needs, capability, or other reasons. The date, method of shipment and the name of the laboratory receiving the sample is listed on the Sample Conditions Page. The subcontracted parameter is listed as such on the Master Work Order.

3.2.3.2 The customer is notified verbally and in writing via a quotation, bottle order, fee schedule, or note on the COC prior to subcontracting the sample. Samples requiring NELAC accreditation are subcontracted only to NELAC accredited laboratories.

3.2.3.3 A completed COC form is sent with the sample(s) to the subcontract laboratory.

3.2.4 Sub-sampling

3.2.4.1 EAI takes precautions to minimize the need to sub-sample. The size and type of containers provided by EAI are specific to requested analyses and will provide the laboratory with adequate sample volume when filled completely. A list of sample volumes/containers, preservatives and hold times may be found on the reverse side of our chain of custody.

3.2.4.2 To insure the representativeness of the analysis performed, the following procedures apply to the sub-sampling of all samples received by EAI.

3.2.4.2.1 In the event of one soil container for multiple parameters, including VOC, sample receiving personnel are responsible for transferring a representative sample into methanol (Sodium Bisulfate and 2 ounce clear jar if following Method 5035) for VOC analysis. The remainder of the sample can then be made available for additional sub-sampling. Sub-sampling prior to the removal of a VOC sample from a container results in a compromised sample. NOTE: The Ohio Environmental Protection Agency does not allow for the sub-sampling of VOC samples. All VOC samples that fall under The Ohio Environmental Protection Agency must be received preserved in methanol or in an Encore sampler.

3.2.4.2.2 All other soil samples are to be well mixed prior to sub-sampling. The sub-sample must be representative of the contents in the sample container.

3.2.4.2.3 Aqueous samples are to be thoroughly mixed prior to sub-sampling.

3.2.4.2.4 Microbiology samples are not to be sub-sampled until after the microbiology analysis has been completed.

3.3 Sample Acceptance Procedure

3.3.1 It is the responsibility of EAI to notify the customer of any sample discrepancies, sample handling or integrity issues, or chain of custody issues which will impact data quality upon sample receipt.

3.3.2 As described in EAI's Sample Acceptance Policy (SAP) the following parameters are checked upon receipt:

3.3.2.1 Full and complete documentation on the COC including name of sample collector, date and time of collection, the sample identification, preservation type, sample matrix and any special notes about the sample.

3.3.2.2 Correct sample container labeling and identification.

3.3.2.3 Proper sample containers and preservation.

3.3.2.3.1 All samples requiring thermal preservation should arrive at the laboratory packed in ice or equivalent.

3.3.2.3.2 Any additional preservation performed in the lab is noted on the Sample Conditions Page.

3.3.2.4 Headspace in VOC vials

3.3.2.5 Holding time adherence

3.3.2.6 Adequate sample volume

3.3.2.7 Damaged sample containers

3.3.3 If any deviations are noted upon sample receipt they are documented on the COC and/or Sample Conditions Page.

3.3.4 The customer is informed of the items noted and reminded of the impact to the use of the data. Re-sampling is recommended when appropriate.

3.3.5 If the customer requests that EAI proceed with the analysis, the customer is informed that the report will include documentation regarding the discrepancies noted.

3.4 Sample Login

3.4.1 It is the responsibility of EAI to uniquely and accurately identify, record and label all samples received in the laboratory. The sample login and tracking process also allows EAI to rapidly and accurately identify the current status of work in progress.

3.4.2 The sample receiving personnel log all samples received at EAI into the laboratory's computer network in a relational database file, which is the Master Login File. Each project is entered into the master file called "BatLog" and given a unique identification number called a "BatNum". Furthermore, each sample within that project is given a unique identification number, "BatSamNum", which is an extension of the BatNum. This is logged into the sample file called "SamLog."

3.4.3 Project specific information entered into "BatLog" includes:

- Laboratory Identification Number (BatNum)
- Client Name and Address
- Date Received
- Number of Samples
- Matrix
- Client ID
- Date that results are needed by
- QA/QC Report Level
- Billing Address

3.4.4 Sample specific information is entered into "SamLog" and includes:

3.4.4.1 Sample Identifications

3.4.4.2 Date and Time of Collection

3.4.4.3 Date and Time of Receipt

3.4.4.4 Analyses Required

3.4.4.5 Sample Matrix

3.4.5 A master work order and department specific work orders are printed after all information is entered into "BatLog" and "SamLog."

3.4.5.1 The master work order contains the following information:

- Laboratory Identification Number
- Client Name and Phone Number
- Date Received
- Matrix
- Sample ID's
- Analyses Required
- Client ID
- Turnaround Status
- QA/QC Reporting Level
- Project Table ID
- Client/Project specific notes regarding RL's, analytes or data deliverables
- The initials of the employee logging in the sample
- A list of all departments involved in the analysis of the sample(s)

3.4.5.2 The department specific work order contains all of the above information that is relevant to each department.

3.4.6 Once all the data has been correctly logged into the system for a given project, the job is electronically posted to the database. This allows each department to electronically receive all relevant data regarding the analysis.

3.4.7 For analyses with short hold times (bacteria, BOD, SUVA and nitrate) copies of the COC are placed in hanging files in the lab for immediate attention.

3.4.8 The master work order and the department work orders receive a secondary review prior to releasing the paperwork to the departments. The COC information and internal project notes are compared against the information logged into the data system. Any errors noted are corrected immediately.

3.4.9 The master work order, chain of custody, and the sample conditions page are placed in a hanging file that displays the unique BatNum. Any additional paperwork that accompanied the samples is also included.

3.4.10 A department specific work order, copies of COC forms and sample conditions page are given to each department involved in the analysis of the samples.

3.4.11 As each department completes the work requested, the department specific work order and final report are placed in the hanging file for further processing.

3.5 Sample Storage and Preservation

3.5.1 It is the responsibility of EAI to protect the integrity of all samples prior to analysis. The receiving lab identifies any violations of sampling and/or preservation protocols for the client.

3.5.2 Samples are delivered to the sample receiving area for processing. While the samples are unpacked and reconciled with the COC they are handled so as to insure that their integrity is maintained.

3.5.3 Sample labels containing a unique lab ID and the client ID are printed and affixed to all sample containers.

3.5.4 For jobs with fifteen (15) or more samples a secondary review of container labels is performed.

3.5.5 Upon receipt of the samples, the sample conditions, temperature and preservation are checked and recorded. The date and initials of the person noting this information is recorded.

3.5.6 If necessary, samples are split and preserved following EPA protocol. All sample manipulations are recorded on the Sample Conditions Page and are dated and initialed by the Sample Custodian or their designee.

3.5.6.1 Ohio VAP samples: Sub-sampling will not occur without client consent/notification.

3.5.6.2 NOTE: The Ohio Environmental Protection Agency does not allow for the sub-sampling of VOC samples. All solid VOC samples that fall under The Ohio Environmental Protection Agency must be received preserved in methanol or in an Encore sampler.

3.5.7 Immediate analyses requested by the client such as pH, Residual Chlorine, unpreserved Sulfide samples, Sulfite, Turbidity, Color and Odor are performed in the receiving lab at the time of receipt. Other immediate analysis testing that is required by specific methods (such as checking cyanide samples for sulfide, ammonia samples for residual chlorine and BOD pH adjustment) is done at the time of analysis.

3.5.8 Samples requiring <48 hour TAT due to holding time requirements or customer requests are immediately communicated to the lab personnel.

3.5.9 EPA recommended holding times are strictly adhered to. Any irregularities regarding time of analysis and holding time are noted on the work order and the final report.

3.5.10 Once the samples have been logged in and labeled, the samples are delivered to the departments for analysis. Samples are stored in specific refrigerators depending on the analysis required. The refrigerators are identified as: VOC refrigerator, Extraction refrigerator, Wet Chem Unpreserved refrigerator, Wet Chem Preserved refrigerator, Micro refrigerator, and a soils refrigerator (for inorganics). VOC soil samples are stored in the VOC refrigerator. Preserved samples for metals do not require refrigeration. They are stored in a designated area in the inorganics lab until analysis.

3.5.11 With the exception of preserved samples for metals, samples are kept refrigerated until analysis. Samples are removed for analysis by the chemist at the time of sample prep or analysis. Once sample prep or analysis is complete the sample is returned to the refrigerator. The refrigerators are periodically cleared of samples that have exceeded their hold time or have all analyses completed. At that time the sample is moved to the disposal area.

3.5.12 In the event that the client requests that samples be held beyond the normal storage time period, under refrigeration and secure, the samples will be put in a storage box that is labeled with these instructions prior to being stored in the refrigerator.

3.6 Sample Tracking

3.6.1 The database files are accessible electronically by any computer on the network. Every sample is given a unique "BatSamNum" and this allows the status of work in progress to be tracked on the network.

3.6.2 For each sample ID entered into "SamLog" labels are printed with the "BatSamNum" and Client Sample ID. The labels are affixed directly to the sample container.

3.6.3 Sample containers may be tracked by their unique Lab ID, preservation and requested analyses. This information is found on the container label.

3.6.4 The status of work in progress is reviewed daily. A list of incomplete projects that are overdue, due, or scheduled to be completed in the next two days, is generated. This list is compared against the work in progress in the hanging file. Each department also prints a list of the work in progress (WIP) in their department.

3.7 Sample Containers

3.7.1 Whenever possible EAI supplies clients with pre-preserved containers to assure that samples are properly preserved at the time of sampling.

3.7.2 Containers are purchased "pre-cleaned" and disposed of after use.

3.7.3 Container preservation is performed by the receiving lab personnel or their designee.

3.7.4 All preserved containers are labeled with a “preservation dot” and a sample information label.

3.7.4.1 A preservation dot is a round color-coded sticker that indicates the type of preservative in the container.

3.7.5 Containers are capped with Teflon lined caps when required.

3.7.6 A sterility check is performed on each lot of microbiological containers prior to use.

3.7.7 All sample containers are stored by preservative and size in the receiving lab area.

3.8 Bottle Orders

3.8.1 When a client calls to request sample containers, the information is entered into a file called "BottleOrder".

3.8.2 Each bottle order record is given a unique number "BONum" which is associated with the client so the request may be tracked. The "BottleOrder" file contains the following information:

3.8.2.1 Customer

3.8.2.2 Date containers are needed by

3.8.2.3 Expected date for samples to be returned

3.8.2.4 Number of sampling locations

3.8.2.5 Analysis requested with notations for QC reporting level

3.8.2.6 List of bottles being provided

3.8.2.7 Name of person filling the order

3.8.2.8 Means by which the containers are being shipped

3.8.3 The appropriate preserved and unpreserved sample containers based on the testing requirements are set up for delivery to the client. In most cases, along with the sample containers, coolers are provided with a COC and ice packs (upon request).

3.8.4 Appendix C lists the most frequently requested container types and preservations.

3.9 Sample Security and Confidentiality

3.9.1 All visitors must sign in/out of the Visitor Log located at the front desk and are accompanied by an EAI employee while in the building.

3.9.2 An EAI escort is required while visitors are in the instrument laboratory, sample prep and analysis laboratory.

3.9.3 EAI accommodates any additional sample security required by the client upon request.

3.9.4 EAI personnel only discuss analytical results with the customer or the customer's representative. All information relating to the customers' samples are kept confidential.

3.9.4.1 Requests to discuss project information with anyone other than those designated by the customer must be approved by the customer and a record of that approval kept with the project file.

3.9.4.2 Requests to send project information to anyone other than those designated by the customer must be approved by the customer and a record of that approval kept in the project file.

3.9.4.3 The project is not to be identified except as requested by the customer.

3.9.4.4 Information not received on a Chain of Custody form or other written notice from the customer should not be included in the report without the customer's approval.

3.9.5 Any information that is proprietary is labeled as such prior to release.

3.9.6 A record of the employee understanding of this policy is in personnel files.

3.10 Sample Disposal, Waste Disposal and Pollution Prevention

3.10.1 Unless other arrangements have been made with the laboratory, all samples are designated for disposal 30 days after the results have been reported to the customer. Results are typically reported to the customer 14 days after sample receipt.

3.10.1.1 Aqueous samples that are determined to be non hazardous are neutralized and disposed of in the sanitary sewer with the approval of the City of Concord.

3.10.1.2 Soil and solid samples that are determined to be non-hazardous are put into a 55 gallon steel drum labeled "Non-Hazardous Soils".

3.10.1.3 Samples determined to be highly contaminated are labeled with an orange dot either upon receipt or when the knowledge is gained. The samples are kept segregated in the storage area.

3.10.1.4 Non-aqueous liquid samples are segregated based on their matrix. Most are considered flammable liquids or waste oils and are collected in the flammable waste stream.

3.10.2 Laboratory waste

3.10.2.1 Chemicals: all expired or unusable chemicals are lab packed based on their characteristics and disposed of properly.

3.10.2.2 Laboratory waste (reagents, standards, digestates and samples wastes): see current Waste Disposal SOP for specifics on the disposal of these wastes. Individual method

SOPs will also contain procedures for waste disposal for that specific method.

3.10.3 EAI uses the services of a subcontractor for the transportation and disposal of any wastes deemed to be hazardous. In addition, EAI uses a subcontractor for the disposal of non-hazardous soil and solid samples.

3.10.4 Microbiologically cultured samples to be discarded are autoclaved for 30 minutes at 121°C/15psi. The liquid portion is then poured down the drain. All autoclaved glassware is discarded in glass disposal boxes.

3.11 Field Sampling

3.11.1 EAI conducts all sample collection in accordance with established and approved techniques, and in such a way that the quality objectives set forth in this manual are met.

3.11.2 EAI does not take responsibility for the sampling done by a client. Every effort is made to instruct our clients in the area of proper sample collection. EAI provides technical services and rental of sampling equipment when necessary.

3.11.3 EAI understands that analytical results are totally dependant upon the acquisition of a representative sample, the addition of the correct preservation, and the proper handling of that sample after collection. Failure to adhere to standard procedures may result in questionable analytical results. Protocol for specific sampling situations is contained in EAI's Field Services SOPs.

3.11.4 EAI prefers to supply the client with the containers and preservation chemicals they require for sampling. EAI recognizes that situations may exist where it is necessary for a client to use other containers. If this situation exists, the sample collector must assure himself of the integrity of the container, and that its composition conforms with the prescribed container type.

3.11.5 An essential part of any sampling project is the clear documentation of the collection and chain of possession of the sample. Sampling personnel record this information on a chain of custody form. Equally important is the clear documentation of field observations and measurements. Sampling personnel record this information in a bound field notebook. Standard entries (as applicable) may include:

- Purpose (type) of sampling
- Location of sampling survey
- Name, address, & phone number of contact person
- Client name, address & phone number
- Sampling point description
- Sampling procedures, equipment & preservation
- Date and time of collection
- Collector's name, address & phone number
- Field observations, maps, sketches & photographs of the sampling area
- Well measurements (casing height and PVC diameter)
- Well depth and groundwater elevation (from top of casing)
- Field tests: pH, temperature, conductivity and conductivity profiles

4 Laboratory Procedures

4.1 General Philosophy

4.1.1 All laboratory procedures performed at EAI generate reliable data to meet the requirements of our customers and/or any certifying/accrediting authorities involved in the end use of the data.

4.1.2 Procedures performed at EAI are based on published methods, both final and draft updates. These include but are not limited to documents published by the EPA, Standard Methods, ASTM, individual state's performance based methods or other recognized organizations. Deviations and/or modifications to the recognized method are documented in EAI's internal Standard Operating Procedures (SOPs). See Section 4.5 for further description of the EAI SOP Philosophy.

4.1.3 All EAI laboratory procedures are documented and approved in individual internal SOPs. Current SOPs are stored electronically in the EAILIMS system. SOPs are periodically reviewed and updated. The inactive revisions are also stored electronically in the EAILIMS system in a separate location. Original hard copies of all SOPs, both current and inactive, are also kept on file by the QA Coordinator. The effective dates of the SOP are included on all SOPs.

4.1.4 General laboratory procedures include procedures for the review and acceptance of new work and methodologies, the performance of Demonstrations of Capability, Initial and Ongoing, the use of Run Logs or Benchsheets and strict requirements for the use of manual integrations to assure data integrity and accuracy.

4.2 Review of new methods and/or new projects.

4.2.1 The acceptance of work for additional methods, either newly published, performance based or methods not currently performed at EAI, and new projects is discussed at the daily operations meeting. Laboratory personnel, instrumentation and capacity are reviewed to determine the feasibility of performing the method and/or handling the project. If the laboratory concludes that it has the capability to perform the new method, the customer is consulted and the standard EAI method start up QC requirements are met.

4.2.1.1 Customer contacts are recorded in the customers file under client contacts.

4.2.1.2 Any ongoing issues with new methods or projects are communicated to the customer by phone or email. Documentation is kept with the work order.

4.2.2 Prior to committing to new work/projects (such as contracts awarded from a bid specification package or projects based on a Quality Assurance Project Plan) EAI management thoroughly reviews all requirements, including but not limited to sample quantity, QC requirements, methodology, reporting limits, resources and capacity, to ensure compliance. All new work is also discussed at the daily operations meeting.

4.2.3 Any concerns that result from the review of project scope/expectations are communicated to the customer. All communication focused on resolving these concerns is documented in the customer file under client contacts.

4.2.4 Quality Assurance Project Plans (QAPP) Review

4.2.4.1 EAI management and the QA Coordinator perform a preliminary review that includes but is not limited to: job scope, analytical methods, deliverable requirements, turn around time, quality control requirements and regulatory reporting limits involved.

4.2.4.2 If the preliminary review indicates the project represents a good partnership, EAI continues with a departmental review. Copies of the QAPP are disseminated to all department managers who then thoroughly review the analyte list(s), reporting limits and other specific requirements to determine EAI's ability to satisfy all QAPP requirements.

4.2.4.3 The QA Coordinator or their designee is the primary person responsible for contacting the client with any questions and concerns regarding the QAPP. All conversations are documented in the customer file or the project file.

4.3 Method Start-up QC Requirements and Ongoing Certification

4.3.1 Demonstration of Method Capability (DOC) is performed prior to the institution of an analytical method, when there is a major method modification or a major change in instrumentation to ensure the accuracy of the data produced by the method.

4.3.1.1 Four (4) LCS samples are processed through the entire procedure.

4.3.1.2 From the resulting data the average percent recovery and the standard deviation of the percent recovery is determined.

4.3.1.3 Retention time studies (where applicable) are performed

4.3.1.4 Resolution checks (where applicable) are performed

4.3.1.5 Methods are accepted when the criteria from the DOC agrees with the criteria of the unmodified method.

4.3.1.6 Each department maintains the DOC records for analyses performed in that department.

4.3.2 Initial Demonstration of Capability (IDC): To ensure data quality all analysts are required to successfully complete an IDC before proceeding with sample analyses. An IDC consists of the following:

4.3.2.1 Initial Precision and Accuracy (IPA): To establish the ability to generate acceptable precision and accuracy.

4.3.2.1.1 Four LCS samples are processed through the entire procedure.

4.3.2.1.2 From the resulting data the average percent recovery and the standard deviation of the percent recovery is determined.

4.3.2.1.3 Acceptance criteria is method specific.

4.3.2.2 Each department maintains the IDC records for analyses performed in that department.

4.3.2.3 An Initial Demonstration of Capability Certification Statement is completed and kept on file by the Department Manager. See Appendix C for this form.

4.3.3 Continuing Demonstration of Capability

4.3.3.1 Continued understanding of the method and proficiency in performing the method/SOP is documented on an annual basis via one of the following steps. A record of this

certification is documented on the form in Appendix C and is kept on file by the Department Manager.

4.3.3.1.1 Acceptable performance on a blind sample on the same or similar test method.

4.3.3.1.2 Completion of an IDC (continuing demonstration of capability).

4.3.3.1.3 At least 4 consecutive laboratory control samples with acceptable precision and accuracy. Acceptance criteria are method specific.

4.3.3.1.4 Analysis of an authentic lab sample analyzed by another trained analyst with statistically acceptable results.

4.3.4 Method Detection Limit (MDL): A method detection limit is determined based on the procedure outlined in 40 CFR 136, Appendix B. MDL studies are performed, annually, or when there are significant changes in instrumentation or methodology that may affect sensitivity or method performance. Some methods may require MDLs to be performed more frequently. MDL Studies are stored electronically in the EAILIMS system.

4.4 Method Modification Philosophy and Process

4.4.1 EAI procedures are based on recognized source methods. However, method modification may be needed to 1) increase the efficiency of the test, 2) increase the sensitivity of analyte detection, 3) change detection limits, 4) decrease the cost of a procedure or 5) meet the specific needs of a client. Modifications to the accepted EPA, ASTM, Standard Methods or other referenced methods are documented in the internal EAI SOP.

4.4.2 Modifications include but are not limited to changes in reagents, volumes of samples or reagents, extraction/analysis times and instrumentation.

4.4.3 A DOC and MDL study are performed for modified methods.

4.4.4 DOCs and MDLs must meet or exceed the acceptance criteria of the unmodified method.

4.4.5 Acceptance of method modifications for routine work is final after sign off by the Department Manager and QA Coordinator.

4.5 Standard Operating Procedure (SOP) Philosophy

4.5.1 “Method” refers to the actual source document published by a recognized organization such as EPA, Standard Methods or ASTM. “SOP” refers to the actual procedures as they are performed at EAI. Appendix A contains a list of Source Method #, Method Description and EAI SOP #.

4.5.2 To ensure consistency and efficiency the procedures for all analyses performed at EAI are documented in internal EAI SOPs. These documents are detailed and specific instructions on how the procedure is performed at EAI. All method modifications of the source method are documented in the internal SOPs.

4.5.3 Every SOP is assigned a unique identification number. The number starts with “QA” followed by the login group number. The last two digits of the SOP number are the revision number.

4.5.4 Analytical data are associated with SOPs by use of the effective dates on the SOP revisions. Data generated within the effective dates of the SOP is traceable to that SOP revision.

4.5.5 EAI's internal SOPs follow the same format and include the following sections:

4.5.5.1 Title and Approval Signatures: SOP title, method description and effective dates are included at the beginning of each SOP as are all necessary signatures needed for SOP approval.

4.5.5.2 Scope and Application: This section defines the type of analysis, matrix and recognized source document.

4.5.5.3 Summary of Method: This section contains a brief summary of the method, detection method, detection limits and/or reporting limits, and holding times. Sample collection, preservation and handling are also referenced in this section.

4.5.5.4 Interferences: Interferences known in the method are referenced in this section.

4.5.5.5 Apparatus: This section describes the instrumentation and support equipment used in the method.

4.5.5.6 Reagents: This section is a list of chemicals required for reagent and standard preparation (include material grades if necessary). It also includes method of preparation, storage, shelf life and documentation (tracking) procedures.

4.5.5.7 Procedure: This is a description of exactly how the procedure is performed at EAI. The SOP may reference other EAI SOPs or specific sections of the source document. Instrument setup and calibration, file locations and documentation requirements are included in this section. Calculations and data interpretation are also found in this section.

4.5.5.8 Quality Control: The type and frequency of QC to be analyzed and acceptance criteria are found in this section.

4.5.5.9 Corrective Actions: Corrective actions specific to the method are discussed here. Corrective Actions applicable to multiple methods/departments are described in Section 10 of the Quality Assurance Manual.

4.5.5.10 Safety, Pollution Prevention, and Waste Management: Any method specific information on these topics is included in this section.

4.5.5.11 References: This section lists all source documents referenced in the SOP.

4.5.5.12 Date of revision, revision number and page number are included in the header listed on each page of the SOP.

4.5.6 Acceptance of an internal SOP for routine work is final after sign off by the Department Manager, Lab Director and QA Coordinator. All SOP pages include a header listing the EAI SOP#, Revision #, Revision Date, page # and total number of pages. A footer including a statement of ownership and the file location of the SOP are also located on each page.

4.5.7 Original copies of the SOP are stamped "ORIGINAL" and are kept on file by the QA Coordinator. Copies are distributed to the appropriate lab personnel.

4.5.8 Internal EAI SOPs or sections thereof may be given out to clients at their specific request or included in Quality Assurance Project Plans (QAPP).

4.6 SOP Storage/Revision/Archival Process

4.6.1 SOP Storage: After final acceptance, all SOPs are stored in a central location in the Active SOP folder located on the EAILIMS. The documents are accessible to EAI employees. Hard copies, including signatures are kept in binders in the appropriate departments. The QA Coordinator keeps original hard copies on file. PDF copies of all current signed SOPs are also located on the EAI intranet.

4.6.2 SOP Revision: Revisions are made either by the analyst responsible for performing the analysis or by the Department Manager. However, if an analyst initiates the revision, all changes are first discussed and approved by the Department Manager. Minor revisions may be made by hand on the original SOP. The out-dated or inaccurate data is crossed out and the updated information is written in using pen. The change is initialed and dated. All lab copies of the "un-revised" SOP are removed from use and replaced with copies of the updated SOP. The original, with the hand-entered changes, is kept on file by the QA Coordinator. Major revisions may require IDCs and/or MDLs before the revision can be finalized. Major SOP revisions require an updated "revision #" and "revision date" and are saved under a name with the new revision #. The new revision is stamped "ORIGINAL" and kept on file by the QA Coordinator. The old revision is stamped "INACTIVE" and archived.

4.6.3 SOP Archival: In order to relate all data points with the SOP by which they were generated it is necessary to archive all previous SOP revisions. Once a SOP has been revised the previous revision is archived in a Main Archive SOP folder. This folder is subdivided by department and if necessary by procedure. An archive date is attached to the header to define the time frame for which that particular SOP was in use. The SOP is also converted to "Read Only" to protect against any changes in the document.

4.7 Bench Sheets and Run Logs

4.7.1 Bench sheets and run logs can be paper logs or electronic logs (such as excel spreadsheets).

4.7.2 Each department will determine the design and format of their bench and/or run logs.

4.7.3 Revisions to paper log pages are made to the master file stored in EAI LIMS. New pages or bench logs will be printed and put into service while unused pages will be Z'd out or completed logs will be filed.

4.7.4 The dates of use for any notebook or logbook page format are determined by date of analysis entered by the analyst.

4.7.5 Electronic logs will contain an "update" date, initials of analyst making the update and a note as to the changes made. This will be saved with the file. Date of analysis will serve as "dates of use" for the revised information.

4.8 Manual Integration

4.8.1 The emphasis of proper manual integration is on chromatographic data reduction but the principals apply to all analytical procedures that are based on an instrument response that may be manipulated by an analyst. Under no circumstances is manual integration used to generate acceptable QC. The use of manual integration must be warranted.

4.8.2 Reasons for manual integration may include:

4.8.2.1 Undetected Peak: A slight shift in retention times or a high relative abundance of ions may cause a peak to go undetected by the data system. It may also result in the detection of a false positive.

4.8.2.2 Incorrect Peak Integration: A peak may have a small amount of splitting and the entire peak area was not integrated.

4.8.2.3 Peak co-elution

4.8.2.4 Sudden rise in baseline

4.8.2.5 Noisy baseline

4.8.3 At a minimum, the following items must be considered when reviewing manual integrations:

4.8.3.1 Does the peak fall in the proper retention time window for the compound of interest?

4.8.3.2 Are the quantitation ions present at the proper ratios for the compound of interest? (GC/MS analyses)

4.8.3.3 Are peaks manually integrated in a manner consistent with the integration of calibration standards and quality control samples?

4.8.3.4 Absence of peak shaving and inflation

4.8.4 If manual integration is required, the analyst must be able to reproduce both the original integration and the manual integration. For organic analyses, an electronic copy of both the automated and manual integration is saved. In other instances hard copies may be printed and kept on file.

4.8.5 Manual integrations may be reviewed at any stage of data review. Annual internal audits will address manual integration, where appropriate.

5 Instrumentation, Chemicals, Glassware, and Facility

5.1 EAI supplies all instrumentation, chemicals, reference materials and support equipment necessary for all testing performed in the lab.

5.2 EAI purchases instrumentation, chemicals, glassware and other supplies that meet or exceed the requirements of the analytical methods.

5.3 Chemicals

5.3.1 Purity

5.3.1.1 All chemicals are Analytical Reagent Grade or of the appropriate quality for the method of intended use. For example, all acids utilized in the Metals Department are of trace metal grade and all methanol utilized in the Volatiles Laboratory is of pesticide quality or higher.

5.3.1.2 All standards ordered are of pure standard material (neat solution) or attained at concentrations certified by the vendor.

5.3.1.2.1 Certificates of Analysis for each standard solution utilized are kept on file within the department. The unique EAI ID is written on the top of the certificate in order to facilitate traceability.

5.3.1.3 Gases utilized throughout the laboratory are of ultra high purity as supplied by vendor.

5.3.2 Ordering

5.3.2.1 Each chemist or each department orders its own chemicals and reagents. For consistency some chemicals may be ordered in bulk by manufacturer lot# and released from the vendor on a set schedule or as needed.

5.3.2.2 Chemical orders of < $1000 do not need pre-approval.

5.3.3 Inventory and Tracking

5.3.3.1 Chemicals are received in the lab by the chemist or department that ordered them. The person receiving the chemical will affix a label to the chemical container identifying the date received and the initials of the person receiving the chemical.

5.3.3.2 Through the PO system the chemist will electronically post a record to the Chemical Inventory File. In the Chemical Inventory File a unique lot number will be assigned to the chemical or chemical lot. This chemical ID number is transferred to the chemical container and the corresponding Certificate of Analysis (if applicable).

5.3.3.3 The chemist who is responsible for the chemical (test method) will complete the pertinent information in the Chemical Inventory File and then create individual records and unique lot numbers for each container received in the lot. The following information should be entered into the Chemical Inventory File by the chemist:

5.3.3.3.1 Chemical alias (if applicable)

5.3.3.3.2 Date received

5.3.3.3.3 Received by (initials)

5.3.3.3.4 Department

5.3.3.3.5 Manufacturer
5.3.3.3.6 Manufacturer's lot number
5.3.3.3.7 Size of individual containers
5.3.3.3.8 Total quantity received in the lot
5.3.3.3.9 Expiration date (if applicable)
5.3.3.3.10 Comments
5.3.3.3.11 Safety information
5.3.3.3.12 Storage information
5.3.3.3.13 Concentration (if applicable)

5.3.3.4 Additional information to be added as individual chemical containers are opened or disposed of:
5.3.3.4.1 Date opened
5.3.3.4.2 Opened by (initials)
5.3.3.4.3 Disposal date

5.3.3.5 Each container will be labeled with its unique lot ID# and expiration date (if applicable).

5.3.3.6 Individual containers are also labeled with the date opened and the analyst's initials.

5.3.4 Storage

5.3.4.1 Solvents are stored in cabinets designated for storing flammable materials.

5.3.4.2 Acids are stored in an appropriate acid storage cabinet.

5.3.4.3 Organic standards are stored in a designated refrigerator or freezer.

5.3.4.4 All other chemicals are segregated based on reactivity considerations and stored in the designated cabinet located in the laboratory and filed in alphabetical order or by test.

5.3.5 Material Safety Data Sheets

5.3.5.1 The Material Safety Data Sheets (MSDS) that accompany the chemicals and reagents are filed in the Technical Reference area outside the general chemistry lab.

5.3.5.2 Department specific MSDS are also kept by the department manager in an easily accessible area

5.3.6 Chemical Inventory

5.3.6.1 One or more standards and reagents, per Method, are traced back to their Chemical Inventory Record during internal audits. At this time, records are checked for accuracy and completeness. Any anomalies are duly noted in the internal audit summary.

5.3.7 Disposal

5.3.7.1 Once a chemical or standard has reached its expiration date it is disposed of properly. The date of disposal is entered into the Chemical Inventory file.

5.4 Reagents

5.4.1 Reagent prep is recorded in a prep log. Lot numbers are recorded in the prep log to trace each reagent to the individual chemicals used in the preparation. Reagents are given a unique lot number. See department specific SOPs for the tracking of reagents prepared in the lab.

5.4.2 All reagents prepared in the lab should be labeled with a description of the reagent, a unique EAI Lot #, date prepared, initials of the person preparing the reagent, and expiration date.

5.4.3 Reagents are checked regularly for signs of deterioration, e.g. discoloration, formation of precipitate, and concentration. Reagents that show signs of deterioration are disposed of appropriately.

5.4.3.1 Shelf lives are assigned at time of ID assignment or reagent login and expiration dates are included on reagent container labels. Reagents are disposed of when the shelf life has expired or when the analyst notices deterioration such as issues during analysis, whichever occurs first.

5.4.4 Reagent lot numbers are recorded in instrument and sample run logs to allow for traceability of the chemicals.

5.5 Standards

5.5.1 All standards and internal LCS chemicals meet the criteria of the methods performed.

5.5.2 The chemical name, chemical lot #s and supplier are noted in a standards preparation log. A unique lot number is assigned to the standard/LCS. This log may be the same log as reagent prep.

5.5.3 If irregularities are traced back to the standard/LCS chemicals, new chemicals are ordered and the chemicals in question are disposed.

5.5.4 All standards/LCSs are labeled with the date prepared, a unique EAI Lot#, initials of the person preparing the standard, the concentration, and the expiration date.

5.5.5 See department specific SOPs for the tracking of standards/LCSs prepared in the lab.

5.5.6 Standard/LCS lot numbers are recorded in instrument and sample run logs to allow for traceability of the chemicals.

5.5.7 Concentrated stock standards are stored until consumption or manufacturer's recommended expiration date, whichever occurs first. Working standards are assigned a shelf life or expiration date based on method recommendation or manufacturers recommendations. Solutions that exhibit signs of deterioration before the expiration date are replaced more frequently, as needed.

5.6 Laboratory Water

5.6.1 Each department uses a quality of water that meets the requirements of the testing being performed. EAI uses deionized, Type I water for most analyses. The system in place provides continuous reagent quality water. Volatile Organics uses water from the tap in the volatiles laboratory that has been passed through an activated carbon filter and collected in a container. This water is purged for 3 hours with ultra high purity nitrogen before use and is kept under constant pressure during the day using nitrogen.

5.6.2 The laboratory pure water is analyzed with routine samples on a batch basis. Laboratory pure water is tested periodically for pH, specific conductance, TOC, ammonia and residual chlorine. The QA Coordinator records the results on a monthly basis in the DI System Maintenance Log.

5.7 Glassware

5.7.1 Standard preparation glassware is Class A.

5.7.2 Burettes used for titration are Class A.

5.7.3 Laboratory glassware is made of borosilicate glass that is resistant to damage by heat, chemicals, and repeated use.

5.7.4 Volumetric glassware is not to be used for the storage of solutions.

5.7.5 Pipettes are free of chips, etching, and cracks.

5.7.6 When practical, glassware is washed immediately after analysis. All cleaning of glassware is method specific. Containers that fail a visual inspection (chips, cracks, fractures, or other visible flaws) are removed from use.

5.7.7 Separate glassware is dedicated for the preparation and analysis of phosphorus and microbiology.

5.7.8 All VOC vials are purchased pre-cleaned and are certified to meet the most current USEPA Specifications and Guidance for Contaminant-Free Sample Containers. Containers for this analysis are not reused.

5.7.9 Where applicable many analyses utilize disposable glassware that meets method requirements.

5.8 Instrumentation/Equipment

5.8.1 The chemist and department manager determine what equipment is necessary for a method by following method guidelines.

5.8.1.1 Equipment totaling <$1000 is ordered directly by the chemist or manager.

5.8.1.2 Annually each department meets with the CEO to determine the equipment needs for the coming year. The CEO puts together a total laboratory budget and then determines what equipment best accomplishes the goals of the business plan.

5.8.1.3 If equipment needs arise during the year the department manager will meet with the CEO to review costs and business potential to determine if the equipment purchase is justified.

5.8.2 All instrumentation is recorded in an electronic Inventory Table, titled 'Assets'. This table is stored on the EAI LIMS system. An Asset ID is assigned to each piece of capitol equipment and affixed to the piece of equipment. Information recorded in this log is:

5.8.2.1 Make and model

5.8.2.2 Manufacturer

5.8.2.3 Serial number

5.8.2.4 Date of purchase

5.8.2.5 Department/location

5.8.2.6 Comments section

5.8.3 Refer to Appendix B for a list of all major instrumentation at EAI.

5.8.4 The following checks are performed on equipment outside of EAI's permanent control:

5.8.4.1 Visual inspection to determine condition of the equipment

5.8.4.2 Review of any pertinent maintenance logs

5.8.4.3 Running of calibration and LCS before operation

5.8.4.4 While in EAI's temporary control maintenance logs and calibration data will be recorded

5.9 Instrumentation/Equipment Maintenance

5.9.1 Preventative maintenance is recognized as a critical element in our Quality Systems. In most cases, some preventative maintenance is a daily routine and occurs prior to sample analysis. Daily or preventative maintenance varies by department and analysis. Details for each instrument may be found in the Method specific SOP.

5.9.2 Maintenance records are kept on all major pieces of instrumentation.

5.9.3 Maintenance logs document all service, routine maintenance and repairs performed on the instrument. It is the responsibility of each analyst to keep these logs up to date.

5.9.4 Instruments are maintained and serviced as recommended by each individual manufacturer.

5.9.5 Maintenance logs include the following information:

5.9.5.1 Name of equipment, manufacturer, serial # or other unique ID

5.9.5.2 Date received and date put into service

5.9.5.3 Purchase condition (new, used, reconditioned)

5.9.5.4 Date of repair or scheduled maintenance

5.9.5.5 Initials of person performing the maintenance

5.9.5.6 Details/reason of malfunction initiating the maintenance or routine maintenance needed

5.9.5.7 Results of the maintenance indicating the operational status of the instrument

5.9.6 Maintenance logs are kept in the vicinity of the identified equipment.

5.9.7 Equipment that is not functioning properly is taken out of service and designated as such.

5.9.7.1 If the equipment is to be repaired it is worked on in its location until the repair is complete and successful calibration is achieved.

5.9.7.2 Instrumentation that is to be taken out of service permanently is taken out of its working location and stored away from the working instrumentation. This is noted in its maintenance log and also in the Asset Table.

5.9.8 Work that may have been affected by an instrument malfunction is reviewed and clients contacted if it is shown that their work was directly affected.

5.9.8.1 Documentation of the malfunction is recorded in the sample run logs, giving a listing of work that may have been affected.

5.10 Facility

5.10.1 Environment

Laboratory accommodation, test areas, energy sources, lighting, heating and ventilation shall be such as to facilitate proper performance of tests. The environment in which these activities are undertaken shall not invalidate the results or adversely affect the required accuracy of the measurement. The laboratory will provide for the effective monitoring control and recording of environmental conditions as appropriate. Such conditions may include biological sterility, dust, electromagnetic interference, humidity, main voltage, temperature, sound, face velocity, and vibration levels. In instances where monitoring or control of any of the above mentioned items are specified in a test method or by

regulation, the laboratory shall meet and document adherence to the laboratory facilities requirements.

5.10.2 Work Areas

5.10.2.1 There shall be effective separation between neighboring areas where the activities therein are incompatible. Access to and use of all areas affecting the quality of these activities shall be defined and controlled. Adequate measures shall be taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. Workspaces must be available to ensure an unencumbered work area. Work areas include access to entryways to the laboratory, sample receipt areas, sample storage areas, chemical and waste storage areas, data handling and storage areas.

5.10.2.2 Work areas shall be kept clean and organized. All samples, reagents and standards are stored safely in the work area. Samples, reagents and standards are put away after use. Paperwork is kept organized and easily available.

5.10.2.3 All entryways and walkways will be kept free and clear of obstructions such as sample carts and supply boxes. Tripping hazards such as wires and cords will be taped down.

5.10.2.4 Monthly safety inspections are performed to identify any areas that need attention or improvement.

6 Calibration

6.1 General Philosophy

6.1.1 High quality analytical results depend on accurate and stable instrument calibration. A calibration curve is constructed prior to the analysis of samples. Some referenced methods require that this be done with every analytical sequence while other methods allow for extended use of a calibration curve as long as the stability of the calibration is verified. The concentrations of the calibration standards are chosen at levels that cover the reporting range.

6.2 Types and Acceptability of Curves

6.2.1 Initial Calibration

6.2.1.1 Instruments are calibrated and monitored as specified by the SOPs. A variety of curve fit algorithms can be used to obtain the best fit for the data points of an initial calibration. The following are general guidelines. Refer to the appropriate SOP for specific requirements.

6.2.1.2 When using an average response factor, an RSD of ≤ 20 is necessary**,** unless otherwise specified by method or EAI SOP.

6.2.1.3 A correlation coefficient (r^2) of ≥ 0.995 is necessary for the use of linear regression.

6.2.1.4 When using a polynomial fit, a weighted coefficient of determination (COD) should be calculated. The curve fit is acceptable if the COD is ≥ 0.99.

6.2.1.5 In all cases, the curve fit must be inspected to ensure the curve matches the standards data. Visual inspection is the surest way to verify the quality of the fit. When using a curve fit it is important to ensure that enough calibration points are used to adequately describe the data.

6.2.1.6 Unless otherwise stated in the method, the initial calibration is verified with a standard obtained from a source independent of the initial calibration standards. Unless otherwise stated in the method, this initial verification standard must be within $\pm$ 15% of the true value to accept the calibration curve. Wider limits may be used if there is historical data to support them.

6.2.1.7 Sufficient data is kept to allow reconstruction of the curve. This may include but is not limited to calculations, raw data, date, method or response factors.

6.2.2 Calibration Verification

6.2.2.1 When the calibration curve is not analyzed on the same day as sample analysis, a calibration verification (CV) is analyzed to verify the curve. This CV may be prepared from the same stock as the initial calibration. The CV is analyzed at the beginning of each batch, every ten samples (if method specified) and at the end of each batch (if method specified). When performing calibration verification, a standard at a concentration near the middle of the calibration range is analyzed and compared to the initial calibration. It is recommended that the concentration of the CV vary if running more than one per batch. Unless otherwise stated in the SOP, the deviation must be within $\pm$ 15% to consider the initial

calibration sound. This deviation may be calculated using response factors or concentration units. Generally, when using response factors this is referred to as percent deviation or difference and when using concentration units it is often referred to as percent drift. See Method specific SOPs for applicability of each calculation. When an analyte does not meet the acceptance criteria, accurate quantitation for that analyte is not possible until another initial calibration is performed. Some methods use a subset of compounds (CCCs) as indicators of the acceptability of the continuing calibration. The deviation must be ≤ 20% for the CCCs to consider the initial calibration sound. This is discussed further in the relevant SOPs.

6.2.3 Project Specific Requirements

6.2.3.1 Project specific Data Quality Objectives (DQOs) may allow for the acceptance of results that do not meet the criteria as stated. For example, if in a procedure the calibration verification (CV) shows a high bias from the initial calibration and subsequent samples analyzed demonstrate that this analyte was not detected, one can conclude that the high bias of the CV does not affect the usability of the data. In such cases, the reason for acceptance of the data is documented.

6.3 Support Equipment and Reference Standard Calibration

6.3.1 Many analytical procedures require the use of support equipment in addition to the main piece of equipment used for quantitation. To ensure that this equipment is working properly, periodic checks are made. Refer to the Lab Equipment SOP for verification procedures and acceptance criteria. If the acceptance criteria are not met for any equipment, it must be repaired before returning to service. In all cases, records that include date, maintenance performed, results obtained and any other relevant information are maintained. Detailed procedures found in the Support Equipment SOP.

6.3.2 Balances

6.3.2.1 Checked daily with class S weights. Three weights are used to verify accuracy over the working range.

6.3.2.1.1 Calibration verification is recorded on days of use.

6.3.2.1.2 These weights are used for calibration and verification only.

6.3.2.1.3 These weights are checked annually by a certified body that can provide documentation of traceability to a national standard of measurement. Documentation of this service is kept in a service logbook and available for review.

6.3.2.2 On an annual basis all balances undergo preventative maintenance and verification of calibration using a separate NIST traceable set of calibration weights. An outside company trained in the maintenance and calibration of balances performs this service. Documentation of this service is kept in a service logbook and is available for review.

6.3.2.3 Balances that do not meet the required accuracy of the intended use are taken out of service. This is documented in the Asset table within FileMaker Pro LIMS.

6.3.3 Thermometers

6.3.3.1 Checked annually by comparison to a NIST traceable thermometer.

6.3.3.2 EAI has a NIST traceable thermometer in house that is checked annually at the state lab or by an outside service. This thermometer is used for calibration only.

6.3.3.2.1 Critical temperatures will include but are not limited to: 4°C, 20°C, 35.5 °C, 44 °C, 100°C and 180°C.

6.3.3.3 Laboratory thermometers are checked against the EAI NIST traceable thermometer. Thermometers are labeled with an ID, a calibration date and a correction factor (if applicable).

6.3.3.4 Documentation of the annual calibration is recorded in the Thermometer Calibration Log and is available for review.

6.3.4 Auto-pipets

6.3.4.1 Auto-pipets that are involved in critical measurements such as preparing standards, spiking LCSs or matrix spikes or performing sample dilutions are checked quarterly using gravimetric methods.

6.3.4.2 Auto-pipets are given a unique identification.

6.3.4.3 Documentation of the calibration is recorded in an electronic database.

6.3.5 Spectrophotometer

6.3.5.1 The spectrophotometer is kept clean and in working order.

6.3.5.2 Alignment is checked quarterly.

6.3.5.3 Lamps are changed as necessary.

6.3.5.3.1 When a lamp is changed an alignment is performed.

6.3.5.4 Pump tubing is replaced as necessary.

6.3.5.5 Service is required when calibration curves for various methods are out of line with historical absorbance data.

6.3.5.6 All maintenance data is recorded in the Spectrophotometer Calibration Log along with the date and analyst's initials.

6.3.6 Autoclave

6.3.6.1 Autoclave maintenance, either internally or by service contract, is performed on an annual basis. Annual checks include but are not limited to pressure, temperature and the timing device. Records of such maintenance inspections are kept on file.

6.3.6.2 The autoclave timing mechanism is checked quarterly with a stopwatch and recorded in the autoclave timer quarterly check spreadsheet.

6.3.6.3 Biological indicators are used monthly; a positive ampoule is incubated with the autoclaved ampoule to verify that ampoules are viable.

6.3.6.4 An autoclave log is kept with the autoclave instrument manual.

6.3.6.4.1 Date, autoclave batch number, load description, total sterilization time, temperature and pressure, use of fast exhaust (when applicable), and operator are recorded for each load.

6.3.6.5 Daily checks

6.3.6.5.1 A maximum-minimum-registering thermometer is used during each cycle and the maximum temperature is recorded in the autoclave log.

6.3.6.5.2 Tape that shows that sterilization has occurred is used with every load. The tape stays with load contents until they are used or discarded.

6.3.6.6 Autoclave cleaning

6.3.6.6.1 Autoclave door gaskets are kept clean and in good condition

6.3.6.6.2 Drains are kept free of debris

6.3.6.6.3 Autoclave is drained after each cycle

6.3.6.6.4 Autoclave interior is kept free of mineral deposits

6.3.7 Glass Microliter Syringes

6.3.7.1 All syringes received without a Certificate of Calibration are evaluated for precision and accuracy prior to use.

6.3.7.2 Upon arrival at the laboratory each syringe is entered into the syringe log and given a sequential number, which is etched into the syringe barrel.

6.3.7.3 An analytical balance, accurate to 0.001g is used for weighing.

6.3.7.4 Using water at standard temperature and pressure, the syringe is filled to 80% of full volume and then weighed. After waiting for the reading to stabilize, the weight is recorded. This step is repeated 7 times.

6.3.7.5 All readings as well as date, syringe number and analysts' initials are recorded in the Pipette Log in FileMaker Pro LIMS. An average mass, average percent recovery and standard deviation are calculated in the file.

6.3.7.6 An accuracy of ± 1% is acceptable for all syringes.

6.3.7.7 If an accuracy reading of ± 1% is not achieved, the syringe must not be used and should be returned to the vendor.

7 Quality Control and Auditing

7.1 The objective of the quality control program is to ensure the data quality objectives of a project or method are met and to provide the documentation necessary to support the results. There are several components of EAI's quality control program that support the efficiency and accuracy of internal procedures.

7.2 QC Components

7.2.1 Method Blank: A blank prepared with each sample batch that demonstrates freedom of background contamination. This blank is subject to the same reagents and procedures as field samples. The concentrations found in the blank should be less than 1/2 the Reporting Limit.

7.2.2 Solvent Blank: An aliquot of solvent analyzed to verify the solvent is free of contaminants and interferences. Such aliquots are typically analyzed when a new lot of solvent (i.e. methylene chloride or methanol) is received from the manufacturer. Solvent blanks may also be utilized to flush out the analytical system.

7.2.3 Lab Control Sample (LCS): Reagent water or blank matrix spiked with a known concentration of analyte(s) at a frequency of one per sample batch or as prescribed in a specific SOP. The LCS is subject to the same reagents and procedures as field samples and is spiked with a solution independent of the calibration. A LCS is analyzed to establish accuracy and to assess the performance of the procedure.

7.2.4 Matrix Spike: A field sample spiked with a known concentration of analyte(s) at a frequency of one per batch or as prescribed in the referenced procedure or SOP. The source of the matrix spiking solution may be shared with the LCS or the calibration standards. The matrix spike is used to demonstrate the effect of the field sample matrix on the procedure's recovery efficiency. Refer to the appropriate SOP for the acceptance criteria.

7.2.5 Duplicate: To obtain precision data duplicate analysis may be performed in one of three ways:

7.2.5.1 Sample Duplicate: Replicate analyses of a field sample performed at the frequency prescribed in the referenced procedure. Results are compared and relative percent difference (RPD) is calculated. Refer to the appropriate SOP for the acceptance criteria.

7.2.5.2 Matrix Spike Duplicate (MSD): A second aliquot of the same field sample chosen as a MS is prepared, spiked and analyzed in the same fashion as the MS. The percent recovery (%R) and the RPD (between the %R of the MS and %R of the MSD) are calculated and compared to the Method specific acceptance criteria listed in the appropriate SOP.

7.2.5.3 LCS Duplicate (LCSD): In the event that there is insufficient sample volume to promote the analysis of a sample or matrix spike duplicate, an analyst may choose to prepare and analyze a LCSD. LCSD samples are prepared in the same manner as an LCS. %R and RPD (between LCS %R and LCSD %R) are calculated and compared to the method specific acceptance criteria found in the appropriate SOP.

7.2.6 Initial Calibration Verification (ICV): A second source standard, independent of calibration standards, analyzed directly after the initial

calibration curve, to verify the accuracy of the initial calibration. Prepared and analyzed as specified in the SOP. A LCS may also be used as the ICV. Consult reference method or SOP.

7.2.7 Calibration verification (CV): A standard prepared from the same source as the calibration standards used to assess calibration accuracy during each analysis run. It is run at a frequency and concentration specified in the SOP. Some methods refer to the CV as a continuing calibration verification (CCV).

7.2.8 Method Detection Limits (MDL): At method startup, after major procedural or instrument modification and annually thereafter, method detection limit studies are performed to document a statistical Method Detection Limit, as described in 40 CFR Pt. 136 App. B. A minimum of seven replicates are analyzed and used to calculate a theoretical minimum concentration that can be measured at 99% confidence that the result is greater than zero. The calculated value should be at a factor of two to five times less than the reporting limit.

7.2.9 Demonstration of Capability (DOC): At method startup and after major instrument or procedural modification a DOC is performed to document that the procedure is capable of generating accurate and precise results.

7.2.10 Instrument Blank: Aliquot of solvent or DI water utilized to demonstrate the instrumentation is free of background contamination.

7.2.11 Others: There are many other QC data elements that are method specific. Refer to the appropriate SOPs for descriptions, frequency and acceptance criteria.

7.2.12 Appendix D of this manual contains a list of the quality control samples analyzed and the associated frequency.

7.3 Control Limits

7.3.1 Control limits or acceptance criteria are in place for the various QC components in a method to determine if an analysis is in control or if matrix issues are present. Control limits are either specified by the method or generated by the laboratory. Control limits may also be specified by the supplier of a quality control sample. If a method describes initial criteria as a starting point for data acceptance, these are followed until enough points have been generated to determine statistical limits based on actual method performance.

7.3.2 If control limits are specified by a method, these are followed and laboratory limits are not generated.

7.3.3 If an outside supplier of a quality control sample specifies limits, these will be followed and laboratory limits are not generated.

7.3.4 If a method does not specify any control limits or specifies initial limits until enough data points can be generated then the laboratory will generate acceptance criteria. The following guidelines apply to generating laboratory control limits:

7.3.4.1 Review of laboratory control limits will take place annually.

7.3.4.2 A minimum of 20 points will be used.

7.3.4.3 For any QC data element such as surrogate or matrix spike recovery, a mean recovery and standard deviation (σ) is determined.

7.3.4.4 Warning limits are calculated as $\pm 2\sigma$ from the mean and acceptance limits are calculated as $\pm 3\sigma$.

7.3.4.5 In all cases, control limits will not be set tighter than $\pm$10%.

7.3.4.6 Each suspected outlier must be evaluated and rejected if found to be statistically unrepresentative. It is important not to disregard specific points because they do not meet a preconceived notion of acceptability. Caution must be used in the rejection of data points since overly restrictive control limits can result from the elimination of valid data.

7.3.4.7 Control limits for matrix spikes are matrix specific.

7.3.4.8 In some cases, control limits are calculated on a subset of analytes instead of the full target compound list. This is done in order to minimize use of toxic compounds. The compounds used are chosen to represent different classes of compounds in the full target list.

7.4 Application of QC results

7.4.1 When the result of any QC measurement is out of the acceptable range, refer to the corrective action procedures in Section 9.

7.5 Control Charting

7.5.1 Data used for the generation of control charts and control limits are maintained and updated regularly. Using Excel or other electronic spreadsheet program the data can be formatted and presented in a control chart format for review.

7.6 Blind QC Sample Analysis

7.6.1 EAI participates in several outside QC programs. These include the semi-annual WS and WP programs through an approved Proficiency Test (PT) Provider and the state of Maine GRO/DRO performance evaluations. Other project specific QC programs are employed as required by specific project needs.

7.6.2 An internal blind PT study is not formally part of the quality systems at this time however, EAI reserves the right to participate in such a study.

7.7 Performance and System Audits

7.7.1 External Audit

7.7.1.1 On a biennial basis, an on site audit is conducted by a NH ELAP assessor. In addition, customers or other regulatory agencies may perform on site audits as necessary. It is EAI policy to cooperate fully with any on site auditor or assessor.

7.7.1.2 On semi-annual basis, proficiency testing is completed for all analytes/groups for which accreditation is requested.

7.7.2 Internal Checklist Based Audits

7.7.2.1 On an annual basis the QA Coordinator or their appointee performs internal audits. This audit includes:

7.7.2.1.1 A review of Training Records (Initial and Ongoing Demonstration of Capability)

7.7.2.1.2 SOPs

7.7.2.1.3 Proficiency testing results and other blind sample results

7.7.2.1.4 MDL studies

7.7.2.1.5 Reagent Labeling and Standards Tracking

7.7.2.1.6 Corrective Action records

7.7.2.1.7 Facilities

7.7.2.1.8 Review of a representative analytical report for traceability to raw data

7.7.2.1.9 Record storage

7.7.2.1.10 Overall implementation of the Quality Assurance Program

7.7.2.2 Checklists modeled after those used by NH ELAP assessors are utilized to facilitate the auditing process. An example of one of these checklists is provided in Appendix C. The completed checklist provides information for the internal audit summary. This summary is in paragraph form and includes any discrepancies or recommendations being made to the department as a result of the auditing process. Both the checklists and the summaries are completed annually for each analysis. Methodologies are combined to create one checklist and summary where applicable, for instance requirements from ABN methods EPA 625 and SW 846 8270C are combined to form one ABN checklist and/or summary. The Department Manager(s), employees and Lab Director review the record of the audit. Written response to any deficiencies noted is required within 15 business days. A copy of the audit and corrective actions is kept on file by the QA Coordinator and is made available to be included in the annual Managerial Review. At the company's discretion, the annual internal audit may be subcontracted.

7.7.3 Internal Data Package Review

7.7.3.1 At the QA Coordinator's discretion or at the request of the Department or Laboratory Manager, the annual internal audit may consist of the review of a full C Level Data Package.

7.7.3.2 The QA Coordinator will submit a written request for a C Level Package for a specific sample set. The analyst and QA Coordinator will base the timeframe for the production of such a package based on workload and other initiatives.

7.7.3.3 The QA Coordinator will review the data package based on NELAC Checklists and EPA Region I Data Validation Guidelines.

7.7.3.4 Areas covered may include but are not limited to:

7.7.3.4.1 Sample hold time and preservation

7.7.3.4.2 Tuning Criteria (if applicable)

7.7.3.4.3 Initial Calibration

7.7.3.4.3.1 Response Factors are hand calculated to verify accuracy of software.

7.7.3.4.3.2 Method Acceptance Criteria

7.7.3.4.4 Calibration Verification

7.7.3.4.4.1 Concentrations are hand calculated from Internal Standard Responses and Area Counts to verify accuracy of software (if applicable).

7.7.3.4.4.2 Method Acceptance Criteria

7.7.3.4.5 Method Blanks

7.7.3.4.6 LCS Samples

7.7.3.4.7 MS/MSD

7.7.3.4.8 Sample Raw Data

7.7.3.4.8.1 Peak Integration (if applicable)

7.7.3.4.8.2 Concentration calculation - verify accuracy of software and FileMakerPro.

7.7.3.4.9 Documentation Practices - review of electronic and bench level log books for proper and complete documentation

7.7.3.4.10 Standard/Regent Tracking

7.7.4 Managerial Review

7.7.4.1 Management is actively involved in the continuous development and improvement to EAI's quality systems. The Lab Director and Department Managers participate in review procedures throughout the calendar year. The QA Coordinator and the QA Committee review the QA Manual annually. This committee is comprised of the Lab Director, QA Coordinator and Department Managers or their designees. External audit results are available to all staff and each department manager is responsible for required corrective action. Internal audit results are submitted to the analyst, Department Manager, Lab Director and President for review and comment. PE results are circulated to all members of management for review. Management facilitates corrective action processes where applicable. The regularly held QA Committee meetings are utilized as a forum to review and discuss all aspects of the quality system.

7.7.5 Performance Audits

7.7.5.1 On an ongoing basis the laboratory ensures the quality of the reported results through the use of internal quality control measures, proficiency testing, second source references for calibrations, re-analyzing samples in question, and correlation of results for sensibility.

7.7.5.2 The results of these audits are maintained in the project files on an ongoing basis.

7.7.6 Audit Findings

7.7.6.1 In the event that the results of any audit cast doubt on the validity of any data generated, a complete review of all potentially affected data will occur. If any data is impacted, the customers will be immediately notified verbally and in writing of the situation, the impact to the data reported and corrective actions taken to correct the problem in the laboratory.

8 Data Reporting and Records Management

8.1 The objective of EAI is to provide our customers with an analytical report that is a clear and accurate presentation of all requested and relevant information. The report can be provided in many formats including: hardcopy document form, electronic data deliverable, FAX, spreadsheet, database or any combination of these formats.

8.2 Data Flow

8.2.1 Data Generation

The analytical data is generated as described in the method SOPs. The sample identification, volume of sample, data and time of analysis, and other pertinent information are recorded in a run log either manually or electronically.

8.2.2 Data Entry

Data entry is performed by the analyst. Data is entered either manually, into a spreadsheet and/or database, or electronically with data transfer directly from the instrument via Excel to the database. For VOCs, Semi VOCs and Metals, the project file contains a hard copy record of the data. For Inorganic wet chemistries the project file includes sufficient information to locate the data records. The project file must contain sufficient information to allow the data reviewer the ability to validate the accuracy of the data entry process.

8.2.3 QC Data

Analysis of quality control samples is performed with every analytical sample batch. All quality control data is checked by the analyst before data is reported. QC data is provided to the customer upon request. Unless specified by the customer or QAPP, QC deliverables will be batch specific. If project specific QC is requested by the client or QAPP and sufficient sample volumes are provided then QC deliverables will be project specific.

8.2.4 Hardcopy Reporting

After the data entry and transcription steps are complete, the QC data is evaluated, and the data is reviewed, a hard copy of the report is generated for the customer.

8.2.5 Backup Data Archives

Analytical data and all associated raw data to allow a re-creation of the project file is available. The archived data is available in hard copy or electronic form and is maintained for 5 years unless otherwise specified by a customer or agency.

8.2.5.1 Ohio VAP: All supporting and analytical data associated with Ohio VAP projects are retained for a minimum of 10 years. Written notification of intent to dispose of Ohio VAP records will be sent via certified mail to the Director of the Ohio Environmental Protection Agency, so that the Agency is afforded the opportunity to retain said records. The laboratory shall retain all Ohio VAP records until such notification is submitted and a written response from the Ohio VAP agency is received at the laboratory. This requirement to notify is not mandatory if the laboratory chooses to retain all documents.

8.2.5.2 Massachusetts: All supporting and analytical data/records pertaining to samples from a project site within the Commonwealth of Massachusetts are maintained for a minimum of 10 years.

8.3 Data Verification

8.3.1 Excel spreadsheet calculations: Prior to the use of any calculations involved in the data generation, and after any changes to those calculations, the calculations will be checked with a virtual LCS to determine the proper functioning of the data design. A record of the calculation check is documented in the spreadsheet.

8.3.2 FileMakerPro Pro (FMP) calculations: The QC Coordinator will run a check on the FMP calculations and keep a record of this check on file.

8.4 Data Review/Sign Off

8.4.1 Technician/Analyst Review

Data generated is double-checked for accuracy by the analyst. The analyst checks for sensibility and transcription errors. QC data is calculated by the computer software and verified against known limits. A QC narrative is compiled by the software and associated with all samples in the batch by a QC batch number. The analyst may add to the narrative any corrective actions or reasons why the data is acceptable for reporting. The analyst immediately initiates resolution of any limit exceedances or errors. The analyst initials and dates the data. For specific corrective action steps, see Section 9.0. The flowcharts found in APPENDIX F, identify items checked during data review. At a minimum the analyst reviews the following prior to data release:

- Initial Calibration meets acceptance criteria
- Tune meets method criteria (where applicable for organic analyses)
- Calibration Verification (CV) meets acceptance criteria
- LCS meets acceptance criteria
- Method blank meets criteria
- All target concentrations within calibration range
- All peaks properly integrated
- All manual integrations properly saved
- Surrogate concentrations meet criteria (where applicable for organic analyses)
- Internal Standard concentrations meet criteria (where applicable for organic and metals analyses)
- Samples analyzed within Tune Window (where applicable for organic analyses)
- All positive “hits” are confirmed (use of QEdit in Organics)
- This includes review of quantitation ions and retention times
- Dilution factors applied (where applicable)
- Duplicate analysis meets criteria
- MS/MSD analysis meets criteria
- Hold times, where applicable, were met
- Any notes or anomalies noted during analysis

8.4.2 Department Manager Review

8.4.2.1 The Department Manager (or designee) reviews all reports generated by their department. The Department Manager

checks the report for significant figures, data inconsistencies, hold times, history, quality control criteria and documentation if necessary. The Department Manager may ask a chemist or technician to check any data that appears inconsistent. The Department Manager may also review bench logs, spreadsheets or instrument data as necessary. The Department Manager then approves the report for release to the customer. The approval is noted via initials and date on the department work order.

8.4.2.2 The report is now ready for faxing to the client however data at this time is not final. A faxed cover sheet stating that attached data is "Preliminary" precedes data faxed at this stage.

8.4.3 Front Office Review

8.4.3.1 When all departments involved in a job have completed their section of the report the front office will compile the complete report and check the following:

- Client ID
- Sample ID(s)
- Correct type and number of analyses
- Receipt and sampling dates
- Special client requests
- COC

8.4.3.2 A Sample Conditions page is printed and the report pages, work orders and raw data are put in order. The report package is now ready for final review and sign off.

8.4.4 Laboratory Director Review

8.4.4.1 When all sections of a report are collated the Laboratory Director (or designee) makes a final review of the data. The report is checked for client description errors, significant figure errors, hold times, compliance with the project needs, sensibility, data inconsistencies and historical data. The Laboratory Director returns the report to the appropriate Department Manager if there are any errors or if data requires rechecking. No data changes are made without the approval of the Department Manager or designee. When all data has been approved, the Lab Director signs and dates the cover letter for the report package.

8.5 Elements of a Report

8.5.1 Each report includes the following sections:

8.5.1.1 Cover page

8.5.1.1.1 Client name and address

8.5.1.1.2 EAI ID #

8.5.1.1.3 Client project ID

8.5.1.1.4 Date received

8.5.1.1.5 EAI Certifications

8.5.1.1.6 Signature and date of final review

8.5.1.1.7 Number of pages in the report (excluding cover page)

8.5.1.2 Sample conditions page

8.5.1.2.1 Lab sample ID

8.5.1.2.2 Client sample ID
8.5.1.2.3 Date received
8.5.1.2.4 Date sampled
8.5.1.2.5 Sample matrix
8.5.1.2.6 % Dry (if applicable)
8.5.1.2.7 Receipt temperature
8.5.1.2.8 Documentation of any discrepancies or sample integrity issues that are noted at the time of sample receipt (for example: improper preservation, improper storage, holding time violations).

8.5.1.3 Case narrative (if requested)

8.5.1.4 Analytical report pages

8.5.1.4.1 Client sample ID
8.5.1.4.2 Laboratory sample ID (BatSamNum)
8.5.1.4.3 Analyte
8.5.1.4.4 Concentration
8.5.1.4.5 Analytical matrix (if applicable)
8.5.1.4.6 Date of analysis
8.5.1.4.7 Time of analysis (if hold time is < 48 hrs)
8.5.1.4.8 Method of analysis
8.5.1.4.9 Analyst initials
8.5.1.4.10 Units
8.5.1.4.11 Narrative (if necessary) to include any deviations or footnotes that describe any sample specific issues noted during the analysis of the samples.
8.5.1.4.12 Dilutions, reporting limits and prep methods may also be included at client request.

8.5.1.5 QC report pages (if requested)

8.5.1.5.1 Where applicable: Blanks, LCS/LCSD, Duplicates, MS/MSD
8.5.1.5.2 Recoveries, RPDs and QC limits

8.5.1.6 Chromatograms (if requested)

8.5.1.7 Copy of Chain of Custody

8.5.2 The time of sample preparation or analysis for any analyses with less than a 48 hour holding time are noted in the report.

8.5.3 Dilution factors are reported for all organic analyses. For inorganic analyses the dilution factors are reported only when the reporting limit is raised and no reportable concentrations are found. A note discussing the reason for the dilution is included in the report when the reporting limit is raised yet there are no reportable concentrations found.

8.5.4 The total number of pages in the report, including chromatograms and custody records, is included in the cover page. The entire report is paginated.

8.5.5 A reference to the sampling procedure used is also included for any samples collected by EAI.

8.5.6 All of the pages submitted with the report comprise the analytical report.

8.5.7 The signed hardcopy report is the official/legal presentation of the data.

8.6 Reporting Conventions

8.6.1 Reported data has the correct units identified for each sample. The units selected depend on the sample matrix and method.

8.6.2 Results are reported as whole integers for values between 1-9. Results greater than 9 are reported with two significant figures.

8.6.3 Results are not blank subtracted, unless specified by the method.

8.6.4 Soil samples are reported on a dry weight basis, unless otherwise specified by method or noted in the report.

8.6.5 Non-aqueous liquids and miscellaneous (non-soil) solid samples may be reported on an “as received basis” and are specified as such on the report.

8.6.6 Aqueous and air results are reported as weight/volume.

8.6.7 Significant figures

8.6.7.1 Significant figures. Every measurement carries with it a degree of uncertainty/confidence, or error. How large this error is depends upon the nature of the measuring device and the skill with which it is determined. The term Significant Figures defines the degree of uncertainty/confidence in a measurement.

8.6.7.2 All data Reporting Limits are reported as 1 (one) significant figure. All measurements presented at the reporting limit and up to the next order of magnitude are reported with one significant figure. Measurements exceeding the number of digits in the reporting limit are reported as 2 (two) significant figures.

8.6.7.3 The possibility of significant figures exceeding the above rule may occur when presenting the data in electronic format. This does not imply greater significance of the data.

8.6.7.4 Table 8.1 contains examples that demonstrate the reporting rules for significant figures.

8.6.8 Rounding Rules

8.6.8.1 All data presentation follows the “EPA” rounding rules as specified in Standard Methods. The following is repeated verbatim from “Rounding Off” section 1050B part 2, Significant Figures, p.1-28, Standard Methods for the Examination of Water and Wastewater, 1989, 17th Edition. “Round off by dropping digits that are not significant. If the digit 6,7,8, or 9 is dropped, increase preceding digit by one unit; if the digit 0,1,2,3, or 4 is dropped, do not alter preceding digit. If the digit 5 is dropped, round off preceding digit to the nearest even number: thus 2.25 becomes 2.2 and 2.35 becomes 2.4.”

8.7 Report Revisions and Reissues

8.7.1 If a change is made to a report after it has been mailed to the customer, it is considered a report revision. Revisions may include data value modifications and/or related client information. The project file must contain a record of the change and a description of the reason for the change. The cover page of the report package will include a note that the report is a revision and state a reason for the revision. The cover page will include a sign-off date which will be considered the date of revision.

8.7.2 A reissue is a resubmission of a report in which no changes have been made. The report must be labeled as a reissue and the date of the reissue must be included in the report. This information will be included on the cover page of the report package.

8.8 Deliverables

8.8.1 QC Deliverables

8.8.1.1 Table 8.2 describes the reporting options provided by EAI.

8.8.2 Electronic Deliverables

8.8.2.1 Presentation of the final reported data may be exported from multiple electronic sources or hand entered and submitted in an electronic format via e-mail or diskette. Examples of available electronic formats include, but are not limited to, XLS, DBF, CSV, DOC, RTF, WKS, TXT, SLK, HTML and FP5. The data content of the electronic deliverable is client selectable and may contain more or less information than the hardcopy report.

8.8.2.2 All electronic deliverables are checked before submission to insure that the electronic information matches the hard copy information.

8.8.2.3 Prior to sending electronic deliverables via e-mail, the user password is verified.

8.8.2.4 Prior to sending electronic deliverables, the analytical data must be approved for release by the Department Manager and Lab Director.

8.8.2.5 A record containing the date of submission of the data is kept on the Master Work Order and recorded in the BatLog.fp5 EDD Layout.

8.8.3 Faxing Procedure

8.8.3.1 Faxing of hardcopy data reports occurs after the Department Manager or designee has released the data.

8.8.3.2 The fax number for the customer is found on the fax sheet in the project file.

8.8.3.3 Prior to using a new fax number for submission of data or entering it into the speed dial, the number must be verified.

8.8.3.4 All hardcopy reported data that is faxed prior to the Lab Director review is considered “Preliminary”, and is labeled as such.

8.8.4 Verbal Results

8.8.4.1 In the event that the customer requests verbal results, the Department Manager or designee must first approve the results for release.

8.8.4.2 The customer must be informed that the results are considered preliminary and not final until the hard copy report is signed.

8.8.5 Reporting of Subcontractor Data

8.8.5.1 Results for samples subcontracted are included in the EAI lab report. The results, as received from the subcontractor and the COC, are provided to the customer.

8.8.5.2 In the event that the customer would like the subcontracted data provided in an EAI format, the report will clearly indicate a

subcontract laboratory generated the data and a copy of the subcontractor data is also included with the report.

8.9 Records Management and Document Control

8.9.1 The records kept must allow the complete reconstruction of laboratory activities.

8.9.2 All records must be legible and recorded in permanent ink.

8.9.3 A single line cross out, with initials of the individual making the correction must be used to correct the errors.

8.9.3.1 In the event that the correction is due to some reason other than a transcription error, the reason shall be documented alongside the correction.

8.9.4 In the event that data is generated but not used, the records are kept (electronically or hard copy) and the data used for reporting is clearly noted as such.

8.9.5 All records and entries must clearly indicate what activity was occurring, by whom, and when.

8.9.6 An initials log is maintained and includes the employee name, actual written initials, and actual signature.

8.9.7 All documents are categorized into the following categories.

8.9.7.1 Laboratory Notebooks

8.9.7.2 Instrument Logs

8.9.7.3 Proficiency Test Results and On Site Audits

8.9.7.4 Laboratory Reports

8.9.7.5 Personnel Files and Training Records

8.9.7.6 Calibration Data

8.9.7.7 Method Detection Limit Studies

8.9.7.8 Initial and Ongoing Demonstration of Capability

8.9.7.9 SOPs

8.9.7.10 Field Services

8.9.7.11 Facility Information: Temperature Logs

8.9.7.12 Administrative Information: Customer Complaints

8.9.7.13 Quality Assurance Manual

8.9.8 Word, Excel or FileMakerPro Pro are used for most documents and runlogs.

8.9.8.1 Word documents will be saved with a new file name before revisions are made. Changes will be tracked in the new Word document before final acceptance. Once revisions are complete, changes are accepted and the new document is placed in the “active” files. Word documents will include effective dates for tracking purposes. The document being replaced is saved as “read only” and archived.

8.9.8.2 Excel and FileMakerPro documents will have changes dated and initialed in the file. Electronic notebooks and documents will be backed up and stored off site.

8.9.9 All documents related to current activities are kept in the laboratory work areas. Each document is labeled with an effective date. Documents that are ready for archival are stored in storage boxes in the Department Manager’s work areas and labeled with the category, the date range of

the documents held in the box, and the department, when applicable (Metals, Wet Chemistry, etc….).

8.9.10 Analytical reports are archived on an annual basis and are filed according to EAI BatNum. The box is labeled with the category and the EAI BatNum range.

8.9.11 Full boxes are given to the QC Coordinator, or designee, to archive in a location protected from fire, theft, or other loss. Prior to archiving each box is given a sequential number, a storage location, and the date of archival. This information is recorded in the archival log and is kept by the QC Coordinator, or designee.

8.9.12 All access to archived information is recorded in the log with the date of access, the individual accessing information and the date of return of the information.

8.9.13 In the event of a transfer of ownership the records will transfer to the new owner. In the event of a change in business status, the customers will be given the option to retrieve documents they own. All unretrieved documents will be destroyed.

8.9.14 All records are maintained for a minimum of 5 years with the following exceptions:

8.9.14.1 Ohio VAP: All records pertaining to the generation of Ohio VAP data will be retained for a minimum of 10 years. Ohio will be notified before records are destroyed.

8.9.14.2 Massachusetts: All records pertaining to the generation of data from a site in within the Commonwealth of Massachusetts will be retained for a minimum of 10 years.

8.9.15 In the event of a records audit, search the log for the category requested and the date range in question.

8.10 Computers and Electronic Data

8.10.1 EAI uses the EPA document “2185- Good Automated Laboratory Practices” as the reference document for implementing information systems related practices and procedures in the laboratory.

8.10.2 Prior to the implementation of any new revisions or upgrades to the system, the computer software is documented.

8.10.3 The integrity of all stored electronic data is protected via a scheduled nightly backup routine.

8.10.4 The integrity of the data processing is protected via hard copy back up and manual final review of all analytical data.

8.10.5 The final reported analytical data is stored in the data storage location “DataWareHouse”. This file is used as read-only and has the functionality of being password protected.

8.10.6 EAI employs a corporate network Domain authentication infrastructure utilizing Microsoft Backoffice Small Business Server 2000, NetWare 4.0, Windows95, Windows NT 4.0 and Windows 2000. Unauthorized access is denied to all computers running Windows NT 4.0 and Windows 2000. Access to Windows95 and Windows for Workgroups 3.11 is completely open (no security) to the end-user with the exception of network access – network access requires username/password logon.

8.10.7 Each end-user has a unique username and password for each network resource.

8.10.8 The EAI LIMS (FLOYD) operates on FileMakerPro5.0v3 and includes additional security features which are separate from the Microsoft

Windows security paradigm. The functionality of this security structure is enabled for all mission-critical files associated with the EAI LIMS.

Table 8.1
Significant Figure Reporting Examples

Reporting Limit	Concentration Found	Result Reported
1	11.5	12
10	11.5	10
100	135	100
1	<1.4 (dry weight)	<1
1	<1.8(dry weight)	<2
1	18	18
10	18	20
1	1.6	2
1	13	13
3	7	7
7	9.2	9
1	0.999	<1
5	6.9	7
9	11.2	11

Table 8.2
Eastern Analytical, Inc.
Data Deliverables Package Options

Description	A	B	C
Sample	X	X	X
Chain of Custody	X	X	X
Percent Solids Data	X	X	X
Surrogates (acceptable ranges incl.)		X	X
QA/QC Narratives (report page)		X	X
Summary Narrative Page		X	X
Method Blanks (B)		X	X
Matrix Spike (MS)		X	X
Control Sample (LCS or ICV)		X	X
Duplicate (DUP or MSD)		X	X
Multi-point calibration			X
Continuing Calibration			X
Tune Report			X
Internal Standard Areas (IS area)			X
Chromatograms*			X
Sample Preparation Log			X
Instrument Run Log			X
Quantitation Report			X

Notes:
*Chromatograms are automatically included for MEDRO reports and 8015 DRO & 8100 (mod.) Level II reports.

“A+” level QA/QC deliverables include benchsheets

“B” level QA/QC deliverables are divided into two categories:

1) Project specific “B” level deliverable

   Project specific QC is designated by the client for a project. Extra sample is collected at a specific location for a specific project and that sample is to be used to meet the project specific QA/QC.

2) Batch “B” level deliverable

   Batch specific QC is defined by the analytical batch. Routinely, samples are randomly chosen to meet the QA/QC requirements on an analytical batch. These samples may or may not pertain to the client project requesting the “B” deliverable but instead represent the batch with which they were processed.

“B+” level QA/QC deliverables include the above “B” level plus benchsheets

9 Corrective Action

9.1 Overview

9.1.1 This section discusses the procedures used to discover, track, document, and resolve problems.

9.1.2 Deviations and their associated corrective actions are documented to ensure steps are put in place to prevent a reoccurrence.

9.1.3 Corrective action applies to all aspects of the QA manual where systemic errors occur. Most deficiencies requiring corrective action fall into three categories. The category of the deviation dictates which corrective action procedure is followed.

9.1.3.1 The first category involves QC deviations that impact an individual sample or a batch of samples that share QC pointers.

9.1.3.2 The second category includes a deficiency of greater magnitude that impacts several sample batches, client delivery groups or has a labwide impact.

9.1.3.3 The third category of corrective action items involves customer inquiries and complaints.

9.2 Deviations related to individual samples or individual batch QC data.

9.2.1 These deviations include but are not limited to the following:

9.2.1.1 Sample preservation deviation

9.2.1.2 Sample hold time deviation

9.2.1.3 Batch QC deviations such as Blanks, LCS, MS/MSD, surrogate, CV, IS, etc.

9.2.2 Each occurrence is handled by the analyst logging in or analyzing the samples or encountering the deviation, or by their supervisor.

9.2.3 Documentation is recorded in one or more of the following places:

9.2.3.1 The work order for sample or delivery group specific impact and deviation

9.2.3.2 The raw data for sample or batch specific impact and deviation

9.2.3.3 The data system for sample or batch specific impact and deviation

9.2.3.4 The Internal Sample Conditions Page for sample receipt deviations

9.2.3.5 Narrated on the final client report for deviations that may have an impact on the reported data

9.2.4 Specific Corrective Action Guidance

9.2.4.1 Sample Preservation and Sample Receipt Deviations

9.2.4.1.1 Evidence of thermal preservation is recorded on the chain of custody at time of sample receipt.

9.2.4.1.2 Samples requiring additional chemical preservation at receipt are recorded on the Internal Sample Conditions page at time of receipt. (Additional preservative is added as required.)

9.2.4.1.3 Broken sample containers, frozen samples, improper containers or preservative and air bubbles (VOC vials) are documented on the Internal Sample

Conditions page. Deviations that may impact the reported data are also reported on the Sample Conditions page contained in the final report.

9.2.4.1.4 The client is contacted if any deviations may impact the requested analyses. Documentation of the client's instructions is noted on the Internal Sample Conditions page.

9.2.4.2 Hold Time Deviation

9.2.4.2.1 If the samples are received by EAI and the recommended holding time has expired, or the samples are dangerously close to expiration, the following steps are followed.

9.2.4.2.1.1 Check with the affected department and determine when the samples could be analyzed.

9.2.4.2.1.2 Contact the customer and inform them of the situation.

9.2.4.2.1.3 If the customer would like us to proceed with the analysis, determine the required TAT and associated surcharges. Login samples and deliver to the laboratory. The use of surcharges is at the discretion of the person communicating with the customer.

9.2.4.2.1.4 If the customer does not want the samples analyzed, cancel the samples and inform the affected departments.

9.2.4.2.1.5 All communication with the customer regarding hold time deviations is recorded on the Internal Sample Conditions page. If the client requests an analysis on an expired sample this is also noted on the Sample Conditions page included in the final report.

9.2.4.2.2 If the samples expire while in the custody of EAI:

9.2.4.2.2.1 Check with the affected department and determine when the samples could be analyzed.

9.2.4.2.2.2 Contact the customer. Explain the situation. If the expiration is a result of EAI error, offer the analysis beyond holding time. Make sure the customer knows this is non-compliant data and it is provided at no charge.

9.2.4.2.2.3 In the situation that additional samples must be collected, EAI takes responsibility for the costs associated with re-sampling.

9.2.4.2.2.4 Results for samples analyzed beyond holding time are qualified with a footnote on the final report.

9.2.4.3 Blank Values Exceed Limits

9.2.4.3.1 Investigate and document the source of contamination.

9.2.4.3.2 Initiate and document the steps required to minimize or eliminate the problem.

9.2.4.3.3 Evaluate data impact. If the concentration in the blank exceeds the RL, evaluate the impact to any reported concentrations of the compound(s) in question.

9.2.4.3.4 Re-analyze all associated samples, unless contaminant of concern is non-detect in client samples or sample volumes do not permit.

9.2.4.3.4.1 If data associated with a contaminated blank must be reported due to sample volume or other limitations, data points must be clearly flagged if the blank concentration is ≥ RL for that parameter. Blank contaminants and concentrations must be included in the QC narrative.

9.2.4.3.4.2 If it is determined that the blank contamination has no impact to data, work orders or raw data shall include a footnote regarding the contamination and a description of how it was concluded there was no data impact.

9.2.4.3.5 Additional guidance may be found in Method specific SOP.

9.2.4.4 LCS Exceeds Limits

9.2.4.4.1 The LCS is the primary indicator of procedural control.

9.2.4.4.2 A LCS failure must trigger an investigation to the preparation and analysis of the LCS and all associated samples. Areas of concern are LCS spike preparation, LCS preparation and the calibration employed for quantitation.

9.2.4.4.3 Once the cause of the failure is determined and rectified associated samples shall be re-analyzed.

9.2.4.4.3.1 If samples cannot be re-analyzed due to insufficient sample volume, data points must be clearly flagged in the QC narrative.

9.2.4.4.3.2 LCS failure would not necessitate re-analysis if the LCS exceeded the highest limit of the acceptance range and the associated samples were non-detect. However, the failure must be noted in the QC narrative.

9.2.4.5 Matrix Spike Exceeds Limits

9.2.4.5.1 Determine procedural control by reviewing results of the laboratory control sample (LCS). If the LCS is in control it may be determined that the procedure is in control. Unless other supporting data can be found, reanalysis of the customer sample may be necessary to demonstrate that the problem is

reproducible and thus related to the specific sample matrix.

9.2.4.5.2 In the event that the investigation shows that the failure is matrix specific and thus, the analytical results generated could be impacted, this is noted in the report.

9.2.4.6 Surrogates Exceed Limits

9.2.4.6.1 Check all calculations, integrations, surrogate solutions, spike amounts and internal standards.

9.2.4.6.2 Check instrument performance.

9.2.4.6.3 If sample volume permits, re-analyze the sample to confirm matrix interference.

9.2.4.6.4 If there is inadequate sample volume for re-analysis, the analyst may evaluate the chromatogram for matrix interferences.

9.2.4.6.5 In the event that the investigation shows that the failure is matrix specific and thus, the analytical results generated could be impacted, this is noted in the report.

9.2.4.7 CV Exceeds Limits

9.2.4.7.1 Investigate problem.

9.2.4.7.2 Samples analyzed after a CV failure are re-analyzed.

9.2.4.7.3 Samples run prior to a CV failure are investigated for possible effects and re-analyzed if necessary. (If bracketing CVs is a Method requirement.)

9.2.4.7.4 If the CV is out of control high and the compounds affected are not detected in the samples, there is no data impact. Report results as usual.

9.2.4.7.5 If the CV is out of control low samples shall be re-analyzed.

9.2.4.7.5.1 If sample volumes do not permit for re-analysis, check QC samples and system to verify that there are no false negatives. If this cannot be verified, determine data impact and discuss with customer. Associated data shall be qualified with a footnote in the final report.

9.2.4.7.6 If the CV is out of control low, sample concentrations that are over a regulatory limit may be reported.

9.2.4.8 Internal Standard Exceeds Limits

9.2.4.8.1 Investigate the problem.

9.2.4.8.2 If sample volumes permit, re-analyze the sample.

9.2.4.8.3 If internal standards meet acceptance criteria in re-analysis, data with acceptable internal standard recovery is reported.

9.2.4.8.4 If the failure is duplicated in re-analysis, associated parameters shall be qualified in the final report with a footnote.

9.2.4.8.4.1 The same footnote shall be applied to final data if sample volumes do not allow for re-analysis.

9.2.4.9 Duplicate Results Exceed Limits

9.2.4.9.1 Verify that the exceedance is sample specific.

9.2.4.9.2 If the error is found to be sample matrix specific, report both concentrations to the customer.

9.2.4.10 Re-analysis

9.2.4.10.1 Review all relevant data and only perform re-analysis if the data integrity is in question or if needed to prove a theory.

9.2.4.10.2 Evaluations of data and re-analysis must be concerned with the method compliance and usability of the data.

9.3 Deviations that effect several batches, groups of samples or have an impact labwide.

9.3.1 Procedure

9.3.1.1 The employee who first recognizes an outlier is responsible for initiating and recommending the corrective action. In the case that someone other than the person who performed the task recognizes the outlier, the person who performed the task is also involved with the recommended corrective action. If detected during final data review, the lab director has the option to pass the project back to the department manager, QA Coordinator or analyst for corrective action initiation and resolution.

9.3.1.2 All persons affected by the investigation are notified of the situation being investigated.

9.3.1.3 All QC deviations that impact data quality, and are a result of laboratory error, are recorded in the FileMakerPro exceptions log.

9.3.1.3.1 Information regarding the deviation such as BatNum affected, analysts, date of occurrence/discovery, parameters affected and corrective actions taken are recorded in the exceptions log.

9.3.1.3.2 A printout of the exception log entry is filed in the project folder(s).

9.3.1.3.3 If the deviation impacts data quality and appears to have occurred due to a systematic problem, the QA Coordinator, Lab Director and/or President may request that an Out of Control Event Form be completed and submitted. The template for this form is stored in the QAQC folder on the network. It contains the same information as the exceptions log, however, typically more detailed and it requires the signature of all involved and a review by the QA Coordinator and Lab Director. These forms are completed and submitted when warranted by an out of control event. An example of an Out of Control Event Form may be found in Appendix C.

9.3.1.3.4 If the deviations are suspected or known to affect the quality of the data being reported, the deviation

is noted on the analytical result page for standard reports and on the narrative page for reports containing quality control data.

9.3.1.3.5 If the deviations do not affect the quality of the data being reported, the reason for the approval of the data is recorded in the file. For a standard report there is no note on the report. If the report contains QC reporting, there is a note on the narrative page.

9.3.1.4 After an initial review of the data, the potential causes of the deviation are listed.

9.3.1.5 The potential causes are researched and the results of the research are documented.

9.3.1.6 The conclusions and corrective action are recorded.

9.3.1.7 A review is done to ensure that all potential projects or processes that could be affected by the deviation have been addressed.

9.3.1.8 Systematic changes are implemented, as applicable.

9.3.1.8.1 Procedural changes are to be communicated to those affected and SOPs are revised to reflect changes needed to prevent a reoccurrence.

9.3.1.8.2 Evaluate modifications to SOP, etc. to determine their effectiveness to prevent repeat occurrences of the specific deviation.

9.3.2 Customer Communication

9.3.2.1 In the event that the deviation results in any change of data the customer is contacted. In addition, any impact to data that is a result of lab error requires customer contact.

9.3.2.2 A record of the conversation with the customer is made in the customer file (Contacts) and on the work order.

9.3.2.3 In the event that the investigation shows laboratory error, an assessment must be made to determine the assignable cause and the data must be evaluated for impacts. If there is no data impact, document the reason for release of the data. If there is data impact, contact the customer.

9.3.3 Report Revisions

9.3.3.1 If the result of the investigation requires a revision of the report, refer to Data Reporting Section 8.0 for guidance.

9.4 Deviations that are related to customer inquiry

9.4.1 One type of customer inquiry is a customer complaint. A customer complaint is any communication from a customer, internal or external, which expresses dissatisfaction with the service provided by EAI.

9.4.1.1 All customer complaints are communicated via an e-mail, which is sent to the Customer Service group. The e-mail is labeled complaint. Customer Service is responsible for making sure the situation gets resolved with the customer and documenting the resolution internally.

9.4.1.2 Upon receipt of a complaint, the employee is authorized to respond as appropriate to correct the situation with the customer as quickly as possible. If additional input is needed to fully understand the nature of the complaint, the affected employees discuss the situation and attempt to resolve it

quickly with the customer. A record of the resolution is also included in the Customer Contact File. If the complaint raises doubt in the quality of data produced by EAI, an internal audit of the procedure is performed and documented by the QA Coordinator or designee.

9.4.1.3 Review and discussion of customer complaints is done on a weekly basis at staff meetings and on a monthly basis during the Sales and Marketing meetings. Any additional follow up notes or necessary corrective actions are noted in the file and a hard copy is printed for the annual review of the Quality Assurance Program.

9.4.2 Another type of customer inquiry is any communication from a customer questioning an analytical result or procedure. Customer inquiries can include but are not limited to questions on data, sampling, billing, methodology or TAT.

9.4.2.1 An inquiry can be handled by any lab personnel. Notification of the inquiry is given to a manager, lab director, customer service or President.

9.4.2.2 Documentation of the inquiry is done in Client Contacts on the EAILIMS. Initials of the employee taking the inquiry along with the date, project ID or BatSamNum and a brief description of the problem are noted.

9.4.2.3 When the investigation into the inquiry is complete this is also noted in Client Contacts with a brief description of the resolution.

9.4.2.4 If data or a report needs to be revised and reissued, a copy of the inquiry will be included in the project file.

10 Definitions

10.1 Blanks: A blank is a sample of laboratory water, solvent or solid free of the analytes of interest. Six types of blanks are utilized in sample analysis.

10.1.1 Instrument blank (IB): Aliquot of solvent or DI water utilized to demonstrate the instrumentation is free of background contamination.

10.1.2 Method blank (MB): Water or a representative matrix that is free of analytes and contains all of the reagents in the same volume as used in the processing of the samples. The method blank is carried through the complete sample preparation and analytical procedures. The MB is used to demonstrate freedom from laboratory background contamination.

10.1.3 Reagent/Solvent Blank (RB): An aliquot of reagent water or other blank matrix used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus. This may be used as a diagnostic tool in addition to the MB.

10.1.4 Calibration blank (CB): Usually an organic or aqueous solution that is prepared with the same volume of chemical reagents used in the preparation of the calibration standards. This is also the first standard used in the calibration curve and is the zero or null reading for the curve. For methods in which the calibration solutions receive the full sample preparation treatment, the calibration blank is identical to, and becomes referred to as the method blank.

10.1.4.1 Initial Calibration Blank (ICB): The ICB is the same as the CB and is used immediately after calibration to determine that system is free of interference.

10.1.4.2 Continuing calibration blank (CCB): The CCB is the same as the CB and is run at the frequency specified in the SOP and is designed to detect any carryover contamination.

10.1.5 Rinse blank (RB): An aliquot of laboratory water or solvent used to prevent cross contamination between samples. Typically analyzed after highly concentrated standards or samples. This blank is utilized strictly as a buffer and analytical results are never reported.

10.1.6 Trip Blank (TB): An aliquot of laboratory water placed in a VOC vial at the time of bottle order preparation. This sample accompanies sample containers to the field and returns to the lab to be analyzed with samples. It is useful in determining cross contamination during sample collection and storage.

10.2 Calibration: The determination by measurement or comparison with a standard, of the correct value of each scale reading on a meter, instrument or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements.

10.2.1 Calibration standard: A concentrated stock solution of known and traceable value that fortifies the solutions used in calibration.

10.2.2 Initial Calibration (ICAL): A multi-level sequence of primary standards used to obtain relationship between the instrument response and the standard concentration.

10.2.3 Initial Calibration Verification (ICV): A second source standard used to verify the accuracy of the initial calibration. Prepared and analyzed as specified in the SOP. The ICV is sometimes referred to as Independent Calibration Verification. A LCS will also fulfill this requirement.

10.2.4 Calibration Verification (CV): A standard from the same source as the calibration standard used to assess calibration accuracy during each analysis run. It is run at a frequency and concentration specified in the SOP. Some methods refer to this standard as a Continuing Calibration Verification (CCV).

10.2.5 Interference Check Sample: A solution prepared to contain known concentrations of interfering elements that will provide an adequate test of the correction factors.

10.2.6 Calibration Verifications are evaluated by 1 of 3 calculations: Percent Recovery, Percent Drift or Percent Difference. The calculation used is defined by calibration curve fit employed and/or the method.

10.2.6.1 Percent Recovery: The percentage of analyte recovered in comparison to the expected concentration. Equation may be found in section 10.4.1.

10.2.6.2 Percent Drift: Utilized when the calculated analyte concentration is determined using linear regression. The percent drift is the calculation of the difference of the instrument response between the initial calibration and each subsequent analysis of the ICV or CCV verification standard.

$$\%Drift = \frac{CalculatedConcentration - TheoreticalConcentration}{TheoreticalConcentration} \times 100$$

10.2.6.3 Percent Difference: Utilized when the calculated analyte concentration is determined using average response factor. It determines the difference between the average response factor of the initial calibration and the response factor of the calibration verification.

$$\%Difference = \frac{RF_v - \overline{RF}}{\overline{RF}} \times 100$$

Where: RF_v *= Response Factor of the Calibration Verification*

$\overline{RF}$ *= Average Response Factor from Initial Calibration*

10.3 Spikes: A known mass of target analyte added to a field sample, sub-sample or analyte free matrix; used to determine recovery efficiency or for other quality control purposes.

10.3.1 Laboratory control sample (LCS): The LCS, also known as the laboratory fortified blank (LFB), is an analyte free matrix which is spiked with analytes from a source which is independent of the calibration solutions. The compounds added to the LCS include all targeted analytes or a subset of compounds that are representative of the reported analytes. This is used to document method performance. The LCS is prepared and analyzed exactly like a sample and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements. The

concentration of the LCS should be greater than the reporting limit for all analytes that are used to determine method control.

10.3.2 Matrix spike (MS): The MS, also known as a laboratory fortified sample matrix (LFM), is an aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The MS is prepared and analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations. The frequency of MS analyses is one per matrix per batch. The source of the matrix spiking solution may be the QCS or the calibration standards. Note: If the calibration standard is used, the calibration must be verified with a second source standard. The concentration of the MS should be greater than the reporting limit for all analytes that are used to determine method control.

10.3.3 A matrix spike duplicate (MSD): The MSD is the spiking of intra-laboratory (unless otherwise specified by the method or QAPP) split samples in the same manner as the matrix spike. The choice of analyzing a duplicate or an MSD is SOP dependent. They are used to document the precision of a method in a given sample matrix.

10.3.4 Post digestion spike (PDS): The PDS is the addition of a known concentration of analyte(s) to a portion of prepared sample or its dilution. The percent recovery of the analytical spike is used as a measure of the degree of interference caused by factors from the sample matrix which are present in the analytical solution. If the spike is not recovered within the specified limits, a matrix effect should be suspected. The PDS is used to attempt to confirm matrix effect when the matrix spike results are outside the acceptable limits. The PDS is run at the frequency specified in the SOP.

10.3.5 Quality control sample (QCS): The QCS is a solution of method analyte(s) of known concentration(s) that are used to fortify an aliquot of the LCS or sample matrix. The QCS source is different from the source of calibration standards. It is used to check laboratory performance with externally prepared test materials. The QCS is analyzed as necessary as a diagnostic for QC anomalies.

10.3.6 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. An externally prepared material containing known quantities of target analytes in solution or in a homogeneous matrix. It is used to document the bias of the analytical process.

10.4 Other Applicable Definitions

10.4.1 Accuracy: Accuracy refers to the agreement between the amount of a component measured by a method and the actual amount present. Accuracy is expressed in terms of percent recovery for QC check samples, laboratory control samples, and matrix spikes. It is determined by analyzing spikes and known QC samples.

Percent recoveries are calculated as follows:

$$\%\ Recovery\ =\ \frac{SC\ -\ UC}{EV}\ \text{x}\ 100$$

Where:
SC = Concentration in the spiked sample
UC = Concentration in the unspiked sample
EV = Expected value

10.4.2 Batch: A batch is a group of analytical samples that are prepared and/or analyzed together with the same process and personnel, using the same lot 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 the 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 can exceed 20 samples.

10.4.3 Comparability: Comparability provides sample data which may be evaluated/compared with sample data generated by EAI during another time period or that generated by another organization altogether. Maintaining and following detailed SOPs for storage, preparation and analysis of the sample achieve comparability. Internal control samples, concentration units, linear ranges and detection limits are some of the parameters considered in the assessment of comparability.

10.4.4 Completeness: Completeness reflects the percentage of valid data points collected from an analytical procedure in comparison to the total number of collected data points. Every attempt is made to produce valid data for all sample points. Although EAI's goal for completeness is 100% a more realistic goal is 90%. Completeness is tracked by evaluating method QC requirements such as laboratory control samples, continuing calibration standards and internals standards. Instances were there are deviations in the quality control are noted and tracked in the QC Narrative section of EAI's database. EAI's goal is to maintain the highest possible completeness percentage for all samples and more specifically to meet project specific completeness goals for the client. Completeness may be calculated as follows:

$$Completeness = \frac{A}{B} * 100$$

Where: A = Total number of valid data points
B = Total number of data points

10.4.5 Precision: Precision is determined by running replicate analyses. Frequency of sample replicates is determined by the method.

10.4.6 Relative Percent Difference (RPD): RPD is the absolute difference between duplicate results, divided by the mean value of the duplicates. When RPD is calculated for MS/MSD, the percent recovery can be used for the values. The relative percent difference or RPD is calculated as follows:

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

Where: A = Concentration of Replicate A
B = Concentration of Replicate B

10.4.7 Method Detection Limit (MDL): At method startup, after major procedural or instrument modification and annually thereafter, method detection limit studies are performed to document a statistical Method Detection Limit, as described in 40 CFR Pt. 136 App. B. A minimum of seven replicates are analyzed and used to calculate a theoretical minimum concentration that can be measured at 99% confidence that the result is greater than zero. The calculated value should be at a factor of two to five times less than the Reporting Limit.

Calculate the MDL in the following manner:

$$MDL = t_{(n-1)} (S)$$

Where: MDL = method detection limit
$t_{(n-1)}$ = the student t value appropriate 99% confidence level and a standard deviation estimate with n-1 degrees of freedom
Refer to Table 1 for appropriate student t values

The 95% confidence limits for MDLs are calculated in the following manner:

LCL = (0.64)(MDL)
UCL = (2.20)(MDL)

Where: LCL and UCL are lower and upper 95% confidence limits based on seven aliquots.

Calculate the mean concentration in the following manner:

$$Mean = (\Sigma x) / n$$

Where x = each data point
n = number of replicates

The mean percent recovery is calculated in the following manner:

$$\%R = (mean / spike\ amount) \times 100$$

Where %R = mean percent recovery
Mean = mean concentration of replicates
Spike amount = Target MDL concentration

Table 1

Number of Replicates	Degrees of Freedom (n-1)	$t_{(n-1\ 1-\alpha = 99)}$
7	6	3.143
8	7	2.998
9	8	2.896
10	9	2.821

10.4.8 Representativeness: Representativeness indicates how well the analytical results reflect the actual concentrations and/or mixture of compounds present in the sample. Following documented sample receipt and storage protocol as well as sample preparation techniques ensures representativeness.

10.4.9 Surrogates: Surrogates are organic compounds that are similar to analytes of interest in physical properties and chemical composition. These compounds are spiked into all blanks, duplicates, calibration standards, QC check samples, MS/MSDs, and samples prior to sample preparation and extraction. The purpose of surrogates is to demonstrate method and instrument performance on each sample.

10.4.10 Internal Standards (IS): Known concentration of select compounds added to field samples, QC samples and calibration standards prior to analysis. They are utilized in calibration to correct for column injection losses and purging losses.

10.4.11 Initial Demonstration of Capability (IDC): At method startup and after major instrument or procedural modification an IDC is performed to document that the procedure is capable of generating accurate and precise results.

10.4.12 Continuing Demonstration of Capability (CDC): An IDC that is performed annually to document ongoing precision and accuracy.

10.4.13 Duplicate: An intra-laboratory split sample which is used to document the precision of a method in a given sample matrix.

10.4.14 Field Duplicate: A second field sample collected at the same location as the original sample. The duplicate sample is collected in succession of the original but is preserved, transported and analyzed independently. Field duplicate analysis is dependant upon client submittal and is useful in evaluating the precision of the sampling process.

10.4.15 Method of Standard Additions: The practice of adding a known amount of an analyte to a sample immediately prior to analysis. It is typically used to evaluate interferences.

10.4.16 Linear Dynamic Range (LDR): The range over which a calibration is linear.

10.4.17 Coefficient of the determination (COD): The (COD) is a calculation used to determine the “goodness of fit” for a non-linear calibration model (e.g. a polynomial fit.) In order to have an acceptable non-linear calibration, the COD must be greater than or equal to 0.99.

10.4.18 Relative Standard Deviation (RSD): RSD is the measure of precision among multiple measurements.

$$RSD = \frac{StdDeviation}{\overline{RF}} \times 100$$

10.4.19 Data Quality Objectives (DQO): DQO's are the statement of the overall level of uncertainty that a decision maker is willing to accept in results derived from environmental data.

10.4.20 Method: In the context of this manual and operations at EAI, the term method refers to the published method used as the foundation for EAI procedures and SOPs.

10.4.21 Holding time: Holding time is the time allowed between sample collection and sample preparation and/or analysis as specified in the method.

10.4.22 Standard Operating Procedures (SOP): A written document which details the method of operations, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.

10.4.23 Performance Check Sample: This is also known as a Proficiency Test Sample. This sample is provided quarterly or semi-annually. The composition of the sample is unknown to the analyst and laboratory. The sample is provided to test whether the analyst/laboratory can produce analytical results within specified performance limits.

10.4.24 Dilution Factor (DF): The dilution factor is the factor by which the sample has been diluted in the course of preparation and analysis, including adjustments for moisture.

10.4.25 Practical Quantitation Limit (PQL): PQL is defined in the Safe Drinking Water Act as the level at which 80% of all laboratories come within +/- 40% of the true value. USEPA also describes the PQL as the lowest level that can be reliably achieved within specified precision and accuracy during routine laboratory operating conditions. The numbers are set by regulatory agencies based on intra-laboratory studies. If an analyte is detected at the PQL, you can be 99% confident of its presence, and if it is not detected, you can be more than 99% confident that the analyte is absent.

10.4.26 Reporting Limit (RL): RL is the lower limit at which the laboratory has decided to report analyte concentrations. It is the level above which, the data are of predictable accuracy. It is normally a factor above the MDL and never is lower than the lowest standard in the calibration curve (DL).

10.4.27 Detection Limit (DL): Equal to the lowest calibration standard.

10.4.28 Quality Assurance Project Plans (QAPP): QAPPs are a compilation of detailed procedures to produce data of sufficient quality to meet the data quality objectives for a specific data collection activity.

11 References

11.1 “Methods for Chemical Analysis of Water and Wastes" EPA-600/4-79-020

11.2 “Test Methods for Evaluating Solid Waste", SW 846, 3rd edition, Update III, Update IVA, & Update IVB

11.3 "Standard Methods for the Examination of Water and Wastewater" 19th Edition, 1995 and 20th Edition, 1998

11.4 "Annual Book of Standards, Part 31, Water" ASTM

11.5 “Method for the Determination of Volatile Petroleum Hydrocarbons (VPH)”, Massachusetts Department of Environmental Protection, January 1998.

11.6 “Method for the Determination of Extractable Petroleum Hydrocarbons (EPH)”, Massachusetts Department of Environmental Protection, January 1998.

11.7 “Method for Determining Diesel Range Organics (Method 4.1.25)”, Maine DEP and HTL.

11.8 “Method for Determining Gasoline Range Organics (Method 4.1.17)”, Maine DEP and HTL.

11.9 “Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979.

11.10 “NELAC”, July 1999, 2000, 2001, 2003 and updates.

11.11 “Manual for the Certification of Laboratories Analyzing Drinking Water”, EPA 815-B-97-001, March 1997.

11.12 “The Compendium of Quality Assurance and Quality Control Requirements and Performance Standards for Selected Analytical Methods Used in Support of Response Actions for the Massachusetts Contingency Plan” BWSC-CAM Revision 1, 27 January 2003

11.13 “Practical Guide for Ground-Water Sampling”, (Barcelona et al., 1985)

Eastern Analytical, Inc.

Quality Assurance /Quality Control Manual

APPENDIX A

Methods and SOPs

Lorraine Olashaw 3-13-06
Lorraine Olashaw, Laboratory Director
(603) 228-0525

Kathleen Noonan 3-13-06
Kathleen Noonan, Q. A. Coordinator
(603) 228-0525

EAI SOP Reference Table

Reference Method	Description	EAI SOP Number**	NELAC Accreditated
Administrative			
NA	Waste & Sample Disposal	1	
NA	Physical Facilities	2	
NA	Sample Receipt and Custody	QA000032	
Extractable Organics			
SW-846 8270 and EPA 625	8270/625 Analysis	QA41500_07	*EPA 625
SW 846 3550B for 8270 Analysis	3550B Ultrasonic Extraction - all SVOC Params	QA41500_09	
3540C for 8081A and 8082	Soxhlet Extraction	QA41500X_03	
SW 846 8000 TPH	SW 846 8000 TPH	QA44000_02	
3510C for 8100/8015DRO, MEDRO and 8270PAH - sep funnel	TPH 8100/8015DRO/8270PAH MEDROAQ Prep	QA44000_05	
	TPH Oil Prep	QA440001	
SW 846 8015B	SW 846 8015B DRO	QA44004_02	
	PCB WIpe prep`	QA45000	
	PCB Oil Prep	QA450001	
608/8081/8082	Pesticide/PCB Analysis	QA456084	*EPA 608
3510C for 8270 and 625 - sep funnel	Sep Funnel Liq Liq Extraction	QA45625_8 3510C	
Maine DRO 4.1.25	Maine DRO 4.1.25 -	QA47000_02	
3550 - 8081 and 8082	Pesticide/PCB S extraction	QA45002_02	
MASS EPH May 2004 Revision 1.1	Massachusetss EPH (silica gel fractionation)	QA46000_01	
Field Services			
SM 3500-FE D and Hach 1,10 Phenanthroline Iron Reagent Method	Field Fe2	QA1260000	
Standard Methods for the Examination of Water and Wastewater 19th edition section 1060	Sample Handling	QA9000001	
Auto Sampler Bottle Cleaning	Auto Sampler Bottle Cleaning	QA9100000	
Practical guide to Groundwater Sampling	Static water level and well depth	QA9100101	
EPA 170.1	Field Temperature	QA9100300	
EPA 150.1	Field pH	QA9100500	
EPA 120.1	Field Conductivity	QA9100600	
EPA 360.1	Field DO	QA9100800	
SM 2580B	Field ORP	QA9100900	
Chemetrics Method 377.1	Field Sulfite	QA9110100	
EPA SOP 2109	Field GC	QA950001	
Standard Methods for the Examination of Water and Wastewater 19th edition senction 1060	VOC Sampling	QA580001	

**Last two digits of each SOP Number are subject to change with document revision.

EAI SOP Reference Table

Reference Method	Description	EAI SOP Number**	NELAC Accreditated
Direct Push Soil Vapor	Direct Push Soil Vapor	QA9616001	
Inorganic Chemistry			
EPA 160.3, SM 2540B	Solids, Total	QA100000TS	*
EPA 160.2, SM 2540D	Solids, Suspended	QA102001TSS	*
EPA 160.1, SM 2540C	Solids, Dissolved	QA104001TDS	*
EPA 160.4, SM 2540E	Solids, Volatile	QA106000VS	
EPA 160.5	Solids, Settleable	QA108000SS	*
EPA 300.0, Lachat 10-510-00-1-A	Anions by IC, Lachat	QA114005IC	*
EPA 325.2, EPA 353.2, Lachat 10-117-07-1-B & 10-107-04-1-A	Chloride, Nitrate/Nitrite by FIA	QA117001Lachat	*
Lachat 10-117-07-1-B & 10-107-04-1-A	Lachat FIA Reagents	QA11711LachatReag	
Lachat 10-117-07-1-B & 10-107-04-1-A	Lachat FIA Start up procedures	QA11720LachatStUp	
EPA 310.1, SM 2320B	Alkalinity, including Carbonate and Bicarbonate Alk	QA130001Alk	*
EPA 335.2, SM4500CNE SW 846 9010B and 9014	Cyanide, Total, Midi Dist	QA134003CNt	*
EPA 335.2, SM4500CNE SW 846 9010B and 9014	Cyanide, PAC	QA137000CNPAC	
EPA 350.3	Ammonia EPA 350.3	QA138002NH3	*
EPA 351.1	TKN by potentiometric	QA140002TKN	*
EPA 365.3/SM 4500P	Phosphorus, Total	QA142002PhosT	*
EPA 365.3/SM 4500P	Phosphorus, Ortho	QA143002PhosO	*
EPA 376.2/ SM 4500S C&D	Sulfide, colorimetric (HACH)	QA144001S2	
EPA 330.5, SM 4500ClG, hach 8167 (T), hach 8021 (F)	Total Residual Chlorine (and Free)	QA148001RCl	*
EPA 405.1, SM 5210B	BOD/CBOD	QA152003BOD	*
NA	BOD Meter Calibration	QA15201BODMeteral	
EPA 410.4/HACH 8000/SM 5220D	COD (HACH)	QA154002COD	*
SM 5310C	TOC, UV Perfulfate, new instrumentation TekDor	QA156004TOC	*
Standard Methods 5910B, NH Env-Ws 382 Disinfectant/Disinfection Byproducts Rule	Specific Ultra Violet Absorption	QA159000SUVA	*
EPA 1664	O&G/TPH hexane ext	QA160203HEM	*
EPA 420.1, SW 846 9065	Phenols, Total	QA166002PN	*
EPA 180.1	Tubidity, NTU	QA170001Turb	*
EPA 110.2	Color	QA172002_color	
EPA 150.1	pH	QA176001pH	*
SW846 9045	pH	QA176103pHsol	
EPA 120.1	Specific conductance	QA178001SpeCon	*
SW 846 1010/7.1.2	Flashpoint/Ignitibility	QA181001FlashIgnit	
SW 846 1030	Ignitability SW 846 1030	QA182000_Ignit1030	

**Last two digits of each SOP Number are subject to change with document revision.

EAI SOP Reference Table

Reference Method	Description	EAI SOP Number**	NELAC Accreditated
SW 846 7.3.3.2 and 7.3.4.2	Reactivity - Cyanide and Sulfide	QA18302RCS	
SW 846 9095	Paint Filter	QA186000Paint	
Spectronic Genesys2 Manual	Spectrophotometer SOP	66101specGene2	
NA	Lachat FIA Data Transfer	QA66500LachDataTransfer	
Microbiology			
	Microbiological Environemntal Monitoring		
SM 9221B	Coliform, Total (MPN)	QA190001TC	*
SM 9223B	Coliform, Colisure (P/A)	QA191100Colisure	*
SM 9223B 19th edition	Coliform, Colilert (P/A) and Colilert 18 (P/A)	QA191110Colilert&Colilert 18	*
SM 9221F 19th edition	Coliform, E. coli (MPN)	QA193001EC	*
SM 9221E 19th Edition	Coliform, Fecal (MPN)	QA196001FC	*
SM 9230B	Coliform, Fecal Strep (MPN)	QA198000FS	*
SM 9215B	Heterotrophic plate count	QA1992001	*
Metals			
WW Digestion Procedure EPA 200.7/200.8	dig-Metals by ICP /ICPMS-WW Digestion	QA2000003	
EPA 200.7	Metals by ICP	QA2000005	*
1311	TCLP Aqueous & Solid Extraction	QA20003_tclp1311	
SW 846 6010B & 6010C	Metals by ICP 6010B & 6010C	QA201006_ICP6010B_6010C	
SW 846 3051A & 3051	dig-Metals by ICP /ICPMS-Microwave Solid digestion 3051 & 3051A	QA230005_MicroDigA_3051_3051A	
WW Block Digestion Procedure EPA 3020 & 3020A	dig-Metals by ICP /ICPMS-WW Digestion	QA241000_Aqdig_3020_3020A	
EPA 200.8	Metals by ICPMS	QA29003_200.8	*
SW 846 6020 & 6020A	Metals by ICPMS	QA292004_6020_6020A	
SW 846 7196A	Hex Chrome - Aqueous	QA29603_CR6+_7196A	
Volatile Organics			
3810, 8015B and "analysis of Dissolved Methane.." Kampbell and Vandegrift	Methane Analysis	QA530001	
EPA 524.2	524VOCs by GCMS	QA540003	*
MA DEP VPH	MADEP VPH	QA561000	
EPA 601	601 VOCs by GCMS	QA57001	
SW-846 Method 8015B update IIB	8015B GRO Analysis	QA570062	
Maine GRO 4.2.17	Maine GRO Analysis	QA570072	
SW846 - 8260B Rev 2, 12/96 624	8260B and 624 VOCs by GCMS	QA580007	*EPA 624

**Last two digits of each SOP Number are subject to change with document revision.

EAI SOP Reference Table

Reference Method QC/Tracking	Description	EAI SOP Number**	NELAC Accreditated
	Manual Integration	4.2	
	Calibration of Support Equipment	QA66002	
SM2540G	% solids determination	QA66100%Dry	
NA	Reagent Tracking	QA66200	
	Glassware Cleaning	QA66300	
NA	MDL Studies	QA664003	
NA	Wet Chem Data Review	QA66400WCdatack	
NELAC Standards	IDC/DOC SOP - Demonstration of Capability	QA665001_DOC	
NA	PT Sample Data Tracking	QA66600	

**Last two digits of each SOP Number are subject to change with document revision.

Eastern Analytical, Inc.

Quality Assurance /Quality Control Manual

APPENDIX B

Instrumentation

Lorraine Olashaw 3-13-06
Lorraine Olashaw, Laboratory Director
(603) 228-0525

Kathleen E. Noonan 3-13-06
Kathleen Noonan, Q. A. Coordinator
(603) 228-0525

Equipment	Model	Qty	Dept	Date of Purchase
Oven	Fisher Isotemp500, model 516G	4	wet	1997
Digital Oven	Thelco Model # 70DM	1	wet	2001
Glassware Oven	Blue-M Stabil-Therm	1	voc	
Sample Refrigerator	Beverage Air, E-Series	1	ext	
Sample Refrigerator	Beverage Air, E-Series	1	voc	
Sample Refrigerator	Beverage Air, ESeries	1	wet	
Sample Refrigerator	Beverage Air, ESeries	1	soils	
Refrigerator	True	1	rec lab	
Ice Machine	Scotsman	1	rec lab	2004
Refrigerator	True GDM-49	1	inorg	
Refrigerator	Roper, RT18DKXAW00	1	micro	
Standards Freezer	GE	1	voc	
Extract Freezer	Cool Lab Freezer	1	ext	
Standards Refrigerator/Freezer	Frigidaire	1	ext	
Thermometer, Total Immersion	ERTCO, Serial # 2693 -Scale: -1 to 201ºC in 0.2ºC Increments	1	QC	Jun-03
GC/MS	HP 5890II/5972	1	ext	1993
GC/MS	HP 6890/5972	1	ext	1997
GC/MS w/LEAP Auto Sampler	HP 6890N/5973N	1	ext	2005
GC/ECD	HP 5890II w/ Dual Towers	1	ext	1993
GC/FID	HP 5890II w/ Single Tower	1	ext	1992
Sonicator	Ultrasonic Processor, 2 module	1	ext	
Soxhlet with NESLAB Chiller	ROT-X-TRACT-L Extractors	2	ext	
Turbo Vap	Zymark TurboVap II	2	ext	1992
Muffle Furnace	Thermolyne 62700	1	ext	
Shaker Table - 8 Position	Glas-Col	1	ext	1998
GC/MS	HP 6890N / 5973	1	voc	1999
GC/MS	HP 5890 II / 5972	1	voc	
GC/MS	HP 6890+ / 5973	1	voc	1999
GC/MS	HP6890N / 5973N	1	voc	2004
GC/PID/FID	HP 5890 Series II / OI	1	voc	2005
GC	HP 6890+ / 5973	1	voc	2000
GC	5890 Series II Plus	1	voc	2005
Archon Purge and Trap Auto Sampler	Varian 51 position	4	voc	
Purge and Trap Concentrator	Tekmar 3000	2	voc	
Purge and Trap Concentrator	Tekmar 3100	1	voc	
Purge and Trap Concentrator	Tekmar/Dohrmann 3100	2	voc	
Autosampler 2016	Tekmar	1	voc	
ZHE TCLP Extractors		2	voc	
Top Loader Balance	Denver XE 400	1	voc	
Analytical Balance	Ohaus Adventurer	1	voc	
ICP	PE Optima 3000	1	met	1993
ICP/MS	Perkin Elmer Elan 6100		met	
DigiPrep Digestion System	SCP Science	1	met	2002
Shaker		1	met	1980

Hot Plate	Fisher	1	met	1994
Magnetic Stirrer Hot Plate	Cole Parmer	1	met	1994
Flow Injection Analyzer	PE Fias 200	1	met	1992
AA	PE 3100	1	met	1992
Water Bath	Fisher Scientific	1	met	
Microwave	CEM Mars 5	1	met	2002
Microwave	924020 MDS 2000	1	met	1997
pH Meter	ORION 250	1	met	
TCLP Mixers		3	met	1994
Balance, Top Loader	Denver XS 2100	1	met	
Balance, Top Loader	Ohaus, GT 210	1	met	
Hot Plate		1	micro	
Dessicators		1	micro	
Water bath	VWR	1	micro	1997
Water Bath	Blue M Magni-Whirl	1	micro	1987
Autoclave	Market Forge STM-E	1	micro	1993
Incubator	ISOTEMP 630D	1	micro	
Incubator	Boekel	1	micro	1987
Incubator	NAPCO	1	micro	1994
Quebec Colony Counter, Leica Darkfield	Model 3325	1	micro	1999
IDEXX Sealer	IDEXX	1	micro	2001
Microscope	VWR	1	micro	2002
Thermometer	76mm Imm, Scale: -1 to 101ºC in 0.1ºC increments	1	micro	
Thermometer	76mm Imm, Scale: -1 to 51ºC in 0.1ºC increments	1	micro	
Thermometer	Total Imm, Scale: -1 to 51ºC in 0.1ºC increments	1	micro	
Thermometer	45mm Imm, Scale: -2 to 68ºC in 0.2ºC increments	1	micro	
Vortex	Fisher, Geni e2, G-560	1	wet	1994
Heating Controller Units		2	wet	
Chart Recorder	Chart recorder	1	wet	
Heating Controller Unit		5	wet	
Water Chiller	Nesco	2	wet	
Vacuum Pumps	Pumps	3	wet	
Heating Mantles	Glas Col	8	wet	
Dessicators		3	wet	
Stir Plates		4	wet	
Flow Injection Analyzer Chemistries include: chloride, nitrate/nitrite, alkalinity and phosphorus	Lachat FIA 8000	1	wet	1997
Flashpoint Tester	Fisher	1	wet	1997
Flashpoint Tester	GCA/Precision Scientific	1	wet	1982
Digestion block	Labconco	1	wet	
TOC Analyzer	Tekmar/Dorhman Phoenix 8000	1	wet	2000
Ion Chromatograph	Lachat QuikChem	1	wet	1999
Ammonia Analyzer	Alletch 380	1	wet	1992
Ammonia Analyzer	Timberline TL201	1	wet	2003
Autosampler #2	ISCO ASMP	1	wet	1994

Autosampler #1	ISCO SHLR		wet	1989
Spectrophotometer	Genesys 2	1	wet	2000
Specific Ion Meter	Fisher Acutemp 825MP	1	wet	1987
Specific Ion Meter	Fisher Acutemp925	1	wet	1991
Incubator	Lab-Line	1	wet	
Incubator	Revco	1	wet	
Turbidimeter	Hach 2100A	1	wet	1983
Balance, Analytical	METTLER AE 200	1	wet	1986
Balance, Top Loading	METTLER PM 4600	1	wet	1986
pH Meter	ORION 250A	1	wet	
Digestion block	HACH 16500-10	1	wet	1989
Digestion block	HACH 16500-10	1	wet	1986
Muffle Furnace	Fisher Isotemp 184A	1	wet	1996
Probe, Ammonia	Orion	1	wet	
Probe, pH	various	3	wet	
Flow Injection Analyzer, XYZ autosampler	Lachat FIA 8000	1	wet	1997
Flow Injection Analyzer,diluter	Lachat FIA 8000	1	wet	1997
Pump, FIA	Watson Marlow	1	wet	1997
Pump, TKN analyzer	Watson Marlow	1	wet	1992
Digestion block, TKN	Lachat, BD-46	1	wet	1998
Distillation system CN	Reliance Glass Works Midi-STil	1	wet	1998
Dissolved Oxygen meter	YSI 5000	1	wet	1999
Dissolved Oxygen probe	YSI 5010 with auto-stirrer	1	wet	1999
Conductivity / TDS Meter	HACH	1	wet	
Ion Chromatograph	Metrohm-Peak	1	wet	2005

Field Service Lab Equipment

pH / ORP / Temp Meter	ORION 260	1	fs	1999
pH / ORP / Temp Meter	ORION 265	1	fs	1997
Oxidation-Reduction Potential Probe	Orion 96-78	3	fs	1997
Probe, pH	Orion 91-07	3	fs	1997
Dissolved Oxygen / Temp meter w/ probe	YSI 95	1	fs	1998
Dissolved Oxygen / Temp Meter	Orion 830	1	fs	1997
Dissolved Oxygen probe	Orion 083010	1	fs	1997
Conductivity / TDS / Salinity / Temp Meter	Orion 135	1	fs	1997
Conductivity / TDS / Salinity Probe	Orion 013010	1	fs	1997
Automatic Sampler	ISCO 6700	1	fs	1997
Water Level Meter	Solinst 101-200P5	1	fs	2000
Personal Air Sampling Pumps	MSA Escort Elf	4	fs	1992
Landfill Gas Analyzer	Landtec GA-90	1	fs	2000
Peristaltic Pump	Geotech Series II	1	fs	2000
Flow Through Cell	Solinst 5Port Custom	1	fs	2001
Portable GC/PID	Photovac 10S+	1	fs	1999
Portable OVM/PID	Thermo 580B PID	1	fs	2005
Vacuum Pump	Gast	1	fs	2005
Generator	Honda eu3000i	1	fs	2005
Metal Detector	Fisher M-66	1	fs	2005

Eastern Analytical, Inc.

Quality Assurance /Quality Control Manual

APPENDIX C

Documents

Lorraine Olashaw 3-13-06
Lorraine Olashaw, Laboratory Director
(603) 228-0525

Kathleen E Noonan 3.13.06
Kathleen Noonan, Q. A. Coordinator
(603) 228-0525

Eastern Analytical, Inc.

QUALITY CONTROL/QUALITY ASSURANCE MANUAL

I, _____, have read and understood the Quality Control/Quality Assurance Manual as written, revision 6, effective date March 21, 2006, and will follow the requirements as set forth in that document.

In addition, I have read and understand the Sample Security and Confidentiality procedures at EAI which are specifically mentioned below.

*Only EAI personnel are allowed independent access to the instrument laboratory, sample prep and analysis laboratory. An EAI employee must accompany all visitors.
*EAI accommodates any additional sample security required by the client upon request.
*EAI personnel only discuss analytical results with the customer or the customer's representative. All information relating to the customers' samples are kept confidential.
*Requests to discuss project information with anyone other that those designated by the customer must be approved by the customer and a record of that approval kept with the project file.
*Requests to send project information to anyone other than those designated by the customer must be approved by the customer and a record of that approval kept in the project file.
*The project is not to be identified except as requested by the customer.
*Information not received on a Chain of Custody form or other written notice from the customer should not be included in the report without the customer's approval.
*Any information that is proprietary is labeled as such prior to release.
*A record of the employee understanding of this policy is in personnel files.

_____
Signature

_____
Date

Dear _____

Welcome to EAI! Our company mission and values guide our business decisions and behaviors every day. You are expected to become familiar with and embrace this foundation upon which our business is based.

The work we do is the basis upon which many critical decisions are made including whether water is safe to drink, property is safe to inhabit, and whether environmental compliance is being met. The analytical data we produce and our ability to defend the integrity of that data is the service that our customers pay us to provide. One sample may look like the next, but each and every sample, and its associated analytical data, can be of major consequence.

Because time is critical in our business, the pressures to meet deadlines and submit reports can be constant. However, it is imperative that we do not lose perspective on the importance of quality. Our philosophy is:

NO DEADLINE OR GOAL IS SO CRITICAL THAT WE CANNOT TAKE THE TIME TO WORK SAFELY, TO THE APPROPRIATE LEVEL OF QUALITY, AND PERFORM OUR JOBS IN A LEGALLY AND ETHICALLY RESPONSIBLE MANNER.

As an employee of EAI, should you ever be asked to violate this philosophy, or become aware of a circumstance that appears to violate this philosophy, you are to report the incident. If you are not satisfied with the response, you are to contact me directly. You have my assurance that your honesty, integrity and confidentiality will be respected.

Thank you for joining EAI and your understanding and commitment to the above.

Sincerely,
Eastern Analytical, Inc.

Michael P. Swett, President

****

Acknowledgement of above statement

_____ _____
Employee Signature Date

Mission Statement

Vision

To be the laboratory of choice within our marketplace, consistently delivering services of excellence, quality and personal attention.

Core Purpose

Combining talents and technology with professional partnerships to help create a cleaner, safer environment.

Value Statement

The company has embraced the following values in our commitment to achieving our mission and satisfying the expectations of our stakeholders.

Customers: Our objective is to achieve 100% customer satisfaction by listening to our customers and providing quality services with distinctive innovative approaches to their needs. Our relationships with our customers will always be open and honest, and will always be conducted in an ethical manner to maintain trust and confidence. We will stand firm in our commitment to remain flexible, reliable, and responsive. Our customers will consider us a partner committed to mutual success.

Employees: Eastern Analytical, Inc.'s (EAI) objective is to give each employee the opportunity to participate in and share in the success of the business. EAI is committed to providing a flexible, honest, fun, and challenging work environment that is always focused on the needs of our customers. Employee involvement, creativity, open communication, and teamwork are valued throughout the company. All employees are to be treated fairly, with personal growth and development supported and encouraged.

Suppliers: Our objective is to continue to develop and maintain mutually beneficial partnerships with suppliers who share our commitment to achieving increasing levels of customer satisfaction. We will promote these relationships which will be focused on continued improvements in quality, service, timeliness, and cost. Our relationships will be sincere, ethical, and will embrace the highest principals of purchasing practice.

Community: Eastern Analytical, Inc. is committed to being a responsible citizen in the business community. We will conduct our business in an ethical and environmentally responsible manner. We will be active in the community and support appropriate civic, educational, and professional activities.

Shareholders: For the shareholder(s), the owner(s) of our company, our objective is to achieve growth in earnings. Financial results should provide our shareholder(s) with a total return on investment that is competitive with similar investment opportunities.

Demonstration of Capability **Initial ___** **Continuing ___**
Certification Statement
Eastern Analytical, Inc., 25 Chenell Drive, Concord, NH 03301

Analyst Name and Initials: **Date:**

Matrix:

Analyte(s) and Method Reference(s):

SOP Title/Revision: QA

We, the undersigned, certify that:

1. The analyst identified above has read, understood and agreed to perform the above referenced analytical test method following the method and SOP listed above.
2. The analyst identified above, using the cited test method, which is in use at this facility for the analyses of samples under NELAP, have met the Initial or Continuing Demonstration of Capability criteria (check one below).
3. The person identified on this certificate performed the test method.
4. A copy of this method and SOP are available for all personnel on site.
5. The data associated with the initial/ongoing demonstration capability are true, accurate, complete, and self-explanatory.
6. All raw data necessary to reconstruct these analyses have been retained at the facility and the associated information is available for review by authorized inspectors.
7. For ongoing certification, state the method used to determine capability:

    ____ Acceptable performance on a blind sample on the same or similar test method

    ____ Completion of an IDC

    ____ At least 4 consecutive laboratory control samples with acceptable precision and accuracy

    ____ Analysis of an authentic lab sample analyzed by another trained analyst with statistically acceptable results

Signature	Analyst Name	Date
Signature	Technical Director Name	Date
Signature	Quality Assurance Officer Name	Date

This certification form must be completed each time a demonstration of capability study is completed.
(1) True: Consistent with supporting data.
Accurate: Based on good laboratory practices consistent with sound scientific principles/practices.
Complete: Includes the results of all supporting performance testing.
Self-Explanatory: Data properly labeled and stored so that the results are clear and require no additional explanation.

Demonstration of Capability – Work Cells **Initial ___** **Continuing ___**

Certification Statement

Eastern Analytical, Inc., 25 Chenell Drive, Concord, NH 03301

Work Cell Analysts (Name and Initials): **Date:**

Matrix:

Analyte(s) and Method Reference(s):

SOP Title/Revision: QA

We, the undersigned, CERTIFY that:

1. The analyst identified above has read, understood and agreed to perform the above referenced analytical test method following the method and SOP listed above.
2. The analyst(s) identified above, using the cited test method(s), which is in use at this facility for the analyses of samples under the ELAP, have met the Initial or Continuing Demonstration of Capability (check one below).
3. The test method(s) was performed by the analyst(s) identified on this certification.
4. A copy of this test method(s) and SOP are available for all personnel on-site.
5. The data associated with the demonstration capability are true, accurate, complete and self-explanatory (1).
6. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized assessors.
7. State the method used to determine capability:

    ____ Acceptable performance on a blind sample on the same test method

    ____ Completion of an IDC

    ____ At least four (4) consecutive LCS samples with acceptable precision and accuracy

    ____ Analysis of an authentic lab sample analyzed by another trained analyst with statistically acceptable results.

Signature	Analyst's Name	Date
Signature	Analyst's Name	Date
Signature	Analyst's Name	Date
Signature	Analyst's Name	Date
Signature	Technical Director's Name	Date
Signature	Quality Assurance Officer's Name	Date

This certification form must be completed each time a demonstration of capability study is completed.
(1) True: Consistent with supporting data.
Accurate: Based on good laboratory practices consistent with sound scientific principles/practices.
Complete: Includes the results of all supporting performance testing.
Self-Explanatory: Data properly labeled and stored so that the results are clear and require no additional explanation.

Eastern Analytical, Inc.
Out of Control Form

Date:

Date of Event (if different):

Analyst:

Analysis:

Type of QC deviation:

Has/will data be reported?

What project(s) are affected?

Is client notification required?

Provide a brief description of the Out of Control Event.

What/has corrective action already been implemented?

Additional Investigative/Corrective Action required/taken

Resolution –

Date event closed –

Analyst _____

Dept. Manager _____

QA Officer _____

Alkalinity
EPA 310.1 SM 2320B

Relevant Aspect of Standards	Reference	Y	N	N/A	Comments
Does the laboratory have an SOP for this analysis?	5.10.1.1				
Does the laboratory have records of the [ ] initial demonstration of capability and [x] continuing demonstrations of performance?	5.12.2.1				
Records Examined: Date of Analysis:____ _____ Analyst:_____ _____					
Records are maintained of the method blank analyzed at a frequency of one per batch of samples per matrix type per sample extraction or preparation method?	D.1.1.a.1				
Are samples associated with a contaminated blank [x] reprocessed or [ ] are the results reported with appropriate data qualifying codes?	D.1.1.a.1				
Are laboratory control samples analyzed at a minimum of 1 per batch of 20 or less samples per matrix type per extraction or preparation method.	D.1.b.1				
Is a matrix spike (sample prepared by adding a known mass of target analyte to a specific amount of matrix sample) performed at a frequency of 1 in 20 samples per matrix type prepared over time, except for analytes for which spiking solutions are not available?	D.1.1.b.2				
Is a matrix spike duplicate (MSD) or a laboratory duplicate performed at a frequency of 1 in 20 samples per matrix, per sample extraction or preparation method?	D.1.2				
Method Specific Requirements:					
Is the sample refrigerated and the sample bottle not opened until analysis?	5.10.2.a EPA 3.1				
Are samples having a high concentration of mineral acids, such as mine wastes and associated receiving waters titrated to pH 3.9 using an ASTM method?	5.10.2.a EPA 3.3				
[ ] A pH meter or electrically operated titrator that uses a glass electrode and can be read to 0.05 pH units is used. If automatic temperature compensation is not provided, samples are analyzed at 25 +/- 2^0C. [ ] Bromcresol green indicator used. [ ] Mixed bromcresol green - methyl red indicator used	5.10.2.a SM 2 SM 3.d & e EPA 4.0				

Alkalinity
EPA 310.1 SM 2320B

Relevant Aspect of Standards	Reference	Y	N	N/A	Comments
[ ] Commercially prepared acid is being used. [ ]The sulfuric acid or HCL is standardized against Sodium Carbonate and labeled properly. (Check records)	5.10.2.a SM 3.c EPA 5.3				
Sample is gently stirred during analysis.	5.10.2.a SM 2.c EPA 6.2.3				
Final pH of 4.5 is achieved by adding smaller amounts of acid as the end point is approached.	5.10.2.a SM 4.c EPA 6.2				
If alkalinity is <20 mg/L, the low alkalinity method is used. (Additional titrant is added to reduce the pH 0.3 units lower using a 100 to 200 mL sample).	5.10.2.a SM 4.d EPA 6.3.2				
Do the records include the identification of any standards, titrants, etc. used in the analysis and preparation of the samples?	5.12.3.1.f				
Does the analyst follow the laboratory SOP?	Intro to Chapter 5 Appendix D				

Alkalinity Internal Audit Checklist
Revision Date: August 2001
Revision Number: 1

VOCs

	Hold Time	Sample Volume	Container	Preservative
Aqueous				
VOC	14 days	40 mL	VOC vials	HCl/Cool
MA DEP VPH	14 days	40 mL	VOC vials	HCl/Cool
ME GRO	14 days	40 mL	VOC vials	HCl/Cool
Methane	14 days	40 mL	VOC vials	H2SO4/Cool
Soil				
VOC	14 days	2 oz	2 oz Glass	
VOC Method 5035 **	14 days	5 g	20 mL preweighed, MEOH vial, 5 mL Syringe *	
VOC Method 5035 LL	[Sodium Bisulfate method — Call for specifications]			
MA DEP VPH	28 days	5 g	20 mL preweighed, MEOH vial, 5 mL Syringe *	
ME GRO	14 days	5 g	20 mL preweighed, MEOH vial, 5 mL Syringe *	

Organics must be collected in glass, not plastic! No headspace.

*Use syringe with end cap for % solids determination. ** Method 5035 is a Massachusetts requirement.

Extractables

Aqueous				
TPH	7 days	1 liter	1 liter Glass	Cool
PAH	7 days	1 liter	1 liter Amber Glass	Cool
ABN	7 days	1 liter	1 liter Amber Glass	Cool
Pesticides/PCB	7 days	1 liter	1 liter Amber Glass	Cool
MA DEP EPH *	14 days / 40 days	1 liter	1 liter Amber Glass	1:1 HCl/Cool
ME DRO *	7 days	1 liter	1 liter Amber Glass	1:1 HCl/Cool

*MA EPH and ME DRO require 1 aqueous sample in triplicate per batch of 20 for QA/QC.

Soil				
TPH	14 days	4 oz	4 oz Glass	Cool
PAH	14 days	4 oz	4 oz Amber Glass	Cool
ABN	14 days	4 oz	4 oz Amber Glass	Cool
Pesticides/PCB	14 days	4 oz	4 oz Amber Glass	Cool
MA DEP EPH	7 days / 40 days	4 oz	4 oz Amber Glass	Cool
ME DRO	14 days	4 oz	4 oz Amber Glass	Cool

Metals

Iron & Manganese (only)	180 days	20 mL	2 oz Plastic (total)	Nitric Acid
ICP Metals & Mercury	180 days	200 mL	8 oz Plastic	Nitric Acid
Mercury (only)	28 days	200 mL	8 oz Plastic	Nitric Acid
Hexavalent Chromium	24 hrs	400 mL	8 oz Plastic	Unpreserved
Solid Samples		400 g	8 oz Plastic/Glass	Cool

Please indicate whether total or dissolved metals results are needed.

Wet Chemistry

BOD/CBOD	48 hrs	400 mL	Plastic	Unpreserved
pH	Immediate *	25 mL	Plastic	Unpreserved
Specific Conductance	28 days	200 mL	Plastic	Unpreserved
Turbidity	48 hrs	100 mL	Plastic	Unpreserved
Solids (TS,TVS,TSS,TDS)	7 days	300 mL	Plastic	Unpreserved
Settleable Matter	48 hrs	1 Liter	Plastic	Unpreserved
Anions **	28 days	100 mL	Plastic	Unpreserved
Nitrate/Nitrite	48 hrs	50 mL	Plastic	Unpreserved
Alkalinity	14 days	200 mL	Plastic	Unpreserved
Oil & Grease	28 days	1 Liter	Glass	Sulfuric Acid
TPH	28 days	1 Liter	Glass	Sulfuric Acid
Phenols	28 days	250 mL	Glass	Sulfuric Acid
TOC	28 days	250 mL	Amber Glass	Sulfuric Acid
Total Phosphorus	28 days	100 mL	HDPE	Sulfuric Acid
Ammonia	28 days	200 mL	Plastic/Glass	Sulfuric Acid
TKN	28 days	150 mL	Plastic/Glass	Sulfuric Acid
COD	28 days	20 mL	Plastic/Glass	Sulfuric Acid
Cyanide	14 days	200 mL	Plastic/Glass	Sodium Hydroxide
Sulfide	7 days	250 mL	Plastic	Zinc Acetate/ Sodium Hydroxide
Sulfite	Immediate *	40 mL	VOC vial	None
Bacteria	Immediate *	100 mL	Sterile Container	Sodium Thiosulfate
Solid Samples		400 g	8 oz Plastic/Glass	Unpreserved

*For samples with immediate hold time, please call us 24 hours in advance of delivery.
**Fluoride, Chloride, Bromide, Sulfate

Combos

Aqueous		
VOC/TPH	7 days	(2) 40 mL VOC vials + (1) liter Glass
VOC/TPH/PAH	7 days	(2) 40 mL VOC vials + (1) liter Amber Glass
Soil		
VOC/TPH	14 days	(1) 20 mL MEOH vial + 5 mL Syringe + (1) 4 oz Glass
VOC/TPH/PAH	14 days	(1) 20 mL MEOH vial + 5 mL Syringe + (1) 4 oz Amber Glass
NH Table 412-3	varies	(2) 8 oz Plastic + (1) 2 oz Glass + (1) 4 oz Glass + (1) 4 oz Amber Glass

eastern analytical, inc.
professional laboratory services
25 Chenell Drive | Concord, NH 03301 | Tel: 603.228.0525 | 1.800.287.0525
Fax: 603.228.4591 | E-Mail: customer_service@eailabs.com | www.eailabs.com

eastern analytical, inc.
professional laboratory services

Eastern Analytical, Inc.

Quality Assurance /Quality Control Manual

APPENDIX D

QC Type and Frequency Chart

Lorraine Olashaw 3-13-06
Lorraine Olashaw, Laboratory Director
(603) 228-0525

Kathleen E Noonan 3-13-06
Kathleen Noonan, Q. A. Coordinator
(603) 228-0525

				FREQUENCY OF:						
Analyte	**Method**	**Calibration**	**Matrix**	**Blanks**	**Dups**	**Matrix Spikes**	**Matrix Spike Dups**	**Continuing Cal Checks**	**LCS's**	**Performance Check Samples**
Color	EPA 110.2	NA	DW, GW, SW	NA	10%	NA	NA	NA	NA	NA
Spec. Con.	EPA 120.1	Instrument cal checked with 3 standards daily	DW, GW, SW WW	1/batch	10%	NA	NA	1/batch	1/batch	1/quarter
Spec. Con.	SM 2510B	Instrument cal checked with 3 standards daily	DW, GW, SW WW	1/batch	10%	NA	NA	1/batch	1/batch	1/quarter
Spec. Con.	SW846 9050	Instrument cal checked with 3 standards daily	DW, DW, SW WW	1/batch	10%	NA	NA	1/batch	1/batch	1/quarter
pH	EPA 150.1	2 stds minimum to bracket range, every 4 hrs	DW, GW, SW WW	NA	10%	NA	NA	every 4 hrs	1/batch	1/quarter
pH	SW846 9040	2 stds minimum to bracket range, every 4 hrs	Aqueous waste, Multiphase waste	NA	10%	NA	NA	every 4 hrs	1/batch	1/quarter
pH/Corrosivity	SW846 9045A	2 stds minimum to bracket range, every 4 hrs	Soils, Solids	NA	10%	NA	NA	every 4 hrs	1/batch	1/quarter
Total Solids	EPA 160.3	NA	DW, SW, GW WW	1/batch	10%	NA	NA	NA	1/batch	1/quarter
Total Solids	SM 2540B	NA	DW, SW, GW WW	1/batch	10%	NA	NA	NA	1/batch	1/quarter
TSS	EPA 160.2	NA	DW, SW, GW WW	1/batch	10%	NA	NA	NA	1/batch	1/quarter
TSS	SM 2540D	NA	DW, SW, GW WW	1/batch	10%	NA	NA	NA	1/batch	1/quarter
Dissolved Solids	EPA 160.1	NA	DW, SW, GW WW	1/batch	10%	NA	NA	NA	1/batch	1/quarter
Dissolved Solids	SM 2540C	NA	DW, SW, GW WW	1/batch	10%	NA	NA	NA	1/batch	1/quarter

				FREQUENCY OF:						
Analyte	**Method**	**Calibration**	**Matrix**	**Blanks**	**Dups**	**Matrix Spikes**	**Matrix Spike Dups**	**Continuing Cal Checks**	**LCS's**	**Performance Check Samples**
Volatile Solids	EPA 160.4	NA	DW, SW, GW WW	1/batch	10%	NA	NA	NA	1/batch	-
Volatile Solids	SM 2540E	NA	DW, SW, GW WW	1/batch	10%	NA	NA	NA	1/batch	-
Settleable Solids	EPA 160.5	NA	DW, SW, GW WW	NA	NA	NA	NA	NA	NA	-
Total/Volatile Solids	SM 2540G	NA	Solids, Sludges	1/batch	10%	NA	NA	NA	NA	-
Turbidity	EPA 180.1	Instrument cal checked with high and low standards	DW, SW, GW WW	1/batch	10%	NA	NA	see cal	1/batch	semiannual
Fluoride	EPA 300.0	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	1/quarter
Chloride	EPA 300.0	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	1/quarter
Nitrite	EPA 300.0	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	1/quarter
Bromide	EPA 300.0	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	-
Nitrate	EPA 300.0	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	1/quarter
O-Phosphate	EPA 300.0	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	1/quarter
Sulfate	EPA 300.0	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	1/quarter

				FREQUENCY OF:						
Analyte	**Method**	**Calibration**	**Matrix**	**Blanks**	**Dups**	**Matrix Spikes**	**Matrix Spike Dups**	**Continuing Cal Checks**	**LCS's**	**Performance Check Samples**
Fluoride	SW846 9046	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	-
Chloride	SW846 9046	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	-
Nitrite	SW846 9046	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	-
Bromide	SW846 9046	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	-
Nitrate	SW846 9046	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	-
O-Phosphate	SW846 9046	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	-
Sulfate	SW846 9046	3 stds and a blk Weekly	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	-
Chloride	EPA 325.2	3 stds and a blk, daily	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	1/quarter
Nitrite	EPA 353.2	3 stds and a blk, daily	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	1/quarter
Nitrate	EPA 353.2	3 stds and a blk, daily	GW, SW, DW WW, Solids	10%	-	10%	10%	10%	10%	1/quarter
Alkalinity	EPA 310.1	NA	GW, SW, DW WW	1/batch	-	1/batch	1/batch	NA	1/batch	1/quarter
Alkalinity	SM 2320B	NA	GW, SW, DW WW	1/batch	-	1/batch	1/batch	NA	1/batch	1/quarter

				FREQUENCY OF:						
Analyte	**Method**	**Calibration**	**Matrix**	**Blanks**	**Dups**	**Matrix Spikes**	**Matrix Spike Dups**	**Continuing Cal Checks**	**LCS's**	**Performance Check Samples**
Cyanide, Total	EPA 335.2	3 stds and a blk every 4 months	GW, SW, DW WW	1/distillation batch	-	1/batch	1/batch	2/distilation batch	1/distillation batch	1/quarter
Cyanide, Total	SM 4500-CN C/E	3 stds and a blk every 4 months	GW, SW, DW WW	1/distillation batch	-	1/batch	1/batch	2/distilation batch	1/distillation batch	1/quarter
Cyanide, Amenable	EPA 335.1	3 stds and a blk every 4 months	GW, SW, DW WW	1/distillation batch	-	1/batch	1/batch	2/distilation batch	1/distillation batch	-
Cyanide, Amenable	SM 4500-CN C/G	3 stds and a blk every 4 months	GW, SW, DW WW	1/distillation batch	-	1/batch	1/batch	2/distilation batch	1/distillation batch	-
Cyanide, Weak& Dissociable	SM 4500-CN I	3 stds and a blk every 4 months	GW, SW, DW WW	1/distillation batch	-	1/batch	1/batch	2/distilation batch	1/distillation batch	-
Cyanide, MA PAC	MA PAC	3 stds and a blk every 4 months	GW, SW, DW WW	1/distillation batch	-	1/batch	1/batch	2/distilation batch	1/distillation batch	-
Cyanide, T & A	SW846 9010A & 9014	3 stds and a blk 4 months	Wastes,Solids, Leachates	1/distillation batch	-	1/batch	1/batch	2/distillation batch	1/distillation batch	-
Ammonia	EPA 350.3	3 stds and a blk every 4 months	GW, SW, DW WW	1/analytical batch	-	10%	10%	1 every 4 hrs	1/batch	semiannual
TKN	EPA 351.4	3 std and a blk Weekly	GW, SW, DW WW	1/analytical batch	-	1/ dig. batch	1/ dig. batch batch	1/analytical batch	1/dig. batch	semiannual
Phosphorus-T	EPA 365.3	4 std and a blk every 4 months	GW, SW, DW Daily	1/ batch WW	-	1/ batch	1/ batch	2/digestion	1/digestion batch	semiannual batch
Phosphate-O	EPA 365.3	4 std and a blk every 4 months	GW, SW, DW WW	1/ batch	-	1/ batch	1/ batch	2/batch	1/batch	1/quarter
Sulfide	EPA 376.2	Internal instrument calibration checked quarterly	GW, SW, DW WW	1/batch	1/ batch	-	-	NA	1/quarter	-
Sulfide	SW846 9030A	NA	WW	1/batch	10%	-	-	NA	1/batch	-

				FREQUENCY OF:						
Analyte	**Method**	**Calibration**	**Matrix**	**Blanks**	**Dups**	**Matrix Spikes**	**Matrix Spike Dups**	**Continuing Cal Checks**	**LCS's**	**Performance Check Samples**
Sulfite	EPA 377.1	NA	GW, SW, DW, WW	1/batch	10%	-	-	NA	-	-
Res. Chlorine	EPA 330.5	NA	GW, SW, DW WW	1/batch	10%	-	-	NA	1/batch (secondary std)	semiannual
Res. Chlorine	SM 4500-Cl G	NA	GW, SW, DW WW	1/batch	10%	-	-	NA	1/batch (secondary std)	semiannual
BOD	EPA 405.1	Instrument Cal Daily	WW, SW, GW	Daily	Daily	Daily	-	NA	Daily	semiannual
BOD/CBOD	SM 5210B	Instrument Cal Daily	WW, SW, GW	Daily	Daily	Daily	-	NA	Daily	semiannual
COD	EPA 410.4	4 stds and a blk Per COD vial lot # or 6 months	WW, SW, GW	1/digestion batch	-	1/batch	1/batch	2/digestion batch	1/digestion batch	semiannual
COD	HACH 8000	4 stds and a blk Per COD vial lot # or 6 months	WW, SW, GW	1/digestion batch	-	1/batch	1/batch	2/digestion batch	1/digestion batch	semiannual
TOC	SM5310C	3 stds and a blk	DW, SW, GW WW	1/batch	-	10%	10%	1/batch	1/batch	1/quarter
TOC	EPA 415.1	3 stds and a blk	DW, GW, SW, WW	1/batch	-	10%	10%	1/batch	1/batch	1/quarter
Total Phenols	EPA 420.1	3 stds and a blk 6 months	SW, GW, WW DW	1/distillation batch	-	1/distillation batch	1/distillation batch	2/distillation batch	1/distillation batch	semiannual
Total Phenols	SW846 9065	3 stds and a blk 6 months	GW, SW, DW WW, Solids	1/distillation batch	-	1/distillation batch	1/distillation batch	2/distillation batch	1/distillation batch	-
Paint Filter	SW846 9095	NA	Solid waste	NA	10%	NA	NA	NA	NA	-

				FREQUENCY OF:						
Analyte	**Method**	**Calibration**	**Matrix**	**Blanks**	**Dups**	**Matrix Spikes**	**Matrix Spike Dups**	**Continuing Cal Checks**	**LCS's**	**Performance Check Samples**
Reactive CN	SW 7.3.3.2	3 stds and a blk every 4 months	Solid waste	1/distillation batch	-	-	-	-	1/distillation batch (system ck)	-
Reactive S-2	SW 7.3.4.2	Internal instrument calibration checked quarterly	Solid waste	1/distillation batch	-	-	-	-	1/distillation batch (system ck)	-
Flashpoint	EPA 1010	NA	Wastes	1/batch	Each hit if possible	NA	NA	NA	1/batch	-
Ignitability	EPA 7.1.2	NA	Wastes	1/batch	NA	NA	NA	NA	NA	-
Metals (ICP)	EPA 200.7	1 std and a blank Daily	GW, SW, DW, WW	10%	-	1/dig batch or 10% inst batch	1/dig batch or 10% inst batch	10%	1/matrix batch	biannual
Metals (ICPMS)	EPA 200.8	3 standards and a blank Daily	GW, SW, DW, WW	10%	-	1/dig batch or 10% inst batch	1/dig batch or 10% inst batch	10%	1/matrix batch	biannual
Metals (ICP)	SW846 6010C	1 std and a blank Daily	GW, WW, TCLP ext, Soil, Solid Wastes	10%	-	1/dig batch or 10% inst batch	1/dig batch or 10% inst batch	10%	1/matrix batch	
Metals (ICPMS)	SW846 6020A	3 standards and a blank Daily	GW, WW, TCLP ext, Soil, Solid Wastes	10%	-	1/dig batch or 10% inst batch	1/dig batch or 10% inst batch	10%	1/matrix batch	
Hexavalent Cr	SM 3500DCR	3 std and a blk Daily	WW, GW, DW	10%	10%	10%	10%	10%	2/batch	-
Hardness	EPA 200.7 EPA 200.8	See 200.7 and 200.8	GW, SW, DW	10%	-	1/dig batch or 10% inst batch	1/dig batch or 10% inst batch	10%	1/matrix batch	biannual
VOCs (GC/MS)	EPA 624 EPA 601 EPA 602	Internal Standard 5 Point avg. RF if < 15% RSD or Linear reg. if >15% RSD	GW,WW	1/ batch	-	5% or LCS 5%	5% or LCSD 5%	24 hrs.	1/batch	semiannual EPA 624 only

				FREQUENCY OF:						
Analyte	**Method**	**Calibration**	**Matrix**	**Blanks**	**Dups**	**Matrix Spikes**	**Matrix Spike Dups**	**Continuing Cal Checks**	**LCS's**	**Performance Check Samples**
VOCs (GC/MS)	EPA 8260B EPA 8021B	Internal Standard 5 Point avg. RF if < 15% RSD or Linear reg. if >15% RSD	GW,WW,SW, Soil	1/batch	-	5% or LCS 5%	5% or LCSD 5%	12 hrs.	1/batch	-
VOCs (GC/MS)	EPA 524.2	Internal Standard 5 Point curve Average RF or linear regression if >15%RSD	DW,GW	1/batch	5%	no method requirement		12 hrs.	1/batch	semiannual
VOCs (GCMS)	EPA 8015B	External Standard 5 Point linear regression if > 15% RSD	GW,SW	1/batch	-	5% or LCS 5%	5% or LCSD 5%	12 hrs.	1/batch	-
VOCs (GCMS)	EPA 8015B (mod)	External Standard 5 Point linear regression if > 15% RSD	GW,WW,SW	1/batch	-	5% or LCS 5%	5% or LCSD 5%	12 hrs.	1/batch	-
VOCs (GC/MS)	ME GRO 4.3.17	External Standard 5 Point linear regression if > 15% RSD	GW,SW, Soil	1/batch	-	5% or LCS 5%	5% or LCSD 5%	12 hrs.	1/batch	-
VOCs (GC/MS)	MA VPH (ranges only)	Internal Standard 5 Point linear regression if > 20% RSD	GW,SW, Soil	1/batch	-	5% or LCS 5%	5% or LCSD 5%	12 hrs.	1/batch	-
VOCs (GC)	Methane, Ethane, Ethene	External Standard Regression if > 15% RSD	GW	1/batch	5%	NA		beginning and end of batch	5%	-
PEST/PCBs (GC)	EPA 608	External Standard 5 Point linear regression	GW,WW	1/batch or 10%	10% when provided	10% when provided		12 hrs or 20 samples	1/batch or 10%	semiannual
PEST/PCBs (GC)	EPA 8081A EPA 8082	External Standard 5 Point linear regression	GW,WW,SW, Oil, Soils, Solid Wastes	1/batch or 5%	5% when provided	5% when provided		12 hrs or 20 samples	1/batch or 5%	-
ABNs (GC/MS)	EPA 625	Internal Standard 5-9 pt avg. RF if < 15% RSD or 6 pt Quadratic reg. if >15% RSD	GW,WW	1/batch or 5%	5% when provided	5% when provided		24 hrs	1/batch or 5%	semiannual

				FREQUENCY OF:						
Analyte	**Method**	**Calibration**	**Matrix**	**Blanks**	**Dups**	**Matrix Spikes**	**Matrix Spike Dups**	**Continuing Cal Checks**	**LCS's**	**Performance Check Samples**
ABNs (GC/MS)	EPA 8270	Internal Standard 5-9 pt avg. RF if < 15% RSD or 6 pt Quadratic reg. if >15% RSD	GW,WW,SW Soils, Solid Wastes	1/batch or 5%	5% when provided	5% when provided		12 hrs.	1/batch or 5%	-
TPH (GC)	EPA 8100 (mod)	External Standard 7 Point linear regression	GW,WW,SW Soils, Solid Wastes	1/batch or 5%	5% when provided	5% when provided		12 hrs or 10 samples	1/batch or 5%	-
EPH (GC/MS)	MAEPH	Internal Standard 5-9 pt avg. RF if < 15% RSD or 6 pt Quadratic reg. if >15% RSD	GW,WW,SW Soils, Solid Wastes	1/batch or 5%	5% or LCSD 5%	MS 5%		12 hrs.	1/batch LCS 5%	-
MEDRO (GC)	EPA 8100 (mod)	External Standard 7 Point linear regression	GW,WW,SW Soils, Solid Wastes	1/batch or 5%	5% when provided	5% when provided		12 hrs or 10 samples	1/batch or 5%	-
HEM	EPA 1664A	NA	SW, GW, WW	1/batch	-	1/batch when provided	1/batch (recommended, not required)	NA	1/batch (PAR)	semiannual
HEM-SGT	EPA 1664A	NA	SW, GW, WW	1/batch	-	1/batch when provided	1/batch (recommended, not required)	NA	1/batch (PAR)	-

				FREQUENCY OF:						
Analyte	**Method**	**Calibration**	**Matrix**	**Blanks**	**Dups**	**Matrix Spikes**	**Matrix Spike Dups**	**Continuing Cal Checks**	**LCS's**	**Performance Check Samples**
Total Coliform MTF	SM*9221B	NA	DW, GW, WW, SW Solid	NA	5% of positive samples	NA	NA	NA	NA	semiannual
E Coli MTF	SM*9221F	NA	DW, GW, WW, SW Solid	NA	5% of positive samples	NA	NA	NA	NA	semiannual
Fecal Coliform MTF	SM*9221E	NA	DW, GW, WW Solid	NA	5% of positive samples	NA	NA	NA	NA	semiannual
Fecal Strep MTF	SM*9230B	NA	DW, GW, WW Solid	NA	5% of positive samples	NA	NA	NA	NA	semiannual
Enterococcus	ASTM D6503-99	NA	DW, GW, WW	NA	5% of positive samples	NA	NA	NA	NA	
Total Coliform Colisure	SM*9223B	NA	DW, GW, SW	NA	5% of positive samples	NA	NA	NA	NA	semiannual
E. Coli Colisure	SM*9223B	NA	DW, GW, SW	NA	5% of positive samples	NA	NA	NA	NA	semiannual

* Standard Methods 19th edition

Eastern Analytical, Inc.

Quality Assurance /Quality Control Manual

APPENDIX E

Organizational Chart

Updated 05-02-06 Kew Updated 11-27-07 Kew updated 10/21/08 Kew
Updated 06.19.06 Kew Updated 05-12-08 Kew Updated 12/08/08 Kew
Updated 07-25-06 Kew Updated 06.23.08 Kew Updated 01/09/09 Kew
Updated 10-24-06 Kew Updated 11-07-08 Kew
Updated 03-14-07 Kew Updated 02-22-09 Kew
Updated 07-20-07 Kew Updated 03-30-09 Kew
Updated 05-04-09 Kew

Lorraine Olashaw 3.13.09

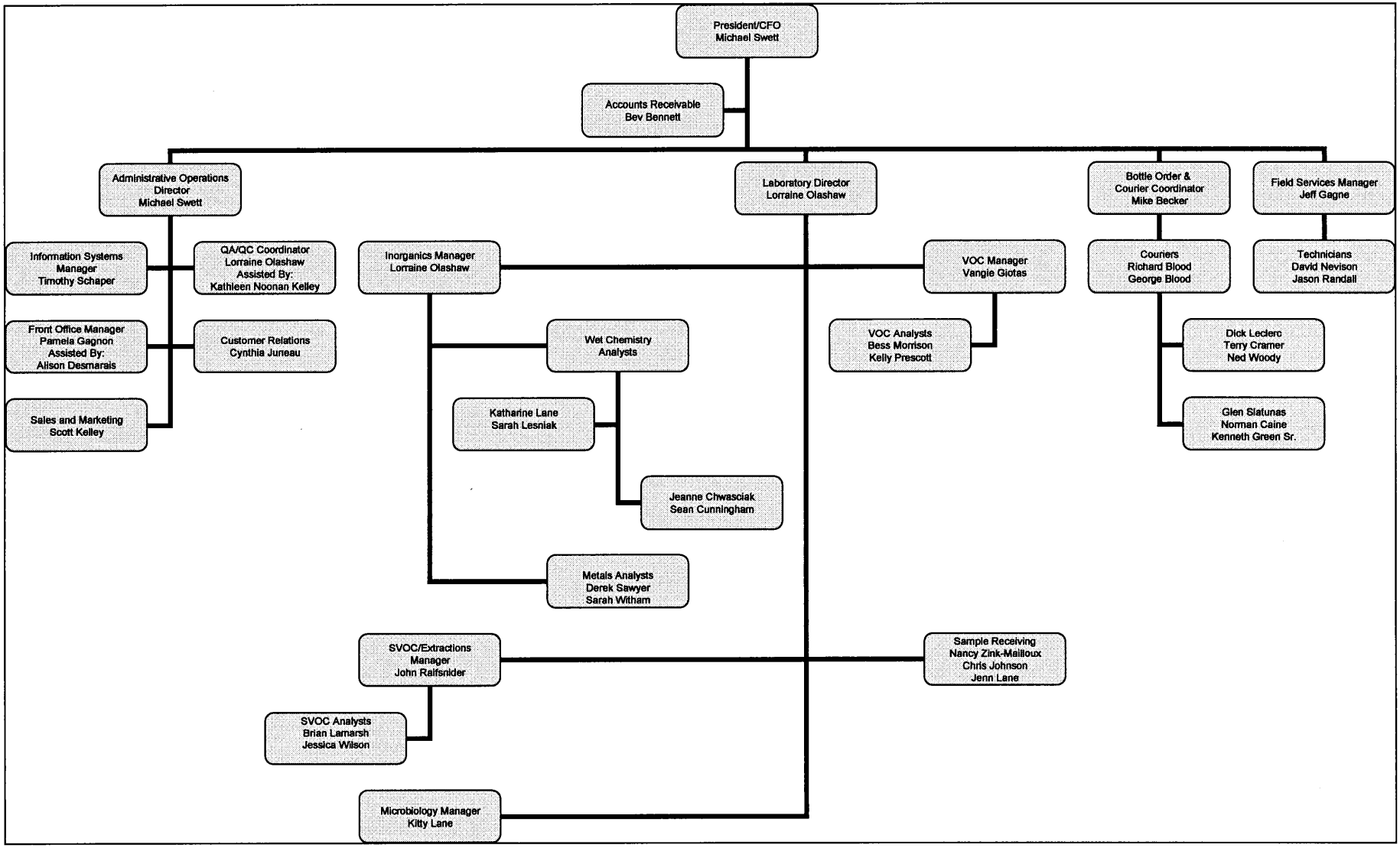
Lorraine Olashaw, Laboratory Director
(603) 228-0525

Kathleen E Noonan 3.13.09

Kathleen Noonan, Q. A. Coordinator
(603) 228-0525

eastern analytical, inc.

professional laboratory services



EAI Org. Chart Revision 23
01/04/2010

Eastern Analytical, Inc.

Quality Assurance /Quality Control Manual

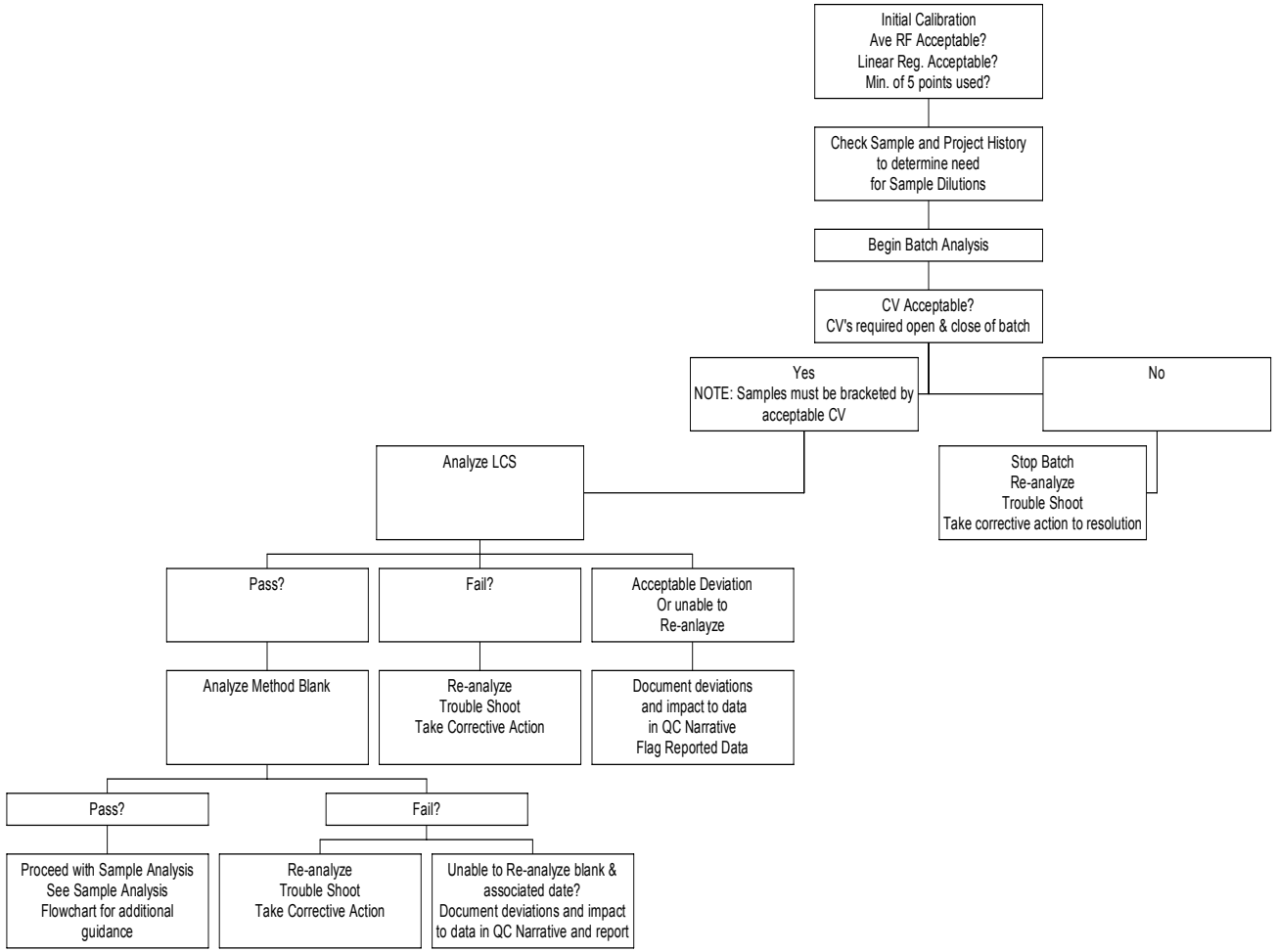
APPENDIX F

Data Review Flowcharts

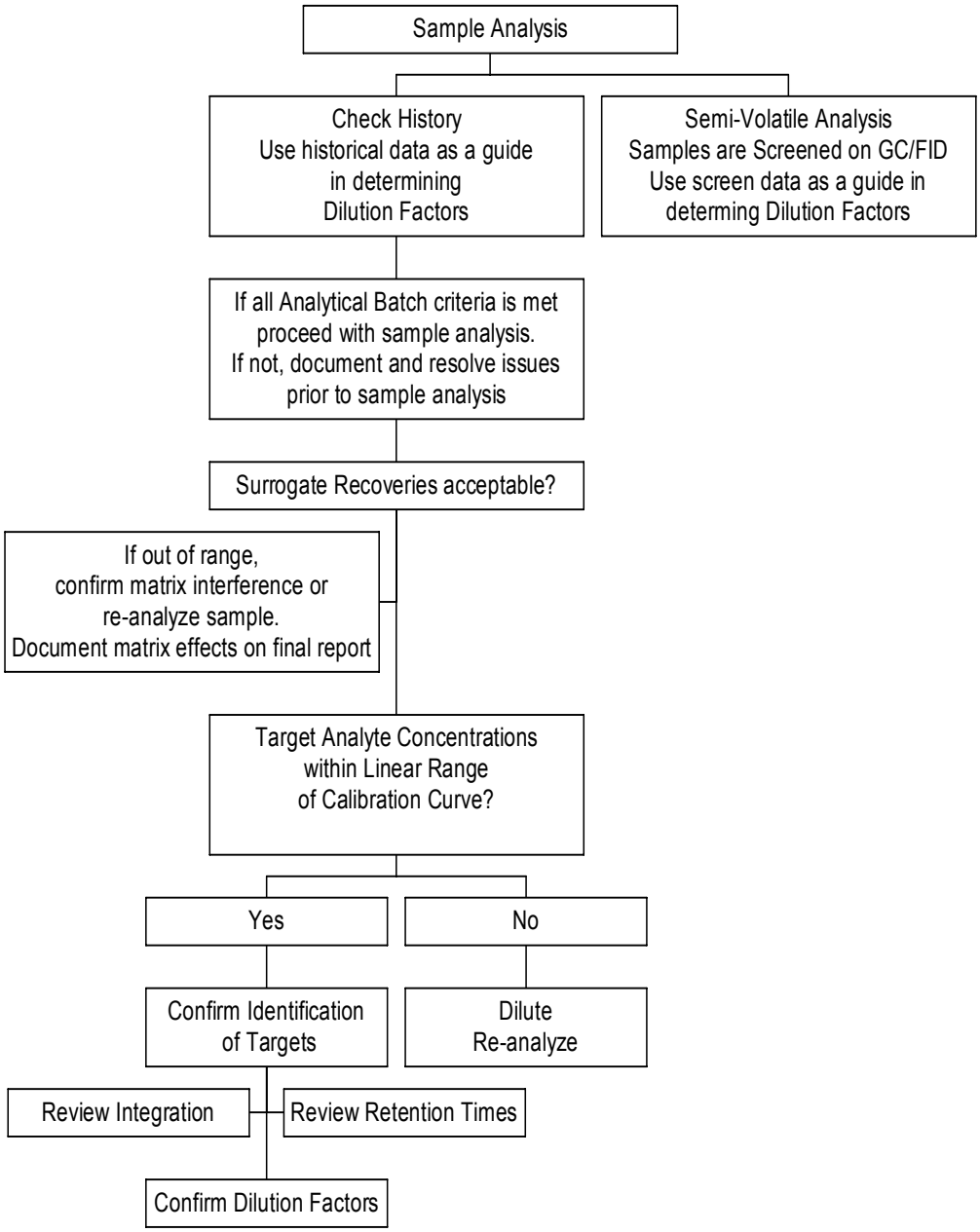
Lorraine Olashaw 03.13.06
Lorraine Olashaw, Laboratory Director
(603) 228-0525

Kathleen E Noonan 03.13.06
Kathleen Noonan, Q. A. Coordinator
(603) 228-0525

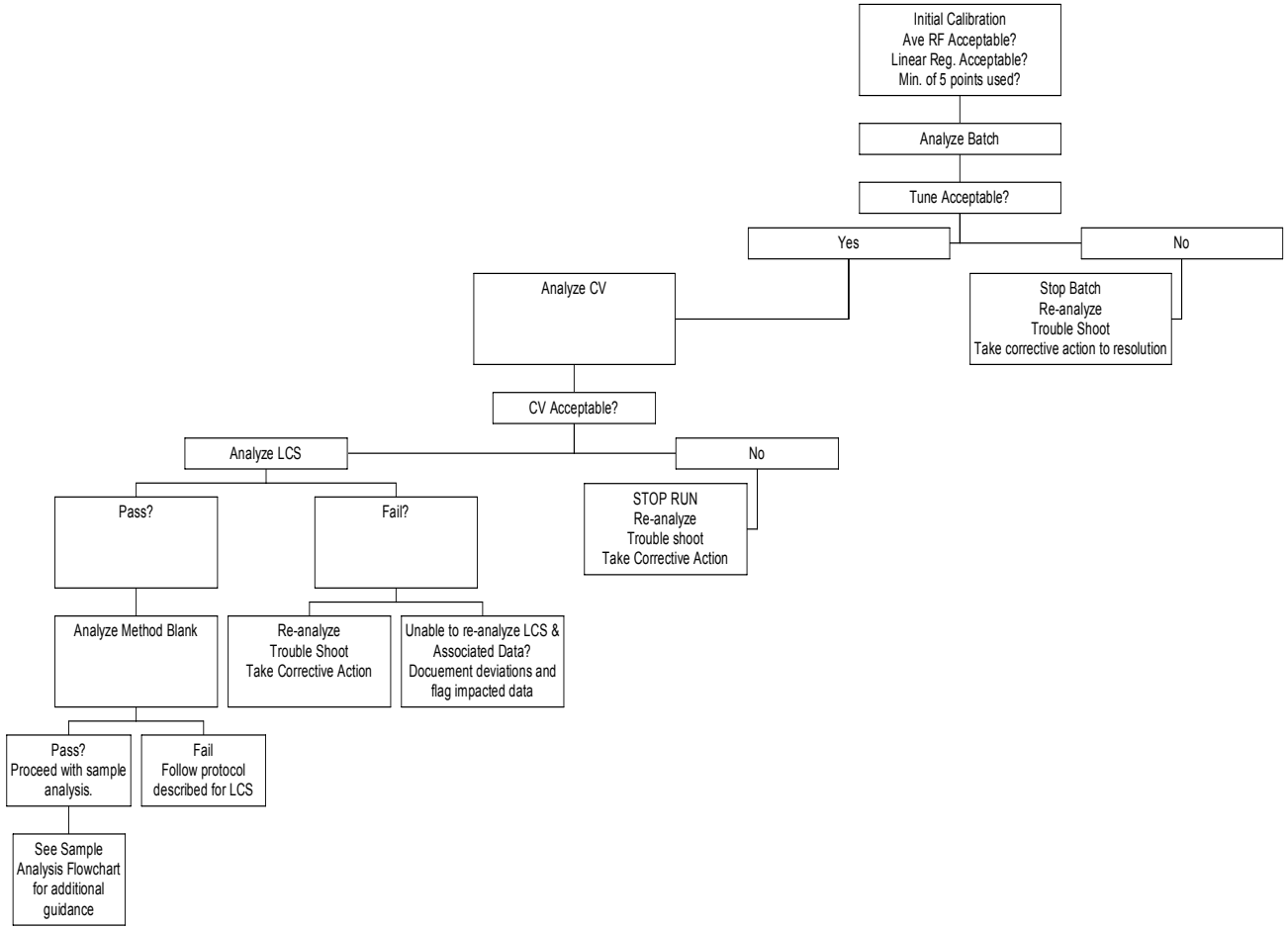
GC
Analtyical Batch
Flowchart



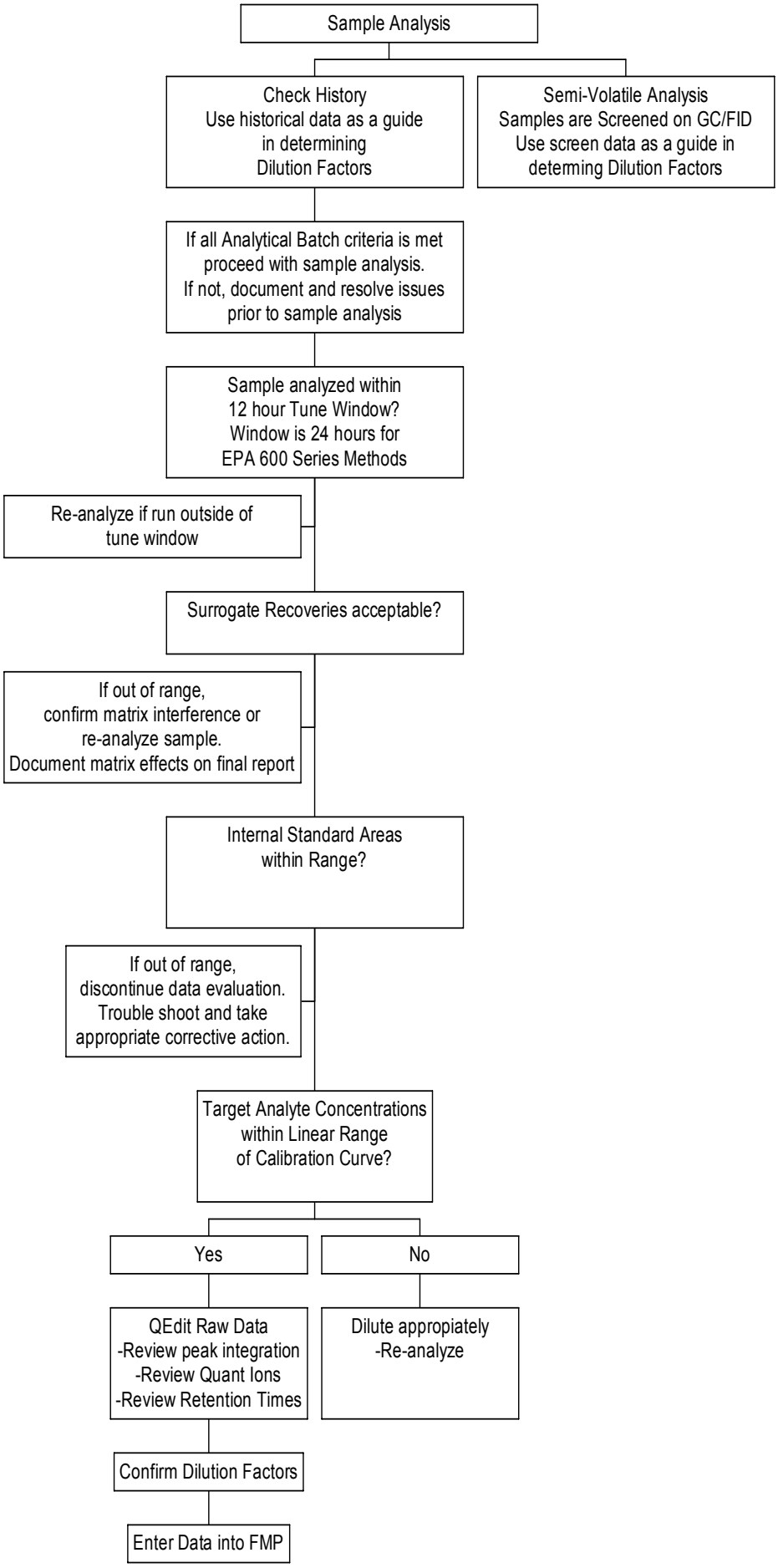
GC
Sample Analysis
Flowchart



GC/MS
Analtyical Batch
Flowchart



GC/MS Sample Analysis Flowchart



Eastern Analytical, Inc.

Quality Assurance /Quality Control Manual

APPENDIX G

EAI Reporting Limits

Lorraine Olashaw, Laboratory Director
(603) 228-0525

Kathleen Noonan, Q. A. Coordinator
(603) 228-0525

eastern analytical, inc.

professional laboratory services

Inorganic Chemistry Reporting Limits

Method	Parameter:	Matrix	RL	Units
120.1 / 2510B-SM	Specific Conductance	AQ	1	µS
160.2 / 2540D-SM	Suspended Solids	AQ	5	mg/L
160.1 / 2540C-SM	Dissolved Solids	AQ	5	mg/L
160.3 / 2540B-SM	Total Solids	AQ	5	mg/L
330.5 / 4500ClG-SM	Total Residual Chlorine	AQ	0.05	mg/L
180.1	Turbidity 1-10	AQ	1	NTU
180.1	Turbidity 0.1-1	AQ	0.1	NTU
310.1 / 2320B-SM	Alkalinity	AQ	1	mg/L
335.2 / 4500CNE-SM	Total Cyanide	AQ	0.02	mg/L
350.3	Ammonia (Probe)	AQ	0.05	mg/L
350.3	Ammonia (TL-201)R10	AQ	0.05	mg/L
351.4	TKN (TL-201)R10	AQ	0.5	mg/L
365.3	Phosphorous-Total	AQ	0.05	mg/L
365.3	O-PO4 spec.	AQ	0.05	mg/L
5210B-SM	BOD	AQ	6	mg/L
410.4 / 8000-HACH	COD (low range) 10-200	AQ	10	mg/L
5310C-SM	TOC (0.5-20 cal)	AQ	0.5	mg/L
420.1	Total Phenols	AQ	0.05	mg/L
1664A	Oil & Grease 1664	AQ	5	mg/L
1664	TPH 1664	AQ	5	mg/L
353.2	Nitrate-FIA	AQ	0.5	mg/L
353.2	Nitrite-FIA	AQ	0.5	mg/L
325.2	Chloride-FIA	AQ	1	mg/L
300	Fluoride IC	AQ	0.1	mg/L
300	Chloride IC	AQ	1	mg/L
300	Nitrite IC	AQ	0.5	mg/L
300	Bromide IC	AQ	0.1	mg/L
300	Nitrate IC	AQ	0.5	mg/L
300	Sulfate IC	AQ	1	mg/L
314.1	Perchlorate	AQ	1	ug/L
	VFA-Lactate	AQ	0.3	mg/L
	VFA-Formate	AQ	0.3	mg/L
	VFA-Acetate	AQ	0.3	mg/L
	VFA-Propionate	AQ	0.6	mg/L
	VFA-Butyrate	AQ	0.6	mg/L

eastern analytical, inc.

professional laboratory services

Inorganic Chemistry Reporting Limits

Method	Parameter:	Matrix	RL	Units
310.1 / 2320B-SM	Alkalinity	Solid	10	mg/kg
335.2 / 4500CNE-SM	Total Cyanide	Solid	5	mg/kg
335.2	PAC Cyanide	Solid	0.1	mg/kg
350.3	Ammonia (Probe)	Solid	5	mg/kg
350.3	Ammonia (Alltech)	Solid	5	mg/kg
351.4	TKN	Solid	50	mg/kg
5210B-SM	BOD	Solid	60	mg/kg
420.1	Total Phenols	Solid	0.5	mg/kg
1664	Oil & Grease 1664	Solid	20	mg/kg
353.2	Nitrate/Nitrite-FIA	Solid	5	mg/kg
353.2	Nitrite-FIA	Solid	5	mg/kg
325.2	Chloride-FIA	Solid	10	mg/kg
300	Fluoride IC-Lachat	Solid	1	mg/kg
300	Chloride IC-Lachat	Solid	10	mg/kg
300	Nitrate IC-Lachat	Solid	5	mg/kg
300	Bromide IC-Lachat	Solid	1	mg/kg
300	Sulfate IC-Lachat	Solid	10	mg/kg

eastern analytical, inc.
professional laboratory services

Metals Reporting Limits

EPA 200.7	ANALYTE	Matrix	RL	Units	EPA 200.8	RL	Units
EPA 200.7	Aluminum	AQ	0.05	mg/L	EPA 200.8	50	ug/L
EPA 200.7	Antimony	AQ	0.05	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Arsenic	AQ	0.05	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Barium	AQ	0.05	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Beryllium	AQ	0.004	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Boron	AQ	0.05	mg/L	EPA 200.8	5	ug/L
EPA 200.7	Cadmium	AQ	0.001	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Calcium	AQ	0.005	mg/L	EPA 200.8	50	ug/L
EPA 200.7	Chromium	AQ	0.002	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Cobalt	AQ	0.05	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Copper	AQ	0.01	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Iron	AQ	0.01	mg/L	EPA 200.8	50	ug/L
EPA 200.7	Lead	AQ	0.01	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Magnesium	AQ	0.005	mg/L	EPA 200.8	50	ug/L
EPA 200.7	Manganese	AQ	0.005	mg/L	EPA 200.8	0.5	ug/L
NA	Mercury	NA	NA	NA	EPA 200.8	0.1	ug/L
EPA 200.7	Molybdenum	AQ	0.005	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Nickel	AQ	0.01	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Phosphorus	AQ	0.05	mg/L	EPA 200.8	50	ug/L
EPA 200.7	Potassium	AQ	0.05	mg/L	EPA 200.8	50	ug/L
EPA 200.7	Selenium	AQ	0.05	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Silica	AQ	0.05	mg/L	EPA 200.8	5	ug/L
EPA 200.7	Silver	AQ	0.005	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Sodium	AQ	5	mg/L	EPA 200.8	100	ug/L
EPA 200.7	Thallium	AQ	0.1	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Tin	AQ	0.05	mg/L	EPA 200.8	5	ug/L
EPA 200.7	Titanium	AQ	0.005	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Vanadium	AQ	0.005	mg/L	EPA 200.8	0.5	ug/L
EPA 200.7	Zinc	AQ	0.005	mg/L	EPA 200.8	0.5	ug/L

eastern analytical, inc.
professional laboratory services

Metals Reporting Limits

6010	Parameter	Matrix	RL	Units	6020	RL	Units
6010	Aluminum	Solid	2	mg/kg	6020	50	mg/kg
6010	Antimony	Solid	2	mg/kg	6020	0.5	mg/kg
6010	Arsenic	Solid	0.4	mg/kg	6020	0.5	mg/kg
6010	Barium	Solid	2	mg/kg	6020	0.5	mg/kg
6010	Beryllium	Solid	0.2	mg/kg	6020	0.5	mg/kg
6010	Cadmium	Solid	0.04	mg/kg	6020	0.5	mg/kg
6010	Calcium	Solid	0.2	mg/kg	6020	50	mg/kg
6010	Chromium	Solid	0.08	mg/kg	6020	0.5	mg/kg
6010	Cobalt	Solid	2	mg/kg	6020	0.5	mg/kg
6010	Copper	Solid	0.4	mg/kg	6020	0.5	mg/kg
6010	Iron	Solid	0.4	mg/kg	6020	50	mg/kg
6010	Lead	Solid	0.4	mg/kg	6020	0.5	mg/kg
6010	Magnesium	Solid	0.2	mg/kg	6020	50	mg/kg
6010	Manganese	Solid	0.2	mg/kg	6020	0.5	mg/kg
6010	Molybdenum	Solid	0.2	mg/kg	6020	0.5	mg/kg
6010	Nickel	Solid	0.4	mg/kg	6020	0.5	mg/kg
6010	Phosphorus	Solid	2	mg/kg	6020	50	mg/kg
6010	Potassium	Solid	2	mg/kg	6020	50	mg/kg
6010	Selenium	Solid	2	mg/kg	6020	0.5	mg/kg
6010	Silica	Solid	2	mg/kg	6020	5	mg/kg
6010	Silver	Solid	0.2	mg/kg	6020	0.5	mg/kg
6010	Sodium	Solid	200	mg/kg	6020	100	mg/kg
6010	Thallium	Solid	4	mg/kg	6020	0.5	mg/kg
6010	Tin	Solid	2	mg/kg	6020	5	mg/kg
6010	Titanium	Solid	0.2	mg/kg	6020	0.5	mg/kg
6010	Vanadium	Solid	0.2	mg/kg	6020	0.5	mg/kg
6010	Zinc	Solid	0.2	mg/kg	6020	0.5	mg/kg
6010	Mercury	Solid	NA	mg/kg	6020	0.1	mg/kg

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
Dichlorodifluoromethane	AqTot	524.2	0.5	ug/l
Chloromethane	AqTot	524.2	0.5	ug/l
Vinyl chloride	AqTot	524.2	0.5	ug/l
Bromomethane	AqTot	524.2	0.5	ug/l
Chloroethane	AqTot	524.2	0.5	ug/l
Trichlorofluoromethane	AqTot	524.2	0.5	ug/l
1,1-Dichloroethene	AqTot	524.2	0.5	ug/l
Methylene chloride	AqTot	524.2	0.5	ug/l
Methyl-t-butyl ether(MTBE)	AqTot	524.2	0.5	ug/l
trans-1,2-Dichloroethene	AqTot	524.2	0.5	ug/l
1,1-Dichloroethane	AqTot	524.2	0.5	ug/l
2,2-Dichloropropane	AqTot	524.2	0.5	ug/l
cis-1,2-Dichloroethene	AqTot	524.2	0.5	ug/l
Bromochloromethane	AqTot	524.2	0.5	ug/l
Chloroform	AqTot	524.2	0.5	ug/l
1,1,1-Trichloroethane	AqTot	524.2	0.5	ug/l
Carbon tetrachloride	AqTot	524.2	0.5	ug/l
1,1-Dichloropropene	AqTot	524.2	0.5	ug/l
Benzene	AqTot	524.2	0.5	ug/l
1,2-Dichloroethane	AqTot	524.2	0.5	ug/l
Trichloroethene	AqTot	524.2	0.5	ug/l
1,2-Dichloropropane	AqTot	524.2	0.5	ug/l
Dibromomethane	AqTot	524.2	0.5	ug/l
Bromodichloromethane	AqTot	524.2	0.5	ug/l
cis-1,3-Dichloropropene	AqTot	524.2	0.5	ug/l
Toluene	AqTot	524.2	0.5	ug/l
trans-1,3-Dichloropropene	AqTot	524.2	0.5	ug/l
1,1,2-Trichloroethane	AqTot	524.2	0.5	ug/l
Tetrachloroethene	AqTot	524.2	0.5	ug/l
1,3-Dichloropropane	AqTot	524.2	0.5	ug/l
Dibromochloromethane	AqTot	524.2	0.5	ug/l
1,2-Dibromoethane	AqTot	524.2	0.5	ug/l
Chlorobenzene	AqTot	524.2	0.5	ug/l
1,1,1,2-Tetrachloroethane	AqTot	524.2	0.5	ug/l
Ethylbenzene	AqTot	524.2	0.5	ug/l
mp-Xylene	AqTot	524.2	0.5	ug/l
o-Xylene	AqTot	524.2	0.5	ug/l
Styrene	AqTot	524.2	0.5	ug/l
Bromoform	AqTot	524.2	0.5	ug/l

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
IsoPropylbenzene	AqTot	524.2	0.5	ug/l
Bromobenzene	AqTot	524.2	0.5	ug/l
1,1,2,2-Tetrachloroethane	AqTot	524.2	0.5	ug/l
1,2,3-Trichloropropane	AqTot	524.2	0.5	ug/l
n-Propylbenzene	AqTot	524.2	0.5	ug/l
2-Chlorotoluene	AqTot	524.2	0.5	ug/l
4-Chlorotoluene	AqTot	524.2	0.5	ug/l
1,3,5-Trimethylbenzene	AqTot	524.2	0.5	ug/l
tert-Butylbenzene	AqTot	524.2	0.5	ug/l
1,2,4-Trimethylbenzene	AqTot	524.2	0.5	ug/l
sec-Butylbenzene	AqTot	524.2	0.5	ug/l
1,3-Dichlorobenzene	AqTot	524.2	0.5	ug/l
p-Isopropyltoluene	AqTot	524.2	0.5	ug/l
1,4-Dichlorobenzene	AqTot	524.2	0.5	ug/l
1,2-Dichlorobenzene	AqTot	524.2	0.5	ug/l
n-Butylbenzene	AqTot	524.2	0.5	ug/l
1,2-Dibromo-3-chloropropane	AqTot	524.2	0.5	ug/l
1,2,4-Trichlorobenzene	AqTot	524.2	0.5	ug/l
Hexachlorobutadiene	AqTot	524.2	0.5	ug/l
Naphthalene	AqTot	524.2	0.5	ug/l
1,2,3-Trichlorobenzene	AqTot	524.2	0.5	ug/l
Acetone	AqTot	524.2	10	ug/l
Carbon disulfide	AqTot	524.2	2	ug/l
Diethyl Ether	AqTot	524.2	5	ug/l
2-Butanone(MEK)	AqTot	524.2	5	ug/l
Tetrahydrofuran(THF)	AqTot	524.2	5	ug/l
4-Methyl-2-pentanone(MIBK)	AqTot	524.2	5	ug/l
2-Hexanone	AqTot	524.2	5	ug/l
Ethyl-t-butyl ether(ETBE)	AqTot	524.2	0.5	ug/l
tert-amyl methyl ether(TAME)	AqTot	524.2	0.5	ug/l
Isopropyl ether(DIPE)	AqTot	524.2	0.5	ug/l
tert-Butyl Alcohol (TBA)	AqTot	524.2	50	ug/l
Vinyl acetate	AqTot	524.2	10	ug/l
2-Chloroethylvinylether	AqTot	524.2	2	ug/l

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
Dichlorodifluoromethane	AqTot	8260B	5	ug/l
Chloromethane	AqTot	8260B	5	ug/l
Vinyl chloride	AqTot	8260B	2	ug/l
Bromomethane	AqTot	8260B	2	ug/l
Chloroethane	AqTot	8260B	5	ug/l
Trichlorofluoromethane	AqTot	8260B	5	ug/l
Diethyl Ether	AqTot	8260B	5	ug/l
Acetone	AqTot	8260B	10	ug/l
1,1-Dichloroethene	AqTot	8260B	1	ug/l
Methylene chloride	AqTot	8260B	5	ug/l
Carbon disulfide	AqTot	8260B	5	ug/l
Methyl-t-butyl ether(MTBE)	AqTot	8260B	5	ug/l
trans-1,2-Dichloroethene	AqTot	8260B	2	ug/l
1,1-Dichloroethane	AqTot	8260B	2	ug/l
2,2-Dichloropropane	AqTot	8260B	2	ug/l
cis-1,2-Dichloroethene	AqTot	8260B	2	ug/l
2-Butanone(MEK)	AqTot	8260B	10	ug/l
Bromochloromethane	AqTot	8260B	2	ug/l
Tetrahydrofuran(THF)	AqTot	8260B	10	ug/l
Chloroform	AqTot	8260B	2	ug/l
1,1,1-Trichloroethane	AqTot	8260B	2	ug/l
Carbon tetrachloride	AqTot	8260B	2	ug/l
1,1-Dichloropropene	AqTot	8260B	2	ug/l
1,2-Dichloroethane	AqTot	8260B	2	ug/l
Trichloroethene	AqTot	8260B	2	ug/l
1,2-Dichloropropane	AqTot	8260B	2	ug/l
Dibromomethane	AqTot	8260B	2	ug/l
Bromodichloromethane	AqTot	8260B	2	ug/l
4-Methyl-2-pentanone(MIBK)	AqTot	8260B	10	ug/l
cis-1,3-Dichloropropene	AqTot	8260B	2	ug/l
Toluene	AqTot	8260B	1	ug/l
trans-1,3-Dichloropropene	AqTot	8260B	2	ug/l
1,1,2-Trichloroethane	AqTot	8260B	2	ug/l
2-Hexanone	AqTot	8260B	10	ug/l
Tetrachloroethene	AqTot	8260B	2	ug/l
1,3-Dichloropropane	AqTot	8260B	2	ug/l
Dibromochloromethane	AqTot	8260B	2	ug/l
1,2-Dibromoethane	AqTot	8260B	2	ug/l
Chlorobenzene	AqTot	8260B	2	ug/l

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
1,1,1,2-Tetrachloroethane	AqTot	8260B	2	ug/l
Ethylbenzene	AqTot	8260B	1	ug/l
mp-Xylene	AqTot	8260B	1	ug/l
o-Xylene	AqTot	8260B	1	ug/l
Styrene	AqTot	8260B	1	ug/l
Bromoform	AqTot	8260B	2	ug/l
IsoPropylbenzene	AqTot	8260B	1	ug/l
Bromobenzene	AqTot	8260B	2	ug/l
1,1,2,2-Tetrachloroethane	AqTot	8260B	2	ug/l
1,2,3-Trichloropropane	AqTot	8260B	2	ug/l
n-Propylbenzene	AqTot	8260B	1	ug/l
2-Chlorotoluene	AqTot	8260B	2	ug/l
4-Chlorotoluene	AqTot	8260B	2	ug/l
1,3,5-Trimethylbenzene	AqTot	8260B	1	ug/l
tert-Butylbenzene	AqTot	8260B	1	ug/l
1,2,4-Trimethylbenzene	AqTot	8260B	1	ug/l
sec-Butylbenzene	AqTot	8260B	1	ug/l
1,3-Dichlorobenzene	AqTot	8260B	1	ug/l
p-Isopropyltoluene	AqTot	8260B	1	ug/l
1,4-Dichlorobenzene	AqTot	8260B	1	ug/l
1,2-Dichlorobenzene	AqTot	8260B	1	ug/l
n-Butylbenzene	AqTot	8260B	1	ug/l
1,2-Dibromo-3-chloropropane	AqTot	8260B	2	ug/l
1,2,4-Trichlorobenzene	AqTot	8260B	1	ug/l
Hexachlorobutadiene	AqTot	8260B	1	ug/l
Naphthalene	AqTot	8260B	5	ug/l
1,2,3-Trichlorobenzene	AqTot	8260B	1	ug/l
Benzene	AqTot	8260B	1	ug/l

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
Dichlorodifluoromethane	SolTotDry	8260B	200	ug/kg
Chloromethane	SolTotDry	8260B	200	ug/kg
Vinyl chloride	SolTotDry	8260B	100	ug/kg
Bromomethane	SolTotDry	8260B	200	ug/kg
Chloroethane	SolTotDry	8260B	200	ug/kg
Trichlorofluoromethane	SolTotDry	8260B	200	ug/kg
Diethyl Ether	SolTotDry	8260B	50	ug/kg
Acetone	SolTotDry	8260B	2000	ug/kg
1,1-Dichloroethene	SolTotDry	8260B	50	ug/kg
Methylene chloride	SolTotDry	8260B	100	ug/kg
Carbon disulfide	SolTotDry	8260B	100	ug/kg
Methyl-t-butyl ether(MTBE)	SolTotDry	8260B	100	ug/kg
trans-1,2-Dichloroethene	SolTotDry	8260B	50	ug/kg
1,1-Dichloroethane	SolTotDry	8260B	50	ug/kg
2,2-Dichloropropane	SolTotDry	8260B	50	ug/kg
cis-1,2-Dichloroethene	SolTotDry	8260B	50	ug/kg
2-Butanone(MEK)	SolTotDry	8260B	500	ug/kg
Bromochloromethane	SolTotDry	8260B	50	ug/kg
Tetrahydrofuran(THF)	SolTotDry	8260B	500	ug/kg
Chloroform	SolTotDry	8260B	50	ug/kg
1,1,1-Trichloroethane	SolTotDry	8260B	50	ug/kg
Carbon tetrachloride	SolTotDry	8260B	50	ug/kg
1,1-Dichloropropene	SolTotDry	8260B	50	ug/kg
Benzene	SolTotDry	8260B	50	ug/kg
1,2-Dichloroethane	SolTotDry	8260B	50	ug/kg
Trichloroethene	SolTotDry	8260B	50	ug/kg
1,2-Dichloropropane	SolTotDry	8260B	50	ug/kg
Dibromomethane	SolTotDry	8260B	50	ug/kg
Bromodichloromethane	SolTotDry	8260B	50	ug/kg
4-Methyl-2-pentanone(MIBK)	SolTotDry	8260B	500	ug/kg
cis-1,3-Dichloropropene	SolTotDry	8260B	50	ug/kg
Toluene	SolTotDry	8260B	50	ug/kg
trans-1,3-Dichloropropene	SolTotDry	8260B	50	ug/kg
1,1,2-Trichloroethane	SolTotDry	8260B	50	ug/kg
2-Hexanone	SolTotDry	8260B	500	ug/kg
Tetrachloroethene	SolTotDry	8260B	50	ug/kg
1,3-Dichloropropane	SolTotDry	8260B	50	ug/kg
Dibromochloromethane	SolTotDry	8260B	50	ug/kg
1,2-Dibromoethane	SolTotDry	8260B	50	ug/kg

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
Chlorobenzene	SolTotDry	8260B	50	ug/kg
1,1,1,2-Tetrachloroethane	SolTotDry	8260B	50	ug/kg
Ethylbenzene	SolTotDry	8260B	50	ug/kg
mp-Xylene	SolTotDry	8260B	50	ug/kg
o-Xylene	SolTotDry	8260B	50	ug/kg
Styrene	SolTotDry	8260B	50	ug/kg
Bromoform	SolTotDry	8260B	50	ug/kg
IsoPropylbenzene	SolTotDry	8260B	50	ug/kg
Bromobenzene	SolTotDry	8260B	50	ug/kg
1,1,2,2-Tetrachloroethane	SolTotDry	8260B	50	ug/kg
1,2,3-Trichloropropane	SolTotDry	8260B	50	ug/kg
n-Propylbenzene	SolTotDry	8260B	50	ug/kg
2-Chlorotoluene	SolTotDry	8260B	50	ug/kg
4-Chlorotoluene	SolTotDry	8260B	50	ug/kg
1,3,5-Trimethylbenzene	SolTotDry	8260B	50	ug/kg
tert-Butylbenzene	SolTotDry	8260B	50	ug/kg
1,2,4-Trimethylbenzene	SolTotDry	8260B	50	ug/kg
sec-Butylbenzene	SolTotDry	8260B	50	ug/kg
1,3-Dichlorobenzene	SolTotDry	8260B	50	ug/kg
p-Isopropyltoluene	SolTotDry	8260B	50	ug/kg
1,4-Dichlorobenzene	SolTotDry	8260B	50	ug/kg
1,2-Dichlorobenzene	SolTotDry	8260B	50	ug/kg
n-Butylbenzene	SolTotDry	8260B	50	ug/kg
1,2-Dibromo-3-chloropropane	SolTotDry	8260B	50	ug/kg
1,2,4-Trichlorobenzene	SolTotDry	8260B	50	ug/kg
Hexachlorobutadiene	SolTotDry	8260B	50	ug/kg
Naphthalene	SolTotDry	8260B	300	ug/kg
1,2,3-Trichlorobenzene	SolTotDry	8260B	50	ug/kg

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
Phenol	AqTot	8270C	1	ug/l
2-Chlorophenol	AqTot	8270C	1	ug/l
2,4-Dichlorophenol	AqTot	8270C	1	ug/l
2,4,5-Trichlorophenol	AqTot	8270C	1	ug/l
2,4,6-Trichlorophenol	AqTot	8270C	1	ug/l
Pentachlorophenol	AqTot	8270C	5	ug/l
2-Nitrophenol	AqTot	8270C	1	ug/l
4-Nitrophenol	AqTot	8270C	5	ug/l
2,4-Dinitrophenol	AqTot	8270C	5	ug/l
2-Methylphenol	AqTot	8270C	1	ug/l
3/4-Methylphenol	AqTot	8270C	1	ug/l
2,4-Dimethylphenol	AqTot	8270C	1	ug/l
4-Chloro-3-methylphenol	AqTot	8270C	1	ug/l
4,6-Dinitro-2-methylphenol	AqTot	8270C	5	ug/l
Benzoic Acid	AqTot	8270C	5	ug/l
N-Nitrosodimethylamine	AqTot	8270C	1	ug/l
n-Nitroso-di-n-propylamine	AqTot	8270C	1	ug/l
n-Nitrosodiphenylamine	AqTot	8270C	1	ug/l
bis(2-Chloroethyl)ether	AqTot	8270C	1	ug/l
bis(2-chloroisopropyl)ether	AqTot	8270C	1	ug/l
bis(2-Chloroethoxy)methane	AqTot	8270C	1	ug/l
1,3-Dichlorobenzene	AqTot	8270C	1	ug/l
1,4-Dichlorobenzene	AqTot	8270C	1	ug/l
1,2-Dichlorobenzene	AqTot	8270C	1	ug/l
1,2,4-Trichlorobenzene	AqTot	8270C	1	ug/l
2-Chloronaphthalene	AqTot	8270C	1	ug/l
4-Chlorophenyl-phenylether	AqTot	8270C	1	ug/l
4-Bromophenyl-phenylether	AqTot	8270C	1	ug/l
Hexachloroethane	AqTot	8270C	1	ug/l
Hexachlorobutadiene	AqTot	8270C	1	ug/l
Hexachlorocyclopentadiene	AqTot	8270C	5	ug/l
Hexachlorobenzene	AqTot	8270C	1	ug/l
4-Chloroaniline	AqTot	8270C	1	ug/l
2-Nitroaniline	AqTot	8270C	5	ug/l
3-Nitroaniline	AqTot	8270C	1	ug/l
4-Nitroaniline	AqTot	8270C	1	ug/l
Benzyl alcohol	AqTot	8270C	1	ug/l
Nitrobenzene	AqTot	8270C	1	ug/l
Isophorone	AqTot	8270C	1	ug/l

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
2,4-Dinitrotoluene	AqTot	8270C	1	ug/l
2,6-Dinitrotoluene	AqTot	8270C	1	ug/l
Benzidine	AqTot	8270C	5	ug/l
3,3'-Dichlorobenzidine	AqTot	8270C	1	ug/l
Pyridine	AqTot	8270C	5	ug/l
Azobenzene	AqTot	8270C	1	ug/l
Dimethylphthalate	AqTot	8270C	1	ug/l
Diethylphthalate	AqTot	8270C	1	ug/l
Di-n-butylphthalate	AqTot	8270C	5	ug/l
Butylbenzylphthalate	AqTot	8270C	1	ug/l
bis(2-Ethylhexyl)phthalate	AqTot	8270C	5	ug/l
Di-n-octylphthalate	AqTot	8270C	1	ug/l
Naphthalene	AqTot	8270C	1	ug/l
2-Methylnaphthalene	AqTot	8270C	1	ug/l
Acenaphthylene	AqTot	8270C	1	ug/l
Acenaphthene	AqTot	8270C	1	ug/l
Dibenzofuran	AqTot	8270C	1	ug/l
Fluorene	AqTot	8270C	1	ug/l
Phenanthrene	AqTot	8270C	1	ug/l
Anthracene	AqTot	8270C	1	ug/l
Fluoranthene	AqTot	8270C	1	ug/l
Pyrene	AqTot	8270C	1	ug/l
Benzo[a]anthracene	AqTot	8270C	1	ug/l
Chrysene	AqTot	8270C	1	ug/l
Benzo[b]fluoranthene	AqTot	8270C	1	ug/l
Benzo[k]fluoranthene	AqTot	8270C	1	ug/l
Benzo[a]pyrene	AqTot	8270C	1	ug/l
Indeno[1,2,3-cd]pyrene	AqTot	8270C	1	ug/l
Dibenz[a,h]anthracene	AqTot	8270C	1	ug/l
Benzo[g,h,i]perylene	AqTot	8270C	1	ug/l
Carbazole	AqTot	8270C	1	ug/l

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
Phenol	SolTotDry	8270C	200	ug/kg
2-Chlorophenol	SolTotDry	8270C	200	ug/kg
2,4-Dichlorophenol	SolTotDry	8270C	200	ug/kg
2,4,5-Trichlorophenol	SolTotDry	8270C	200	ug/kg
2,4,6-Trichlorophenol	SolTotDry	8270C	200	ug/kg
Pentachlorophenol	SolTotDry	8270C	1000	ug/kg
2-Nitrophenol	SolTotDry	8270C	200	ug/kg
4-Nitrophenol	SolTotDry	8270C	200	ug/kg
2,4-Dinitrophenol	SolTotDry	8270C	1000	ug/kg
2-Methylphenol	SolTotDry	8270C	200	ug/kg
3/4-Methylphenol	SolTotDry	8270C	200	ug/kg
2,4-Dimethylphenol	SolTotDry	8270C	200	ug/kg
4-Chloro-3-methylphenol	SolTotDry	8270C	200	ug/kg
4,6-Dinitro-2-methylphenol	SolTotDry	8270C	1000	ug/kg
Benzoic Acid	SolTotDry	8270C	1000	ug/kg
N-Nitrosodimethylamine	SolTotDry	8270C	200	ug/kg
n-Nitroso-di-n-propylamine	SolTotDry	8270C	200	ug/kg
n-Nitrosodiphenylamine	SolTotDry	8270C	200	ug/kg
bis(2-Chloroethyl)ether	SolTotDry	8270C	200	ug/kg
bis(2-chloroisopropyl)ether	SolTotDry	8270C	200	ug/kg
bis(2-Chloroethoxy)methane	SolTotDry	8270C	200	ug/kg
1,3-Dichlorobenzene	SolTotDry	8270C	200	ug/kg
1,4-Dichlorobenzene	SolTotDry	8270C	200	ug/kg
1,2-Dichlorobenzene	SolTotDry	8270C	200	ug/kg
1,2,4-Trichlorobenzene	SolTotDry	8270C	200	ug/kg
2-Chloronaphthalene	SolTotDry	8270C	200	ug/kg
4-Chlorophenyl-phenylether	SolTotDry	8270C	200	ug/kg
4-Bromophenyl-phenylether	SolTotDry	8270C	200	ug/kg
Hexachloroethane	SolTotDry	8270C	200	ug/kg
Hexachlorobutadiene	SolTotDry	8270C	200	ug/kg
Hexachlorocyclopentadiene	SolTotDry	8270C	1000	ug/kg
Hexachlorobenzene	SolTotDry	8270C	200	ug/kg
4-Chloroaniline	SolTotDry	8270C	200	ug/kg
2-Nitroaniline	SolTotDry	8270C	200	ug/kg
3-Nitroaniline	SolTotDry	8270C	200	ug/kg
4-Nitroaniline	SolTotDry	8270C	200	ug/kg
Benzyl alcohol	SolTotDry	8270C	200	ug/kg
Nitrobenzene	SolTotDry	8270C	200	ug/kg
Isophorone	SolTotDry	8270C	200	ug/kg

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
2,4-Dinitrotoluene	SolTotDry	8270C	200	ug/kg
2,6-Dinitrotoluene	SolTotDry	8270C	200	ug/kg
Benzidine	SolTotDry	8270C	400	ug/kg
3,3'-Dichlorobenzidine	SolTotDry	8270C	200	ug/kg
Pyridine	SolTotDry	8270C	200	ug/kg
Azobenzene	SolTotDry	8270C	200	ug/kg
Dimethylphthalate	SolTotDry	8270C	200	ug/kg
Diethylphthalate	SolTotDry	8270C	200	ug/kg
Di-n-butylphthalate	SolTotDry	8270C	500	ug/kg
Butylbenzylphthalate	SolTotDry	8270C	200	ug/kg
bis(2-Ethylhexyl)phthalate	SolTotDry	8270C	200	ug/kg
Di-n-octylphthalate	SolTotDry	8270C	200	ug/kg
Naphthalene	SolTotDry	8270C	200	ug/kg
2-Methylnaphthalene	SolTotDry	8270C	200	ug/kg
Acenaphthylene	SolTotDry	8270C	200	ug/kg
Acenaphthene	SolTotDry	8270C	200	ug/kg
Dibenzofuran	SolTotDry	8270C	200	ug/kg
Fluorene	SolTotDry	8270C	200	ug/kg
Phenanthrene	SolTotDry	8270C	200	ug/kg
Anthracene	SolTotDry	8270C	200	ug/kg
Fluoranthene	SolTotDry	8270C	200	ug/kg
Pyrene	SolTotDry	8270C	200	ug/kg
Benzo[a]anthracene	SolTotDry	8270C	200	ug/kg
Chrysene	SolTotDry	8270C	200	ug/kg
Benzo[b]fluoranthene	SolTotDry	8270C	200	ug/kg
Benzo[k]fluoranthene	SolTotDry	8270C	200	ug/kg
Benzo[a]pyrene	SolTotDry	8270C	200	ug/kg
Indeno[1,2,3-cd]pyrene	SolTotDry	8270C	200	ug/kg
Dibenz[a,h]anthracene	SolTotDry	8270C	200	ug/kg
Benzo[g,h,i]perylene	SolTotDry	8270C	200	ug/kg
Carbazole	SolTotDry	8270C	200	ug/kg

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
PCB-1016	AqTot	8082	0.5	ug/l
PCB-1221	AqTot	8082	0.5	ug/l
PCB-1232	AqTot	8082	0.5	ug/l
PCB-1242	AqTot	8082	0.5	ug/l
PCB-1254	AqTot	8082	0.5	ug/l
PCB-1248	AqTot	8082	0.5	ug/l
PCB-1260	AqTot	8082	0.5	ug/l

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
PCB-1016	SolTotDry	8082	100	ug/kg
PCB-1221	SolTotDry	8082	100	ug/kg
PCB-1232	SolTotDry	8082	100	ug/kg
PCB-1242	SolTotDry	8082	100	ug/kg
PCB-1248	SolTotDry	8082	100	ug/kg
PCB-1254	SolTotDry	8082	100	ug/kg
PCB-1260	SolTotDry	8082	100	ug/kg

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
Aldrin	AqTot	8081A	0.5	ug/l
alpha-BHC	AqTot	8081A	0.5	ug/l
beta-BHC	AqTot	8081A	0.5	ug/l
Lindane (gamma-BHC)	AqTot	8081A	0.5	ug/l
delta-BHC	AqTot	8081A	0.5	ug/l
Chlordane	AqTot	8081A	5	ug/l
4,4'-DDT	AqTot	8081A	0.5	ug/l
4,4'-DDE	AqTot	8081A	0.5	ug/l
4,4'-DDD	AqTot	8081A	0.5	ug/l
Dieldrin	AqTot	8081A	0.5	ug/l
Endosulfan I	AqTot	8081A	0.5	ug/l
Endosulfan II	AqTot	8081A	0.5	ug/l
Endosulfan Sulfate	AqTot	8081A	0.5	ug/l
Endrin	AqTot	8081A	0.5	ug/l
Endrin Aldehyde	AqTot	8081A	0.5	ug/l
Heptachlor	AqTot	8081A	0.5	ug/l
Heptachlor Epoxide	AqTot	8081A	0.5	ug/l
Methoxychlor	AqTot	8081A	0.5	ug/l
Toxaphene	AqTot	8081A	5	ug/l

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
Aldrin	SolTotDry	8081A	10	ug/kg
alpha-BHC	SolTotDry	8081A	10	ug/kg
beta-BHC	SolTotDry	8081A	10	ug/kg
Lindane (gamma-BHC)	SolTotDry	8081A	10	ug/kg
delta-BHC	SolTotDry	8081A	10	ug/kg
Chlordane	SolTotDry	8081A	100	ug/kg
4,4'-DDT	SolTotDry	8081A	10	ug/kg
4,4'-DDE	SolTotDry	8081A	10	ug/kg
4,4'-DDD	SolTotDry	8081A	10	ug/kg
Dieldrin	SolTotDry	8081A	10	ug/kg
Endosulfan I	SolTotDry	8081A	10	ug/kg
Endosulfan II	SolTotDry	8081A	10	ug/kg
Endosulfan Sulfate	SolTotDry	8081A	10	ug/kg
Endrin	SolTotDry	8081A	10	ug/kg
Endrin Aldehyde	SolTotDry	8081A	10	ug/kg
Heptachlor	SolTotDry	8081A	10	ug/kg
Heptachlor Epoxide	SolTotDry	8081A	10	ug/kg
Methoxychlor	SolTotDry	8081A	10	ug/kg
Toxaphene	SolTotDry	8081A	100	ug/kg

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
TPH (C9-C40)	AqTot	8100mod	0.5	mg/l

Parameter Name	Matrix	Analytical Method	Reporting Limit	Units
TPH (C9-C40)	SolTotDry	8100mod	50	mg/kg

Appendix I

YSI 556MPS Manual

YSI Environmental

Pure Data for a Healthy Planet.™

YSI 556 MPS
Multi Probe System

Operations Manual

Contents

1. Safety

1.1 General Safety Information

Read all safety information in this manual carefully before using the YSI 556 Multi-Probe System (MPS). Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review *Appendix D Health and Safety*.

⚠ **WARNING**

Warnings are used in this manual when misuse of the instrument could result in death or serious injury to a person.

⚠ **CAUTION**

Cautions are used in this manual when misuse of the instrument could result in mild or serious injury to a person and/or damage to equipment.

⚠ **IMPORTANT SAFETY INSTRUCTIONS!**

⚠ **SAVE THESE INSTRUCTIONS!**

⚠ In essence, the most important safety rule for use of the YSI 556 MPS is to utilize the instrument ONLY for purposes documented in this manual. This is particularly true of the YSI 6117 rechargeable battery pack that contains nickel metal hydride (NiMH) batteries. The user should be certain to read all of the safety precautions outlined below before using the instrument.

⚠ YSI 6117 Rechargeable Battery Pack Safety Information

⚠ **Restrictions on Usage**

1. Never dispose of the battery pack in a fire.
2. Do not attempt to disassemble the YSI 6117 battery pack.
3. Do not tamper with any of the electronic components or the batteries within the battery pack. Tampering with either the electronic circuitry or the batteries will result in the voiding of the warranty and the compromising of the system performance, but, more importantly, can cause safety

hazards which result from overcharging such as overheating, venting of gas, and loss of corrosive electrolyte.

4. Do not charge the battery pack outside the 0–40°C temperature range.
5. Do not use or store the battery at high temperature, such as in strong direct sunlight, in cars during hot weather, or directly in front of heaters.
6. Do not expose the battery pack to water or allow the terminals to become damp.
7. Avoid striking or dropping the battery pack. If the pack appears to have sustained damage from these actions or malfunctions after an impact or drop, the user should not attempt to repair the unit. Instead, contact YSI Customer Service. Refer to *Appendix E Customer Service*.
8. If the battery pack is removed from the YSI 556 MPS, do not store it in pockets or packaging where metallic objects such as keys can short between the positive and negative terminals.

⚠ Precautions for Users with Small Children

Keep the battery pack out of reach of babies and small children.

⚠ Danger Notifications – Misuse creates a STRONG possibility of death or serious injury.

FAILURE TO CAREFULLY OBSERVE THE FOLLOWING PROCEDURES AND PRECAUTIONS CAN RESULT IN LEAKAGE OF BATTERY FLUID, HEAT GENERATION, BURSTING, AND SERIOUS PERSONAL INJURY.

1. Never dispose of the battery pack in a fire or heat it.
2. Never allow the positive and negative terminals of the battery pack to become shorted or connected with electrically conductive materials. When the battery pack has been removed from the YSI 556 MPS, store it in a heavy plastic bag to prevent accidental shorting of the terminals.

3. Never disassemble the battery pack and do not tamper with any of the electronic components or the batteries within the battery pack. The battery pack is equipped with a variety of safety features. Accidental deactivation of any of these safety features can cause a serious hazard to the user.
4. The NiMH batteries in the battery pack contain a strong alkaline solution (electrolyte). The alkaline solution is extremely corrosive and will cause damage to skin or other tissues. If any fluid from the battery pack comes in contact with a user's eyes, immediately flush with clean water and consult a physician immediately. The alkaline solution can damage eyes and lead to permanent loss of eyesight.

⚠ Warning Notifications – Misuse creates a possibility of death or serious injury

1. Do not allow the battery pack to contact freshwater, seawater, or other oxidizing reagents that might cause rust and result in heat generation. If a battery becomes rusted, the gas release vent may no longer operate and this failure can result in bursting.
2. If electrolyte from the battery pack contacts the skin or clothing, thoroughly wash the area immediately with clean water. The battery fluid can irritate the skin.

⚠ Caution Notifications – Misuse creates a possibility of mild or serious injury or damage to the equipment.

1. Do not strike or drop the battery pack. If any impact damage to the battery pack is suspected, contact YSI Customer Service. Refer to *Appendix E Customer Service*.
2. Store the battery pack out of reach of babies and small children.
3. Store the battery pack between the temperatures of -20 and 30°C.
4. Before using the battery pack, be sure to read the operation manual and all precautions carefully. Then store this information carefully to use as a reference when the need arises.

⚠ YSI 616 Cigarette Lighter Charger Safety Information

1. This section contains important safety and operating instructions for the YSI 556 MPS cigarette lighter battery charger (YSI 616; RadioShack Number 270-1533E). BE SURE TO SAVE THESE INSTRUCTIONS.
2. Before using the YSI 616 cigarette lighter charger, read all instructions and cautionary markings on battery charger, battery pack, and YSI 556 MPS.
3. Charge the YSI 6117 battery pack with the YSI 616 cigarette lighter charger ONLY when the YSI 6117 is installed in the YSI 556 MPS.
4. Do not expose charger to rain, moisture, or snow.
5. Use of an attachment not recommended or sold by the battery charger manufacturer may result in a risk of fire, electric shock, or injury to persons.
6. To reduce risk of damage to cigarette lighter and cord, pull by cigarette lighter rather than cord when disconnecting charger.
7. Make sure that the cord is located so that it will not be stepped on, tripped over, or otherwise subjected to damage or stress.
8. Do not operate charger with damaged cord or cigarette lighter connector – replace it immediately.
9. Do not operate charger if it has received a sharp blow, been dropped, or otherwise damaged in any way; contact YSI Customer Service. Refer to *Appendix E Customer Service*.
10. Do not disassemble charger other than to change the fuse as instructed. Replace the part or send it to YSI Product Service if repair is required (refer to *Appendix E Customer Service*). Incorrect reassembly may result in a risk of electric shock or fire.
11. To reduce risk of electric shock, unplug charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.

⚠ YSI 556 MPS Water Leakage Safety Information

The YSI 556 MPS has been tested and shown to comply with IP67 criterion, i.e. submersion in 1 meter of water for 30 minutes with no leakage into either the battery compartment or the main case. However, if the instrument is submersed for periods of time in excess of 30 minutes, leakage may occur with subsequent damage to the batteries, the rechargeable battery pack circuitry, and/or the electronics in the main case.

If leakage into the battery compartment is observed when using alkaline C cells, remove batteries, dispose of batteries properly, and dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

If leakage into the battery compartment is observed when using the YSI 6117 rechargeable battery pack, remove the battery assembly and set aside to dry. Return the battery pack to YSI Product Service for evaluation of possible damage. Finally dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** If water has contacted the rechargeable battery pack, do not attempt to reuse it until it has been evaluated by YSI Product Service (refer to *Appendix E Customer Service*). Failure to follow this precaution can result in serious injury to the user.

If it is suspected that leakage into the main cavity of the case has occurred, remove the batteries immediately and return the instrument to YSI Product Service for damage assessment. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** Under no circumstances should the user attempt to open the main case.

2. General Information

2.1 Description

The rugged and reliable YSI 556 MPS (Multi-Probe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multi-parameter system. Featuring a waterproof, impact-resistant case, the YSI 556 MPS simultaneously measures dissolved oxygen, conductivity, temperature, and optional pH and ORP. A simple cellular phone style keypad and large display make the instrument easy to use. The YSI 556 MPS is compatible with YSI EcoWatch™ for Windows™ software.

The YSI 556 MPS assists the user in conforming to Good Laboratory Practice (GLP) standards which help ensure that quality control/quality assurance methods are followed. Battery life is displayed with a fuel gauge, and the user can choose standard alkaline batteries or an optional rechargeable battery pack.

The 1.5 MB memory can store more than 49,000 data sets. Other options include a flow cell and barometer. The internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure.

Features

- Waterproof - meets IP67 specifications
- Field-replaceable DO electrode module; pH and pH/ORP sensors
- Compatible with Ecowatch™ for Windows™ data analysis software
- Assists with Good Laboratory Practice Standards (GLP)
- Choice of DO membrane material for different applications
- Easy-to-use, screw-on cap DO membranes
- User-upgradable software from YSI website
- Three-year warranty on the instrument; one-year on the probe modules
- Available with 4,10, and 20 m cable lengths
- Stores over 49,000 data sets, time and date stamped
- Auto temperature compensating display contrast

- Optional barometer
- Optional rechargeable battery pack or standard alkaline batteries

2.2 Unpacking the Instrument

1. Remove the instrument from the shipping box. Note that the probe module and sensors are shipped in a separate box and will be unpacked later in Section *3.2 Unpacking the Probe Module*.

   NOTE: Do not discard any parts or supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

   NOTE: If any parts are missing or damaged, contact your YSI Service Center immediately. Refer to *Appendix E Customer Service* or www.ysi.com.

2.3 Features of the YSI 556 Multi-Probe System

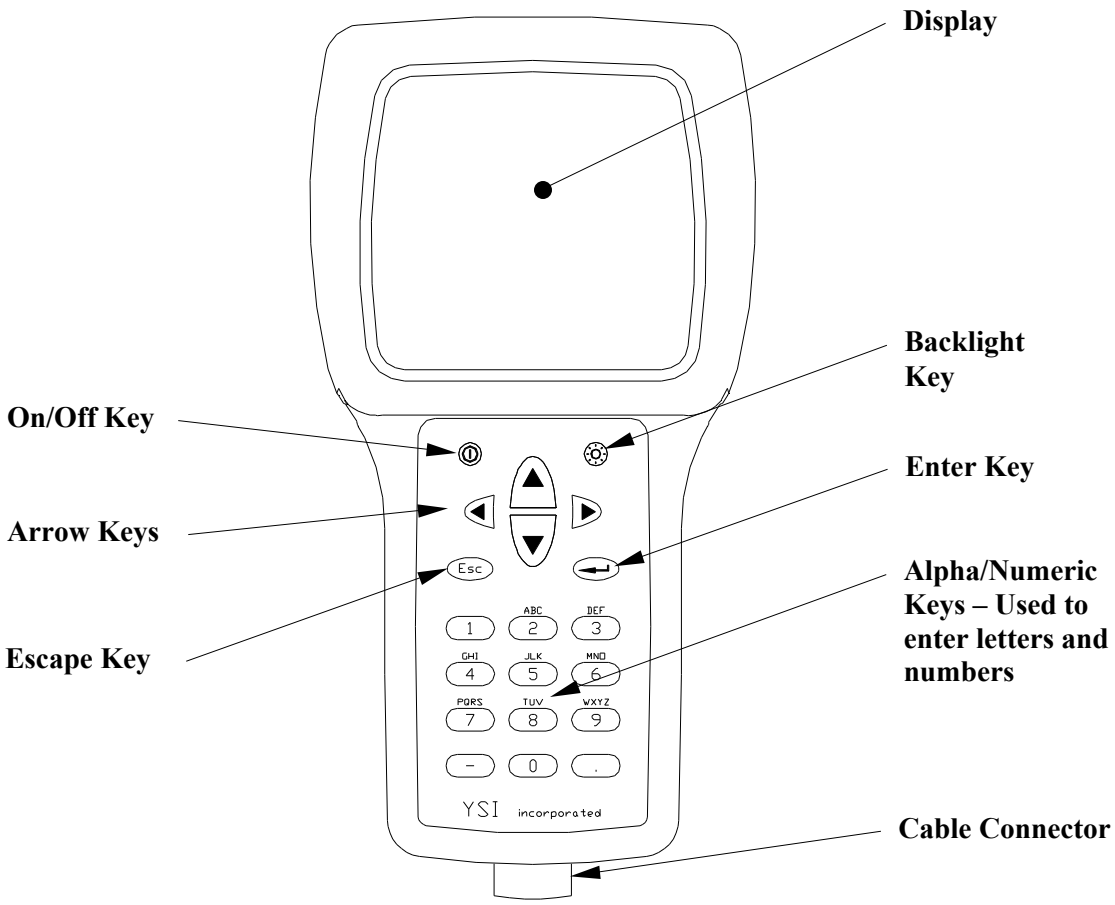


Figure 2.1 Front View of YSI 556 MPS

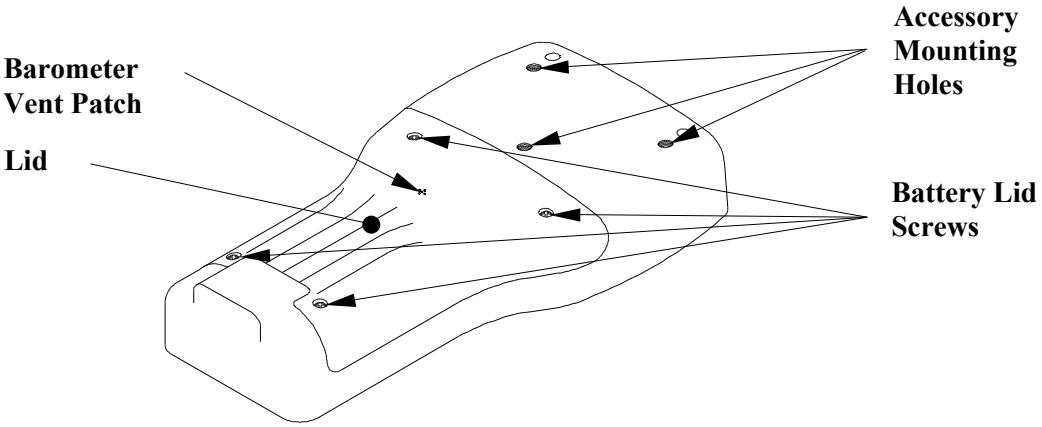


Figure 2.2 Back View of YSI 556 MPS

2.4 Batteries

2.4.1 Battery Life

Standard Alkaline Batteries

With the standard battery configuration of 4 alkaline C cells, the YSI 556 MPS will operate continuously for approximately 180 hours. Assuming a standard usage pattern when sampling of 3 hours of "on time" in a typical day, the alkaline cells will last approximately 60 days.

Optional Rechargeable Battery Pack

When fully charged, the optional rechargeable battery pack will provide approximately 50 hours of battery life.

2.4.2 Inserting 4 C Batteries

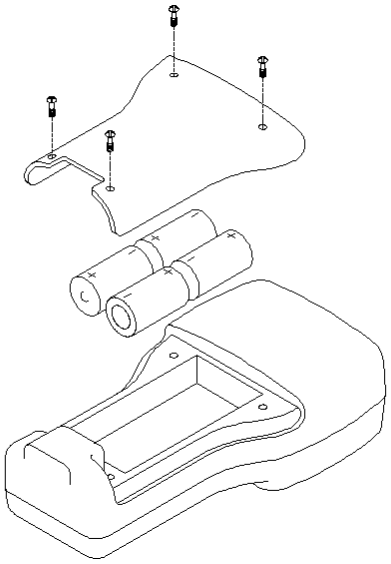


Figure 2.3 Inserting C Cells

⚠ **CAUTION: Install batteries properly to avoid damage to the instrument.**

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.
2. Remove the battery lid.
3. Insert four C batteries between the clips following the polarity (+ and -) labels on the bottom of the battery compartment.
4. Check gasket for proper placement on the battery lid.
5. Replace the battery lid and tighten the 4 screws securely and evenly.

   NOTE: Do not over-tighten the screws.

2.4.3 Inserting Optional Rechargeable Battery Pack

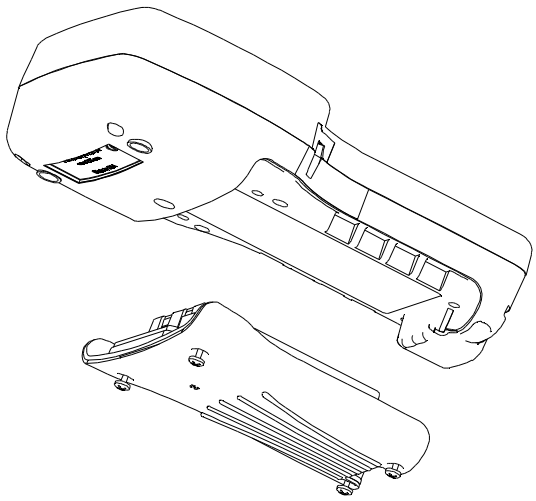


Figure 2.4 Inserting Battery Pack

⚠ **CAUTION: Read all cautions and warnings that come with the battery pack *before* using the battery pack.**

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.

2. Remove the C battery lid and store for future use. Remove C batteries, if installed.

3. Check for proper placement of gasket on the rechargeable battery pack and lid.

4. Install the rechargeable battery pack and lid and tighten the 4 screws securely and evenly.

   NOTE: Do not over tighten the screws.

2.4.4 Charging the Optional Rechargeable Battery Pack

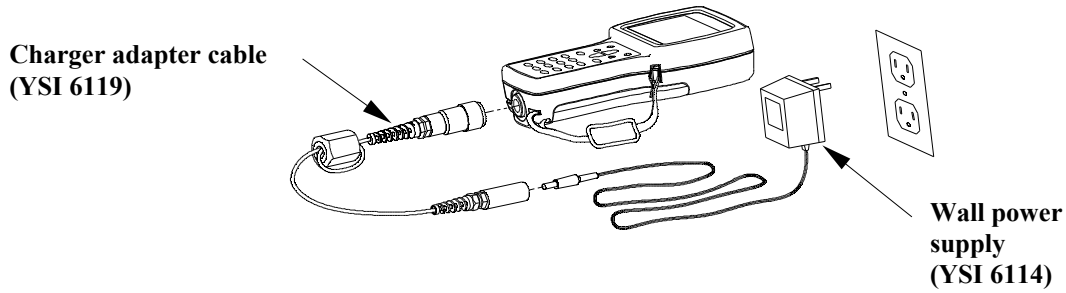


Figure 2.5 Charging the Battery Pack

⚠ **CAUTION: Do not use or store the battery pack at extreme temperatures such as in strong direct sunlight, in cars during hot weather or close to heaters.**

1. Install the rechargeable battery pack into the instrument as described in Section *2.4.3 Inserting Optional Rechargeable Battery Pack*.

2. Attach the charger adapter cable (YSI 6119) to the instrument.

   NOTE: Wall power supplies for use in countries outside the US and Canada can be found in *Appendix B Instrument Accessories*.

3. Insert the barrel connector of the wall power supply into the barrel of the adapter cable.

⚠ **CAUTION: Do not charge the battery pack continuously for more than 48 hours.**

⚠ **CAUTION: Do not drop or expose to water.**

⚠ **CAUTION: Do not charge the battery pack at temperatures below 0°C or above 40°C.**

4. Plug the wall power supply into an AC power outlet for approximately 2 hours to obtain an 80% to 90% charge and for 6 hours to get a full charge.

   NOTE: The battery pack can be recharged whether the instrument is on or off.

2.4.5 Storing the Battery Pack

Remove the battery pack from the instrument when the instrument will not be used for extended periods of time to prevent over discharge of the battery pack.

Store the battery pack in a heavy plastic bag to prevent accidental shorting of the terminals. Store between –20 and 30°C.

2.4.6 Optional Cigarette Lighter Charger

⚠ **CAUTION: Read all warnings and cautions that come with the charger before using the charger.**

⚠ **CAUTION: Only use cigarette lighter charger when *rechargeable* battery pack is inserted into instrument.**

⚠ **CAUTION: Do not mishandle cigarette lighter charger. Do not expose to moisture.**

1. Plug the barrel connector of the cigarette lighter charger into the mating end of the YSI 6119 Charger Adapter Cable.

2. Attach the MS-19 end of the YSI 6119 Charger Adapter Cable to the instrument.

3. Make one of the following modifications to the other end of the charger:

   Slide the adapter ring off the plug to use the device with an American or Japanese vehicle.

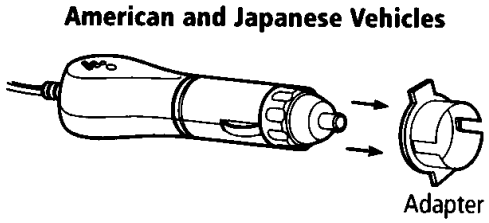


Figure 2.6 Charger Plug Adapter Use

Leave the adapter ring on the plug and position it so that the slots on the adapter ring line up with the plug's spring clips to use the device on a European vehicle.

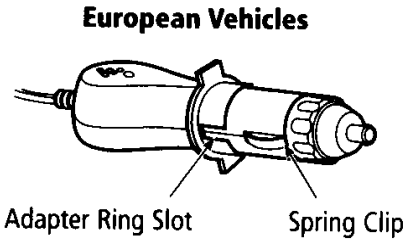


Figure 2.7 European Charger Plug Adapter Use

NOTE: If the charger stops working properly, refer to Section *13 Troubleshooting*.

2.5 Power On

Press and release the on/off button in the upper left corner of the instrument keypad to turn the instrument on or off. See Figure 2.1 Front View of YSI 556 MPS.

2.6 Setting Display Contrast

The display contrast automatically compensates for temperature changes. However, under extreme temperature conditions you may wish to optimize the display by manual adjustment as follows:

1. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “up” arrow to increase (darken) the contrast.

2. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “down” arrow to decrease (lighten) the contrast.

2.7 Backlight

Press and *release* the backlight key in the upper right corner of the keypad to turn the backlight on or off. See Figure 2.1 Front View of YSI 556 MPS.

NOTE: The backlight turns off automatically after two minutes of non-use.

2.8 General Screen Features

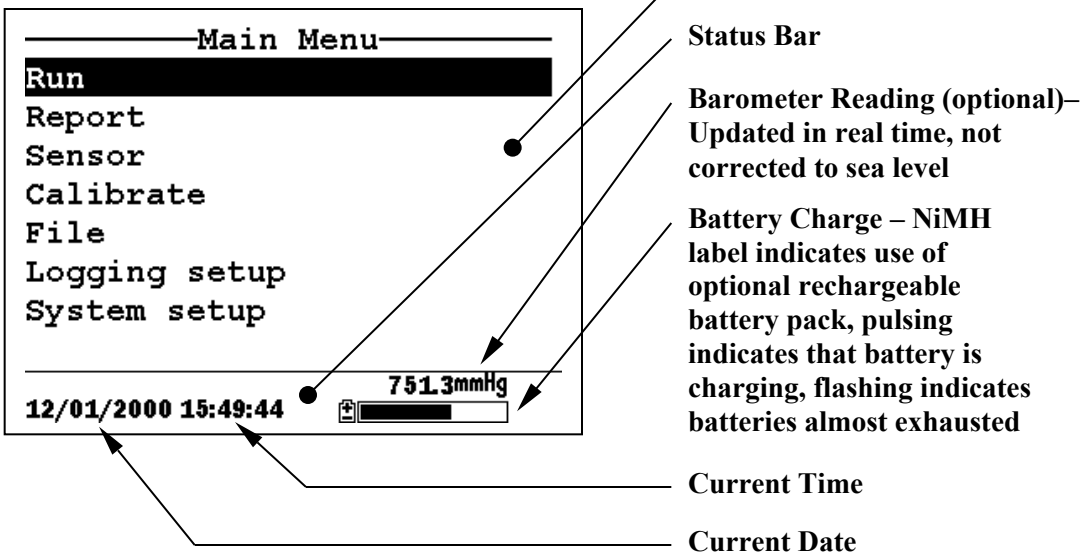


Figure 2.8 Main Menu Screen

2.9 Keypad Use

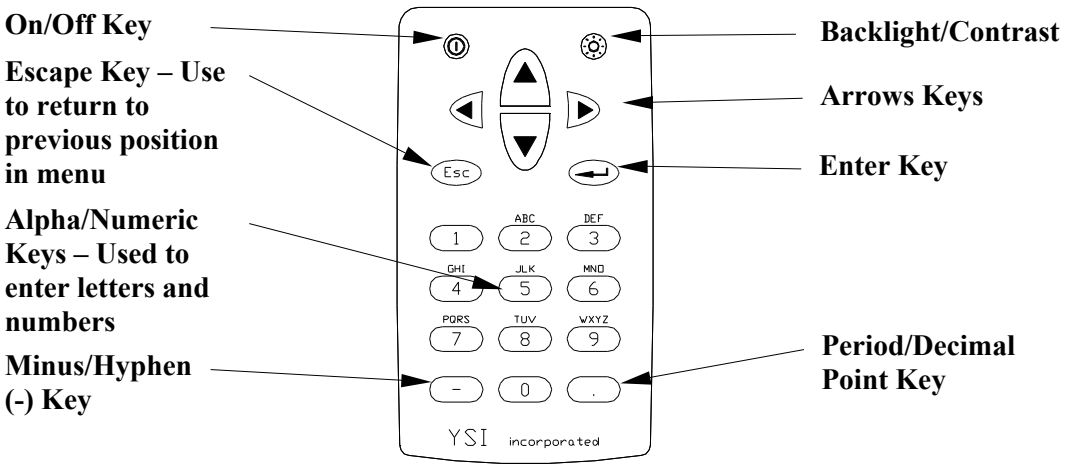


Figure 2.9 Keypad Features

KEY	LETTER/ NUMBER
1	1
2	ABC2abc3
3	DEF3def3
4	GHI4ghi4
5	JKL5jkl5
6	MNO6mno6
7	PQRS7pqrs7
8	TUV8tuv8
9	WXYZ9wxyz9
0	0

Figure 2.10 Keypad Letters & Numbers

1. See Figure 2.10 Keypad Letters & Numbers and press the appropriate key repeatedly until letter or number desired appears in display.

NOTE: Press the key repeatedly in rapid succession to get to the desired letter or number. If you pause for more than a

second, the cursor automatically scrolls to the right to prepare for the next input.

EXAMPLE 1: Press the **6** key *once* and *release* to display an uppercase "M."

EXAMPLE 2: Press the **6** key *four times* and *release* to display the number "6."

EXAMPLE 3: Press the **6** key *five times* and *stop* to display a lowercase "m."

2. Press the left arrow key to go back and reenter a number or letter that needs to be changed.

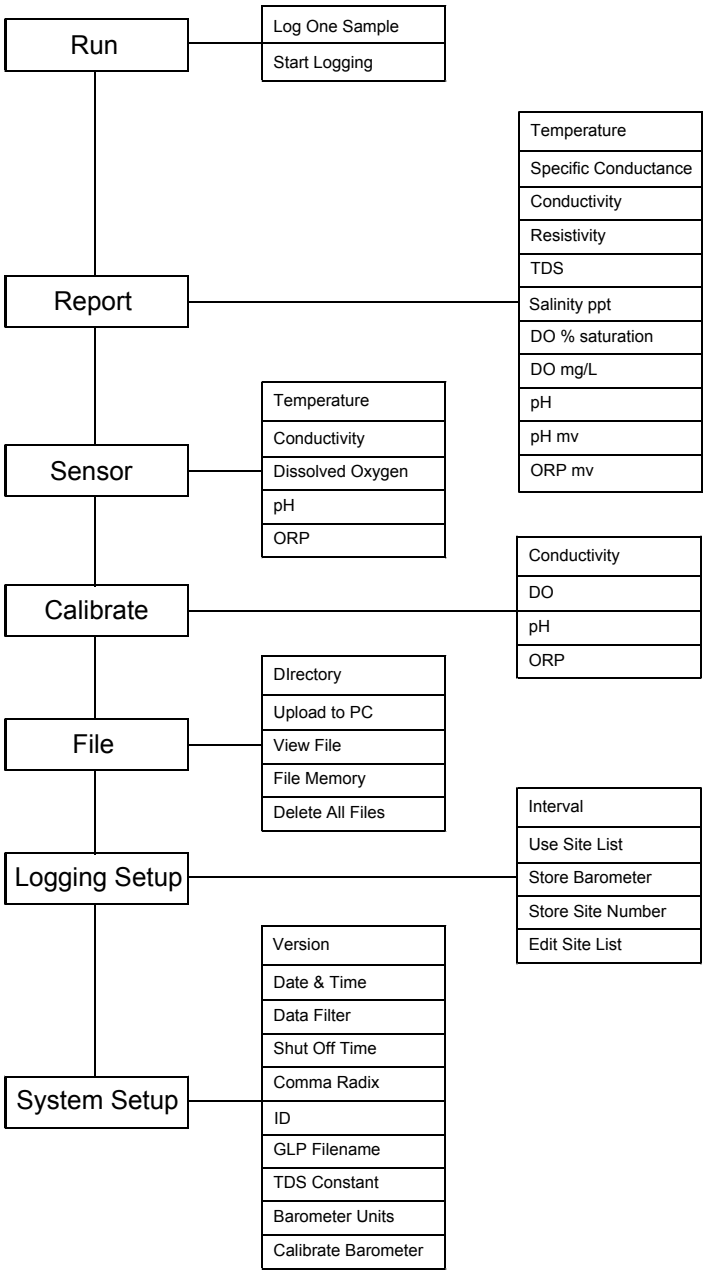
3. Press the **Enter** key when your entry is complete.

NOTE: The instrument software permits only numeric entries in many instances, such as when setting the clock or entering calibration parameters.

2.10 Instrument Reset

The YSI 556 MPS is characterized by sophisticated software that should provided trouble-free operation. However as with all high-capability software packages, it is always possible that the user will encounter circumstances in which the instrument does not respond to keypad entry. If this occurs, the instrument function can easily be restored by removing and then reapplying battery power. Simply remove either your C-cells or rechargeable battery pack from the battery compartment, wait 30 seconds and then replace the batteries. See Section *2.4 Batteries* for battery removal/reinstallation instructions.

2.11 Menu Flowchart



3. Probe Module

3.1 Introduction

The YSI 5563 Probe module is used for measuring dissolved oxygen, temperature, conductivity, and optional pH and ORP. The probe module is rugged, with the sensors enclosed in a heavy duty probe sensor guard with attached sinking weight. A 4, 10 or 20 meter cable is directly connected to the probe module body making it waterproof. An MS-19 connector at the end of the cable makes the YSI 5563 fully compatible with the YSI 556 Multi-Probe System.

3.2 Unpacking the Probe Module

1. Remove the YSI 5563 Probe module from the shipping boxes.

   NOTE: Do not discard any parts or supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

   NOTE: If any parts are missing or damaged, contact your YSI Service Center immediately. Refer to *Appendix E Customer Service* or www.ysi.com.

3.3 Features of the YSI 5563 Probe Module

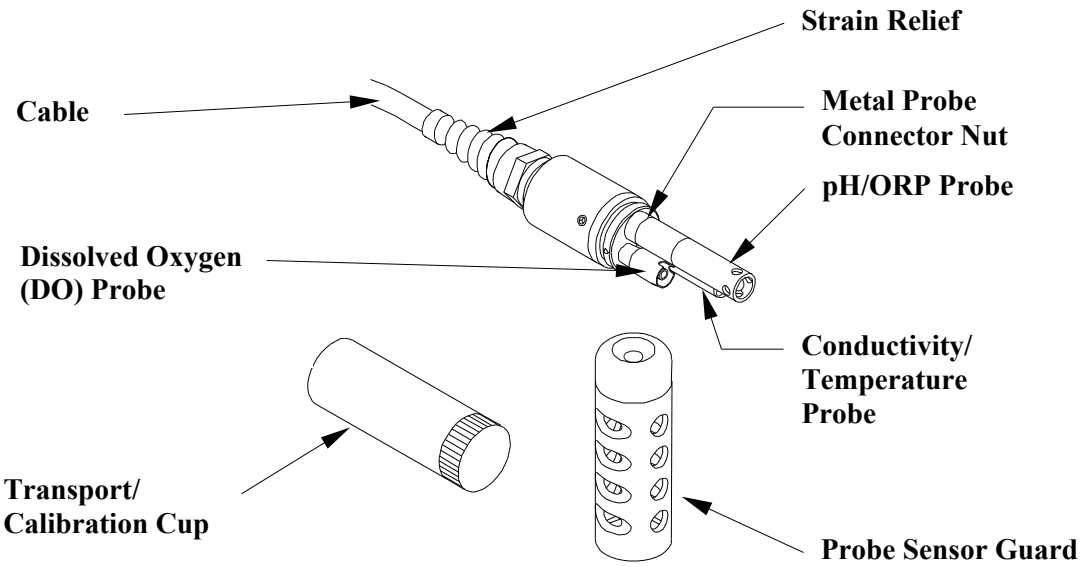


Figure 3.1 Probe Module

3.4 Preparing the Probe Module

To prepare the probe module for calibration and operation, you need to install the sensors into the connectors on the probe module bulkhead. In addition to sensor installation, you need to install a new DO membrane cap.

3.4.1 Sensor Installation

Whenever you install, remove or replace a sensor, it is extremely important that the entire probe module and all sensors be thoroughly dried prior to the removal of a sensor or a sensor port plug. This will prevent water from entering the port. Once you remove a sensor or plug, examine the connector inside the probe module sensor port. If any moisture is present, use compressed air to completely dry the connector. If the connector is corroded, return the probe module to your dealer or directly to YSI Customer Service. Refer to *Appendix E Customer Service*.

Conductivity/Temperature and pH, pH/ORP Sensor Installation

1. Unscrew and remove the probe sensor guard.

2. Using the sensor installation tool supplied in the YSI 5511 maintenance kit, unscrew and remove the sensor port plugs.

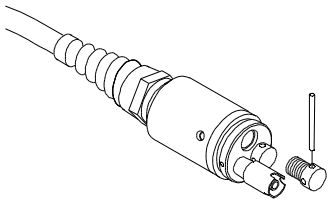


Figure 3.2 Port Plug Removal

3. Locate the port with the connector that corresponds to the sensor that is to be installed.

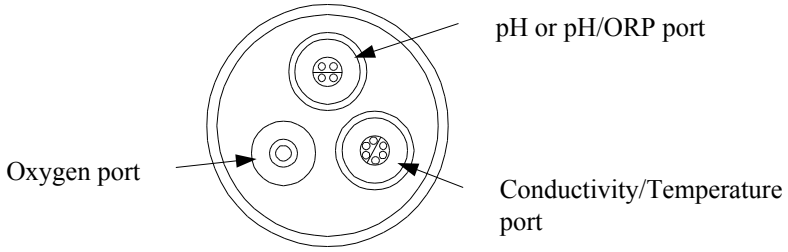


Figure 3.3 Sensor Port Identification

4. Apply a thin coat of o-ring lubricant (supplied in the YSI 5511 maintenance kit) to the o-rings on the connector side of the sensor (see Figure 3.4 O-Ring Lubrication).

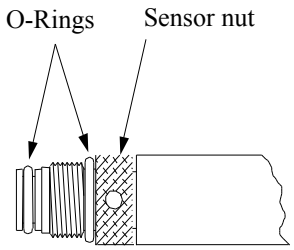


Figure 3.4 O-Ring Lubrication

⚠ **CAUTION:** Make sure that there are NO contaminants between the O-ring and the sensor. Contaminants that are present under the O-ring may cause the O-ring to leak.

5. Be sure the probe module sensor port is free of moisture and then insert the sensor into the correct port. Gently rotate the sensor until the two connectors align.

6. With connectors aligned, screw down the sensor nut using the sensor installation tool.

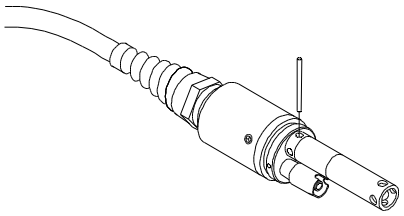


Figure 3.5 Sensor Installation

⚠ **CAUTION:** Do not cross thread the sensor nut. Tighten the nut until it is flush with the face of the probe module bulkhead. Do not over tighten.

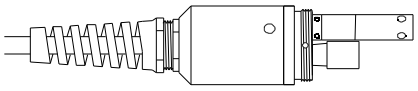


Figure 3.6 Bulkhead Seating

7. Repeat steps 3-6 for any other sensors.

8. Replace the probe sensor guard.

Dissolved Oxygen Sensor Installation

The YSI 5563 comes with the DO sensor already installed. Refer to Section *11.1.2 DO Sensor Replacement* for instructions on installing the YSI 558 Replaceable DO Module Kit.

3.4.2 Membrane Cap Selection

The YSI 5563 is shipped with a YSI 5909 kit that contains membrane caps made with 2 mil polyethylene (PE), a material which should be ideal for most field applications of the 556. However, YSI also offers membrane caps made with two other materials (1 mil polyethylene and 1 mil Teflon) which some users may also prefer. All membranes available for the 556/5563 system provide comparable accuracy if used properly. The difference between the two thicknesses of PE is found in the trade-off of flow dependence and response time as described below. Teflon is offered because some users may prefer to continue using the traditional membrane material used by YSI. To avoid confusion, the membrane caps are color coded as described below and can be ordered in kits as noted:

1 mil Teflon – Black Caps (Kit = YSI 5906)
1 mil Polyethylene (PE) – Yellow Caps (Kit = YSI 5908)
2 mil Polyethylene (PE) – Blue Caps (Kit = YSI 5909)

The 1 mil Teflon caps will offer traditional, reliable performance for most dissolved oxygen applications. The 1 mil PE caps will provide a significantly faster dissolved oxygen response (as long as your 556 Data Filter is set correctly as described below in Sections 10.2 and 10.3.1)) while also giving readings which are significantly less flow dependent than the 1 mil Teflon caps. Finally, 2 mil PE caps will show a large reduction in flow dependence over 1 mil Teflon while not significantly increasing the response time. Generally, one of the PE caps is likely to provide better performance for your application.

IMPORTANT: No matter which type of membrane cap you select, you will also have to confirm your selection in the 556

software from the Sensor menu as described in Section *4 Sensors*.

3.4.3 Membrane Cap Installation

NOTE: The YSI 5563 DO sensor (already installed in the probe module) was shipped dry. A shipping membrane was installed to protect the electrode. **A new membrane cap must be installed before the first use**.

1. Unscrew and remove the probe sensor guard.
2. Unscrew, remove, and discard the old membrane cap.
3. Thoroughly rinse the sensor tip with distilled water.
4. Prepare the electrolyte according to the directions on the electrolyte solution bottle.
5. Hold the new membrane cap and fill it at least 1/2 full with the electrolyte solution.
6. Screw the membrane cap onto the sensor moderately tight. A small amount of electrolyte should overflow.

⚠ **CAUTION:** Do not touch the membrane surface.

7. Screw the probe sensor guard on moderately tight.

3.5 Transport/Calibration Cup

The YSI 5563 Probe module has been supplied with a convenient transport/calibration cup. This cup is an ideal container for calibration of the different sensors, minimizing the amount of solution needed. Refer to Section *6 Calibrate*.

3.5.1 Transport/Calibration Cup Installation

1. Remove probe sensor guard, if already installed.

2. Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body.

3. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not overtighten as this could cause damage to the threaded portions.

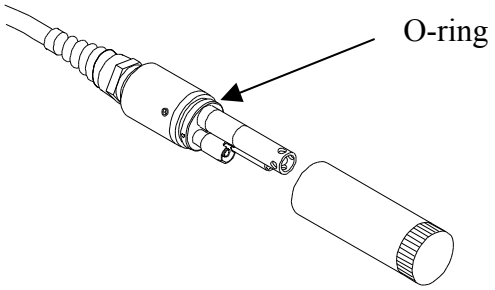


Figure 3.7 Transport/Calibration Cup Installation

3.6 Instrument/Cable Connection

Attach the cable to the instrument as follows:

1. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI 556 instrument. See Figure 2.1 Front View of YSI 556 MPS.

2. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place.

Remove the cable from the instrument by turning the cable connector counterclockwise until the cable disengages from the instrument.

The Sensors Enabled screen allows the user to enable or disable each of the sensors and select which membrane material will be used for the dissolved oxygen sensor. Disabled sensors will not be displayed on the screen in real time or logged to files.

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

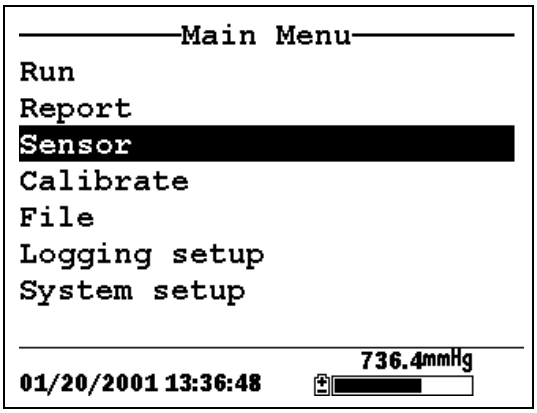


Figure 4.1 Main Menu Screen

3. Use the arrow keys to highlight the **Sensor** selection.

4. Press the **Enter** key to display the sensors enabled screen.

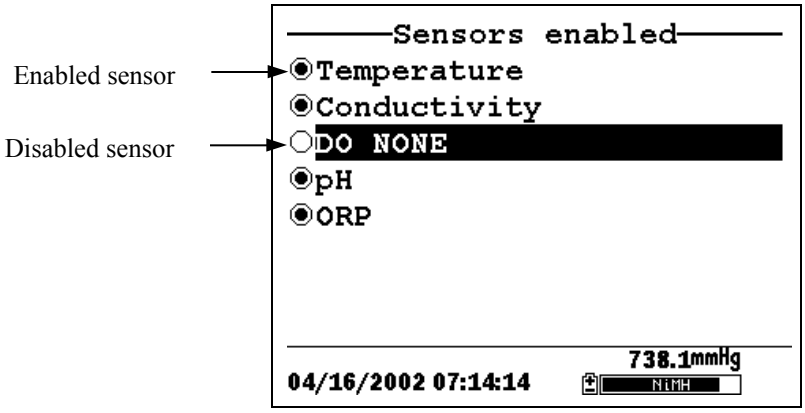


Figure 4.2 Sensors Enabled Screen Before DO Membrane Selection

A black dot to the left of a sensor indicates that sensor is enabled. Sensors with an empty circle are disabled.

Highlight the "DO None" entry as shown above and press **Enter** to display the membrane choice screen. Consult Section *3.4.2 Membrane Cap Selection* for information on the advantages of each type of membrane material. Blue membrane caps using 2 mil polyethylene (PE) were shipped with your YSI 5563 and are likely to be the best choice for most 556 field applications.

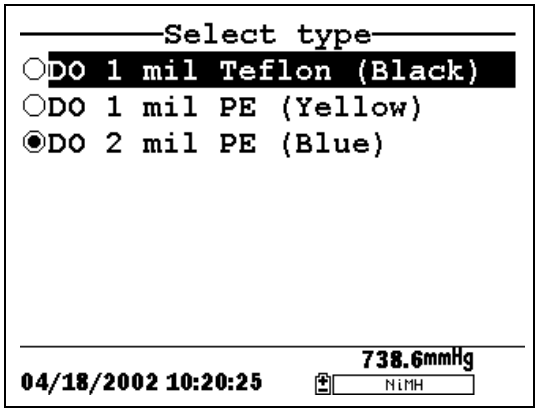


Figure 4.3 Membrane Selection Screen

Highlight the desired membrane choice – in this case, 2 mil PE -- and press Enter to activate your selection with a dot to the left of the screen. Then press **Escape** to return to the Sensor menu that now shows your DO membrane selection.

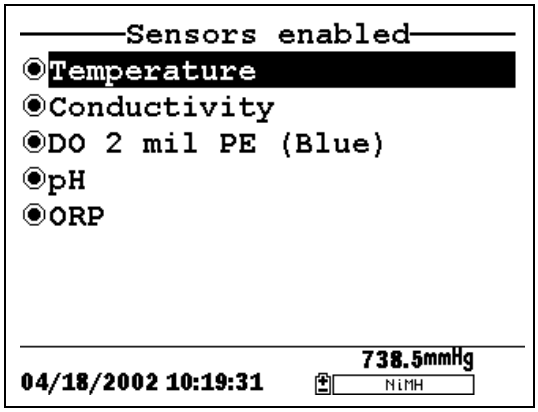


Figure 4.4 Sensors Enabled Screen After DO Membrane Selection

NOTE: The Temperature sensor cannot be disabled. Most other sensors require temperature compensation for accurate readings. In addition, the conductivity sensor must be activated in order to obtain accurate dissolved oxygen mg/L readings.

5. Use the arrow keys to highlight the sensor you want to change, then press the **Enter** key to enable or disable it.

6. Repeat step 5 for each sensor you want to change.

7. Press the **Escape** key to return to the main menu screen.

5. Report

The Report Setup screen allows the user to select which sample parameters and units the YSI 556 MPS will display on the screen. It does NOT determine which parameters are logged to memory. Refer to Section *4 Sensors*.

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

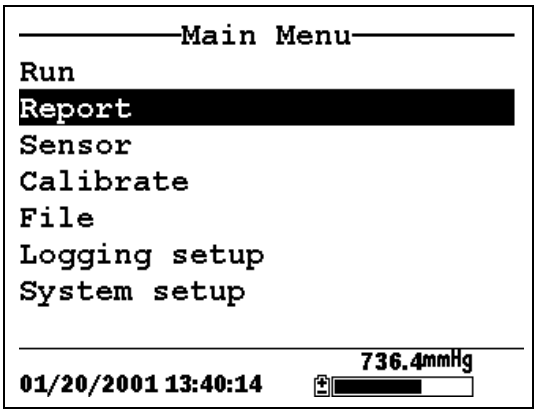


Figure 5.1 Main Menu

3. Use the arrow keys to highlight the **Report** selection.

4. Press the **Enter** key to display the report setup screen.

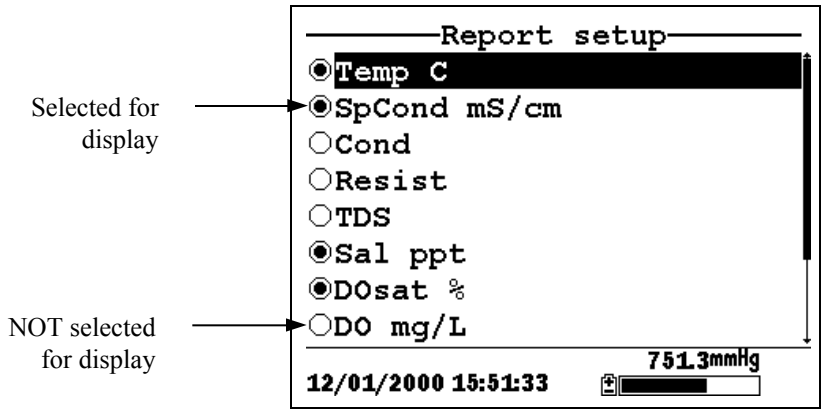


Figure 5.2 Report Setup Screen

NOTE: A black dot to the left of a parameter indicates that parameter is selected for display. Parameters with an empty circle will not be displayed.

NOTE: You may have to scroll down past the bottom of the screen to see all the parameters.

5. Use the arrow keys to highlight the parameter you want to change, then press the **Enter** key. If you can't find the parameter you want, even after scrolling down past the bottom of the screen, the sensor used for that parameter is disabled. Refer to Section *4 Sensors*.

6. If you selected Temperature, Specific Conductivity, Conductivity, Resistance or Total Dissolved Solids, the Units screen will appear.

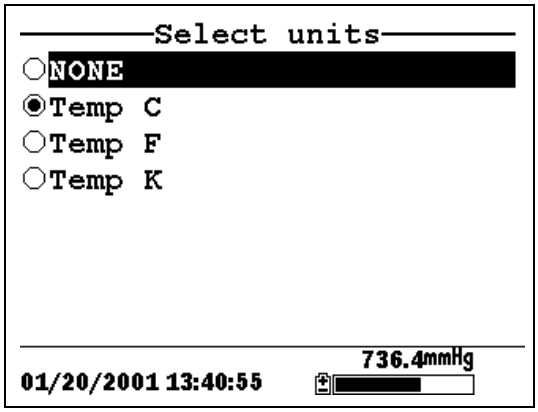


Figure 5.3 Units Screen

7. Use the arrow keys to select the units desired, then press the **Enter** key to return to the report setup screen.

   If you selected Salinity, Dissolved Oxygen %, Dissolved Oxygen mg/L, pH, pH mv or ORP mv, the selection dot will simply toggle on or off.

8. Repeat steps 5 and 6 for each parameter you want to change.

NOTE: All parameters may be enabled at the same time.

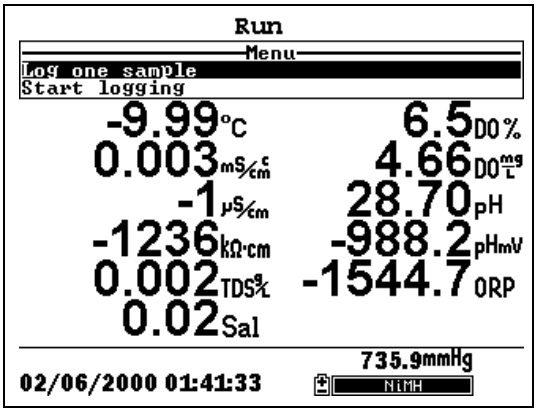


Figure 5.4 All Parameters Displayed

9. Press the **Escape** key to return to the Main menu screen.

6. Calibrate

All of the sensors, except temperature, require periodic calibration to assure high performance. You will find specific calibration procedures for all sensors that require calibration in the following sections. If a sensor listed is not installed in your probe module, skip that section and proceed to the next sensor until the calibration is complete.

⚠ **CAUTION:** Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review *Appendix D Health and Safety*. Some calibration standard solutions may require special handling.

6.1 Getting Ready to Calibrate

6.1.1 Containers Needed to Calibrate the Probe Module

The transport/calibration cup that comes with your probe module serves as a calibration chamber for all calibrations and minimizes the volume of calibration reagents required.

Instead of the transport/calibration cup, you may use laboratory glassware to perform calibrations. If you do not use the transport/calibration cup that is designed for the probe module, you are cautioned to do the following:

- Perform all calibrations with the Probe Sensor Guard installed. This protects the sensors from possible physical damage.
- Use a ring stand and clamp to secure the probe module body to prevent the module from falling over. Most laboratory glassware has convex bottoms.
- Ensure that all sensors are immersed in calibration solutions. Many of the calibrations factor in readings from other sensors (e.g., temperature sensor). The top vent hole of the conductivity sensor must also be immersed during some calibrations.

6.1.2 Calibration Tips

1. If you use the Transport/Calibration Cup for dissolved oxygen (DO) calibration, make certain to loosen the seal to allow pressure equilibration before calibration. The DO calibration is a water-saturated air calibration.
2. The key to successful calibration is to ensure that the sensors are completely submersed when calibration values are entered. Use recommended volumes when performing calibrations.
3. For maximum accuracy, use a small amount of previously used calibration solution to pre-rinse the probe module. You may wish to save old calibration standards for this purpose.
4. Fill a bucket with ambient temperature water to rinse the probe module between calibration solutions.
5. Have several clean, absorbent paper towels or cotton cloths available to dry the probe module between rinses and calibration solutions. Shake the excess rinse water off of the probe module, especially when the probe sensor guard is installed. Dry off the outside of the probe module and probe sensor guard. Making sure that the probe module is dry reduces carry-over contamination of calibrator solutions and increases the accuracy of the calibration.
6. If you are using laboratory glassware for calibration, you do not need to remove the probe sensor guard to rinse and dry the sensors between calibration solutions. The inaccuracy resulting from simply rinsing the sensor compartment and drying the outside of the guard is minimal.
7. If you are using laboratory glassware, remove the stainless steel weight from the bottom of the probe sensor guard by turning the weight counterclockwise. When the weight is removed, the calibration solutions have access to the sensors without displacing a lot of fluid. This also reduces the amount of liquid that is carried between calibrations.
8. Make certain that port plugs are installed in all ports where sensors are not installed. It is extremely important to keep these electrical connectors dry.

6.1.3 Recommended Volumes

Follow these instructions to use the transport/calibration cup for calibration procedures.

_ Ensure that an o-ring is installed in the o-ring groove of the transport/calibration cup bottom cap, and that the bottom cap is securely tightened.

NOTE: Do not over-tighten as this could cause damage to the threaded portions.

_ Remove the probe sensor guard, if it is installed.

_ Remove the o-ring, if installed, from the probe module and inspect the installed o-ring on the probe module for obvious defects and, if necessary, replace it with the extra o-ring supplied.

_ Some calibrations can be accomplished with the probe module upright or upside down. A separate clamp and stand, such as a ring stand, is required to support the probe module in the inverted position.

_ To calibrate, follow the procedures in the next section, Calibration Procedures. The approximate volumes of the reagents are specified below for both the upright and upside down orientations.

_ When using the Transport/Calibration Cup for dissolved oxygen % saturation calibration, make certain that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly and that approximately 1/8” of water is present in the cup.

Sensor to Calibrate	Upright	Upside Down
Conductivity	55ml	55ml
pH/ORP	30ml	60ml

Table 6.1 Calibration Volumes

6.2 Calibration Procedures

6.2.1 Accessing the Calibrate Screen

1. Press the **On/off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.
3. Use the arrow keys to highlight the **Calibrate** selection.

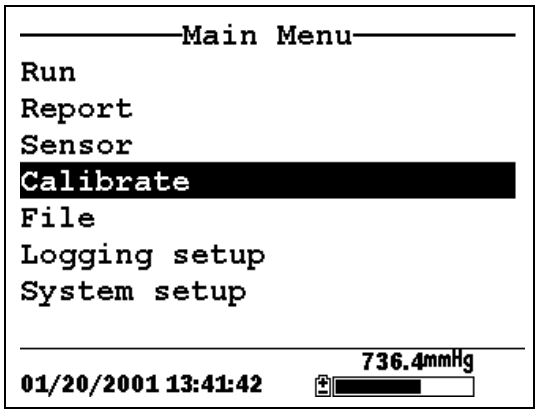


Figure 6.1 Main Menu

4. Press the **Enter** key. The Calibrate screen is displayed.

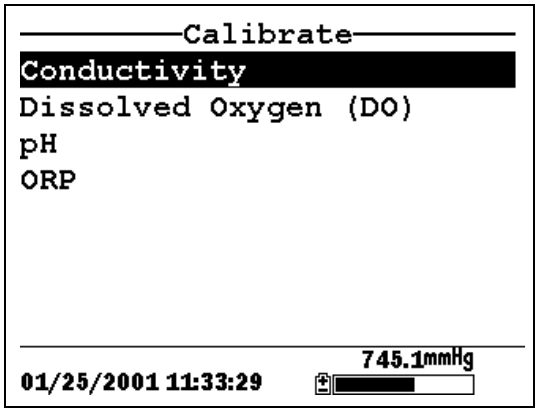


Figure 6.2 Calibrate Screen

6.2.2 Conductivity Calibration

This procedure calibrates specific conductance (recommended), conductivity and salinity. Calibrating any one option automatically calibrates the other two.

1. Go to the calibrate screen as described in Section 6.2.1 Accessing the Calibrate Screen.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed.

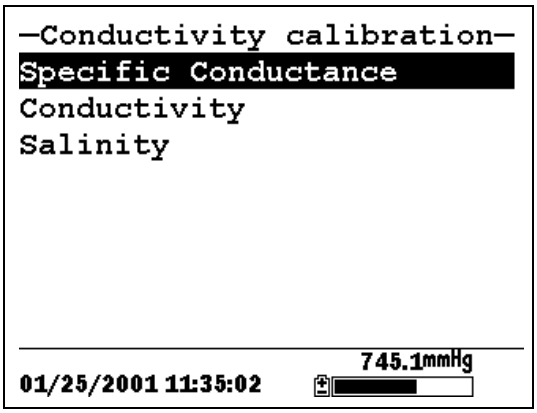


Figure 6.3 Conductivity Calibration Selection Screen

4. Use the arrow keys to highlight the Specific Conductance selection.

5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed.

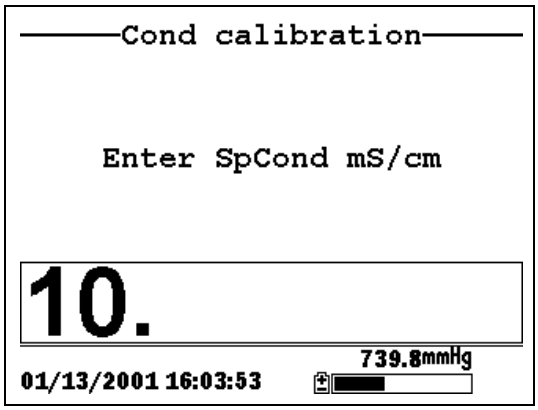


Figure 6.4 Conductivity Calibration Entry Screen

6. Place the correct amount of conductivity standard (see Table 6.1 Calibration Volumes) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the conductivity standard you choose should be within the same conductivity range as the samples you are preparing to measure. However, we do not recommend using standards less than 1 mS/cm. For example:

- For fresh water use a 1 mS/cm conductivity standard.
- For brackish water use a 10 mS/cm conductivity standard.
- For seawater use a 50 mS/cm conductivity standard.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Be certain that you avoid cross-contamination of solutions. Make certain that there are no salt deposits around the oxygen and pH/ORP sensors, particularly if you are employing standards of low conductivity.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

   NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the vent hole is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not overtighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the standard you are using.

    NOTE: Be sure to enter the value in **mS/cm at 25°C**.

11. Press **Enter**. The Conductivity Calibration Screen is displayed.

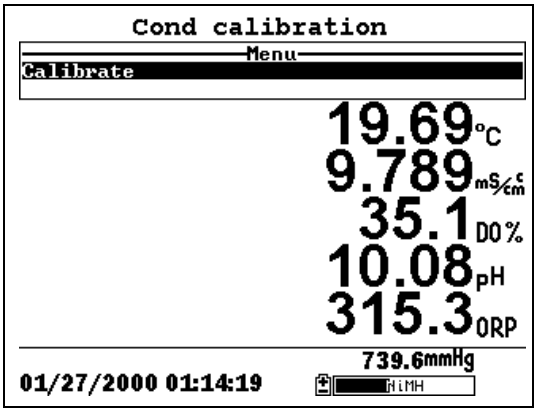


Figure 6.5 Conductivity Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors

will appear on the screen and will change with time as they stabilize.

13. Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

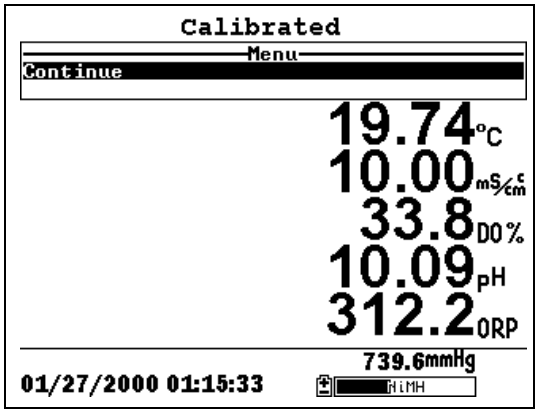


Figure 6.6 Calibrated

14. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen.

15. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

16. Rinse the probe module and sensors in tap or purified water and dry.

6.2.3 Dissolved Oxygen Calibration

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

NOTE: The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating.

2. Use the arrow keys to highlight the **Dissolved Oxygen** selection. See Figure 6.2 Calibrate Screen.
3. Press **Enter**. The dissolved oxygen calibration screen is displayed.

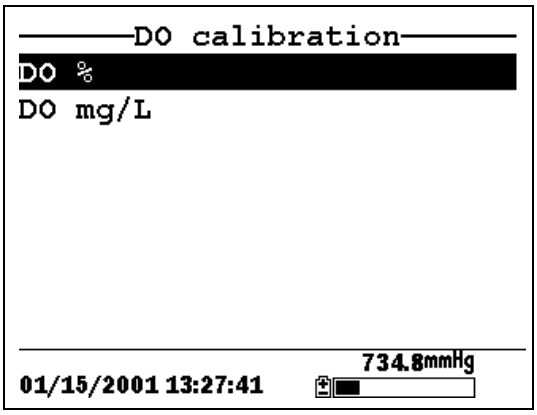


Figure 6.7 DO Calibration Screen

DO Calibration in % Saturation

1. Use the arrow keys to highlight the DO% selection.
2. Press **Enter**. The DO Barometric Pressure Entry Screen is displayed.

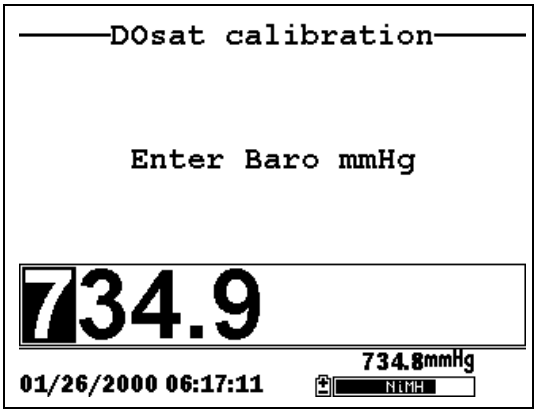


Figure 6.8 DO Barometric Pressure Entry Screen

3. Place approximately 3 mm (1/8 inch) of water in the bottom of the transport/calibration cup.

4. Place the probe module into the transport/calibration cup.

   NOTE: Make sure that the DO and temperature sensors are **not** immersed in the water.

5. Engage only 1 or 2 threads of the transport/calibration cup to ensure the DO sensor is vented to the atmosphere.

6. Use the keypad to enter the current local barometric pressure.

   NOTE: If the unit has the optional barometer, no entry is required.

   NOTE: Barometer readings that appear in meteorological reports are generally corrected to sea level and must be uncorrected before use (refer to Section *10.10 Calibrate Barometer, Step 2*).

7. Press **Enter**. The DO% saturation calibration screen is displayed.

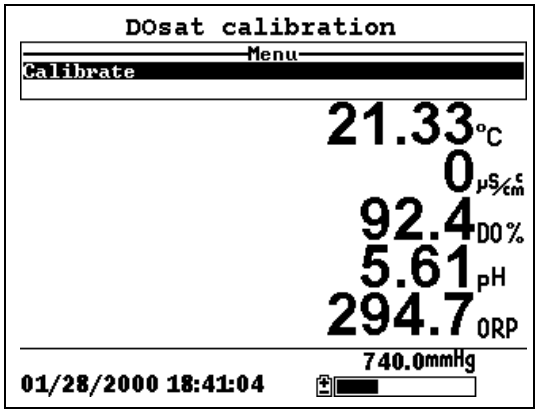


Figure 6.9 DO Sat Calibration Screen

8. Allow approximately ten minutes for the air in the transport/calibration cup to become water saturated and for

the temperature to equilibrate before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the reading under DO %. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue. See Figure 6.6 Calibrated.

10. Press **Enter**. This returns you to the DO calibration screen, See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

DO Calibration in mg/L

DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).

1. Go to the DO calibrate screen as described in Section *6.2.3 Dissolved Oxygen Calibration*, steps 1 through 3.

2. Use the arrow keys to highlight the **DO mg/L** selection.

3. Press **Enter**. The DO mg/L Entry Screen is displayed.

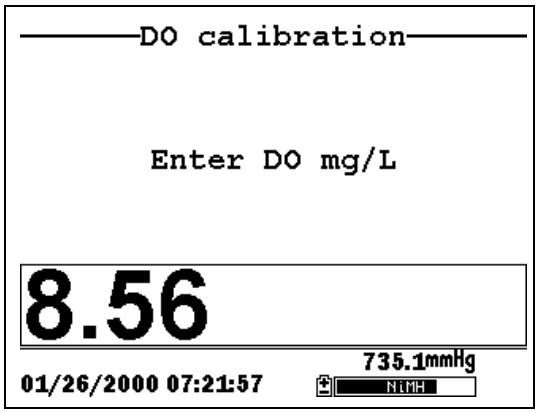


Figure 6.10 DO mg/L Entry Screen

4. Place the probe module in water with a known DO concentration.

   NOTE: Be sure to completely immerse all the sensors.

5. Use the keypad to enter the known DO concentration of the water.

6. Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.

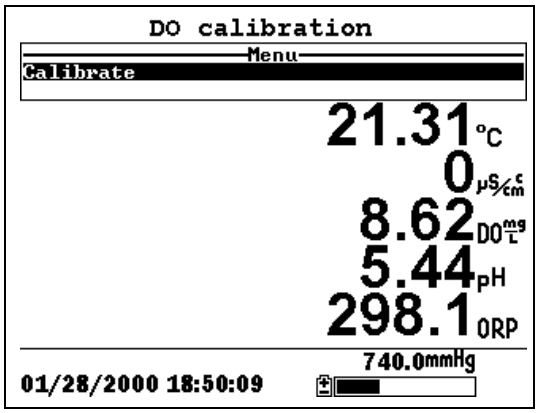


Figure 6.11 DO mg/L Calibration Screen

7. Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.

8. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

10. Press **Enter**. This returns you to the DO calibration screen. See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

6.2.4 pH Calibration

1. Go to the calibrate screen as described in *Section 6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **pH** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The pH calibration screen is displayed.

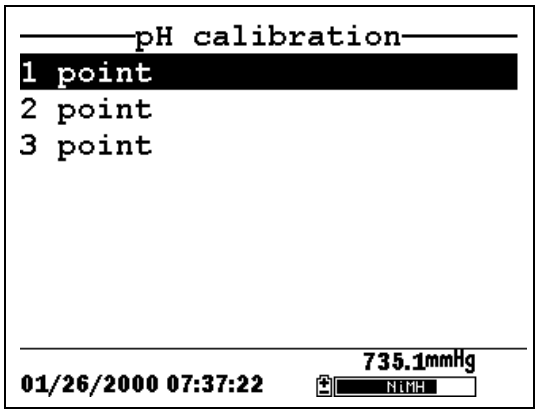


Figure 6.12 pH Calibration Screen

_ Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.

_ Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.

_ Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.

4. Use the arrow keys to highlight the **2-point** selection.

5. Press **Enter**. The pH Entry Screen is displayed.

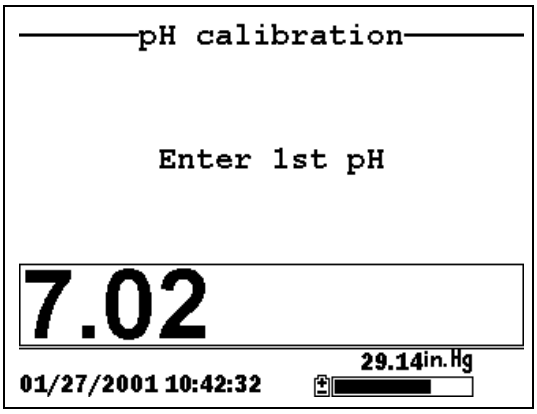


Figure 6.13 pH Entry Screen

6. Place the correct amount (see Table 6.1 Calibration Volumes) of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not overtighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

11. Press **Enter**. The pH calibration screen is displayed.

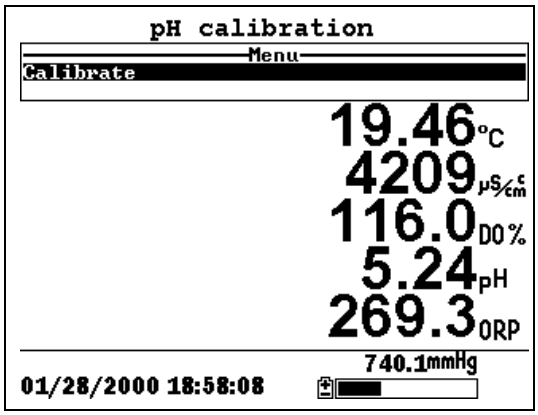


Figure 6.14 pH Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

13. Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

14. Press **Enter**. This returns you to the Specified pH Calibration Screen, See Figure 6.13 pH Entry Screen.

15. Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.

16. Repeat steps 6 through 13 above using a second pH buffer.

17. Press **Enter**. This returns you to the pH Calibration Screen, See Figure 6.12 pH Calibration Screen.

18. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

19. Rinse the probe module and sensors in tap or purified water and dry.

6.2.5 ORP Calibration

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **ORP** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The ORP calibration screen is displayed.

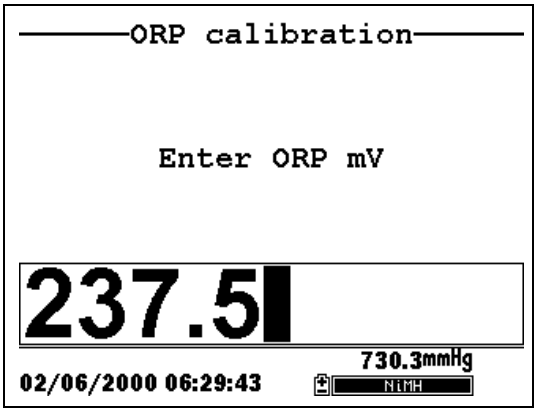


Figure 6.15 Specified ORP Calibration Screen

4. Place the correct amount (see Table 6.1 Calibration Volumes) of a known ORP solution (we recommend Zobell solution) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.

5. Carefully immerse the sensor end of the probe module into the solution.

6. Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes should ensure that the sensor is covered.

7. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not overtighten as this could cause damage to the threaded portions.

8. Use the keypad to enter the correct value of the calibration solution you are using at the current temperature. Refer to Table 6.2 Zobel Solution Values.

Temperature °C	Zobell Solution Value, mV
-5	270.0
0	263.5
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0
40	211.5
45	205.0
50	198.5

Table 6.2 Zobel Solution Values

9. Press **Enter**. The ORP calibration screen is displayed.

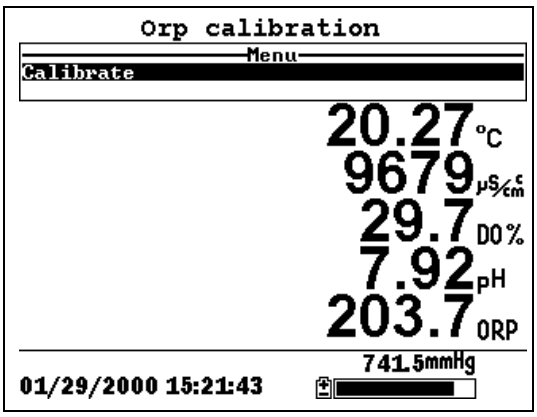


Figure 6.16 ORP Calibration Screen

10. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

NOTE: Verify that the temperature reading matches the value you used in Table 6.2 Zobel Solution Values.

11. Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

12. Press **Enter**. This returns you to the Calibrate Screen. See Figure 6.2 Calibrate Screen.

13. Rinse the probe module and sensors in tap or purified water and dry.

6.3 Return to Factory Settings

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

   NOTE: We will use the Conductivity sensor as an example; however, this process will work for any sensor.

3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed. See Figure 6.3 Conductivity Calibration Selection Screen.

4. Use the arrow keys to highlight the **Specific Conductance** selection.

5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed. See Figure 6.4 Conductivity Calibration Entry Screen.

6. Press and hold the **Enter** key down and press the **Escape** key.

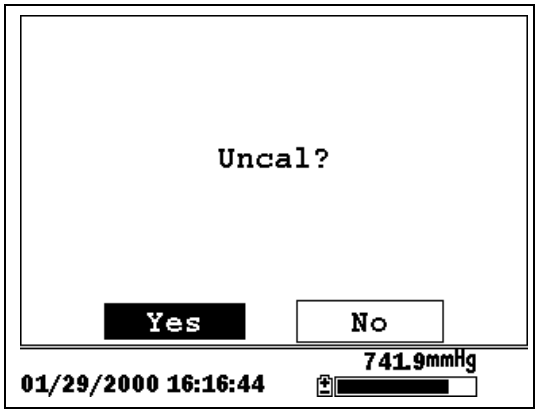


Figure 6.17 ORP Calibration Screen

7. Use the arrow keys to highlight the **YES** selection.

CAUTION: This returns a sensor to the factory settings. For example, in selecting to return specific conductance to the factory setting, salinity and conductivity will automatically return to their factory settings.

8. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen.

9. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

7. Run

The Run screen displays data from the sensors in real-time and allows the user to log sample data to memory for later analysis. Refer to Section *9 Logging* for details on logging sample data.

7.1 Real-Time Data

NOTE: Before measuring samples you must prepare the probe module (refer to Section *3.4 Preparing the Probe Module*), attach the probe module to the instrument (refer to Section *3.6 Instrument/Cable Connection*) and calibrate the sensors (refer to Section *6 Calibrate*).

1. Press the **On/off** key.

OR select Run from the main menu to display the run screen.

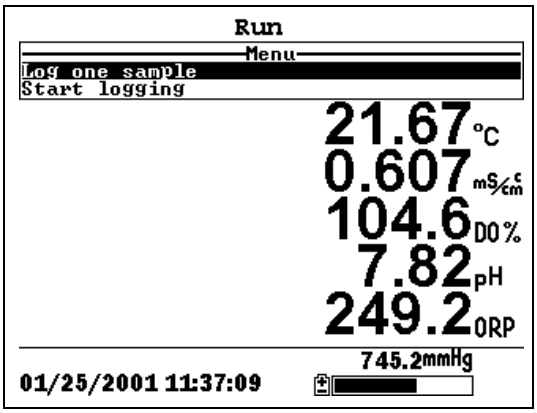


Figure 7.1 Run Screen

2. Make sure the probe sensor guard is installed.

3. Place the probe module in the sample. Be sure to completely immerse all the sensors.

4. Rapidly move the probe module through the sample to provide fresh sample to the DO sensor.

5. Watch the readings on the display until they are stable.

6. Refer to Section *9 Logging* for instructions on logging sample data.

8. File

The File menu allows the user to view, upload or delete sample data and calibration record files stored in the YSI 556 MPS.

8.1 Accessing the File Screen

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

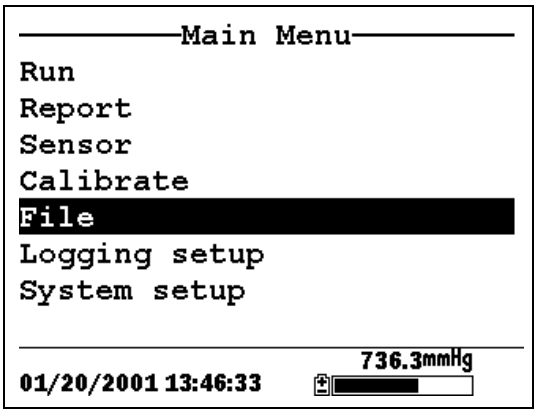


Figure 8.1 Main Menu Screen

3. Use the arrow keys to highlight the **File** selection.

4. Press the **Enter** key. The file screen is displayed.

Figure 8.2 File Screen

8.2 Directory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Directory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file list screen is displayed.

   NOTE: Files are listed in the order in which they are logged to memory. Sample Data files have the file extension **.dat**, while Calibration Record files have the file extension **.glp**.

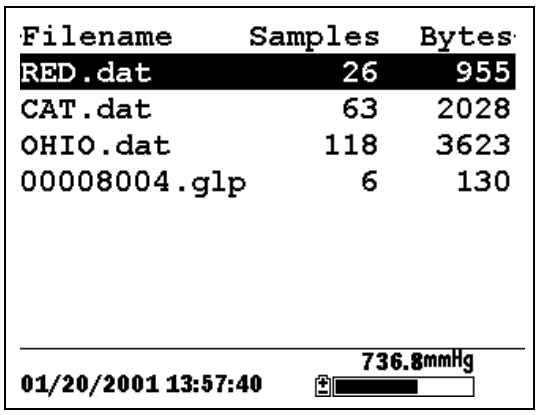


Figure 8.3 File List Screen

4. Use the arrow keys to highlight a file.

5. Press the **Enter** key. The file details screen is displayed.

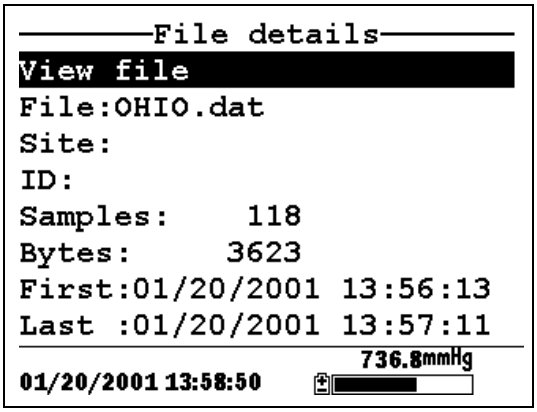


Figure 8.4 File Details Screen

6. Press the **Enter** key to view the file data. Refer to Section *8.3 View File* for details.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.3 View File

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*. See Figure 8.2 File Screen.

2. Use the arrow keys to highlight the **View file** selection.

3. Press the **Enter** key. A list of files is displayed. See Figure 8.3 File List Screen.

4. Use the arrow keys to highlight an individual file.

   NOTE: You may have to scroll down to see all the files.

5. Press the **Enter** key. The file data is displayed with the file name at the top of the display.

   NOTE: If no file name was specified, the data is stored under the default name NONAME1.dat.

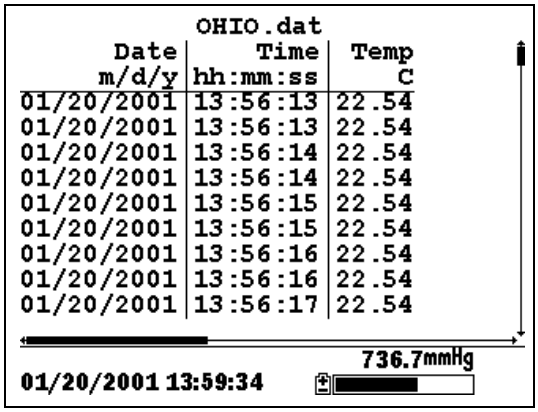


Figure 8.5 File Data Screen

6. Use the arrow keys to scroll horizontally and/or vertically to view all the data.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.4 Upload to PC

EcoWatch™ for Windows™ must be used as the PC software interface to the YSI 556 MPS. Refer to *Appendix G EcoWatch* for more information. EcoWatch for Windows is available at no cost via a download from the YSI Web Site (www.ysi.com) or by contacting YSI Customer Support. Refer to *Appendix E Customer Service.*

8.4.1 Upload Setup

1. Disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

2. Connect the YSI 556 MPS to a serial (Comm) port of your computer via the 655173 PC Interface cable as shown in the following diagram:

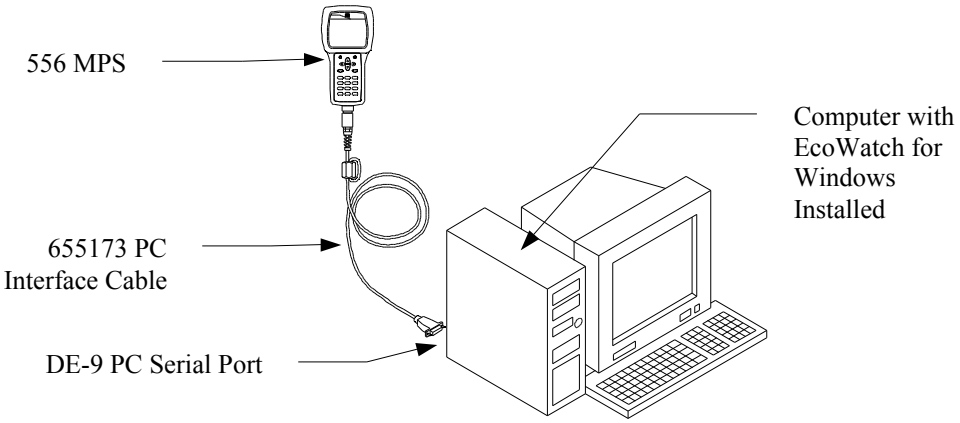


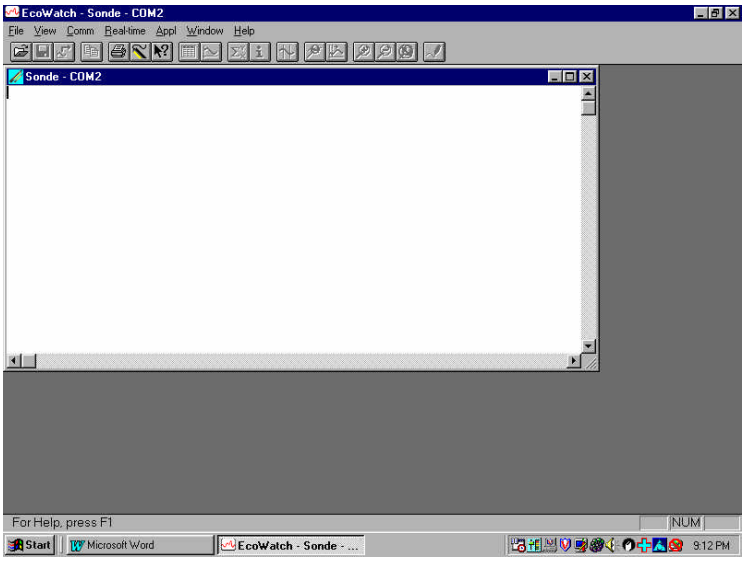
Figure 8.6 Computer/Instrument Interface

3. Open EcoWatch for Windows on your computer.

NOTE: See *Appendix G EcoWatch* for installation instructions.

4. Click on the sonde/probe icon  in the upper toolbar.

5. Set the Comm port number to match the port the YSI 556 MPS is connected to. After this setup procedure, the following screen will be present on your PC monitor:



8.4.2 Uploading a .DAT File

1. Setup the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section *8.1 Accessing the File Screen.*

3. Use the arrow keys to highlight the **Upload to PC** selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the DAT file that you wish to transfer and press **Enter**, both the YSI 556 MPS and PC displays show the progress of the file transfer.

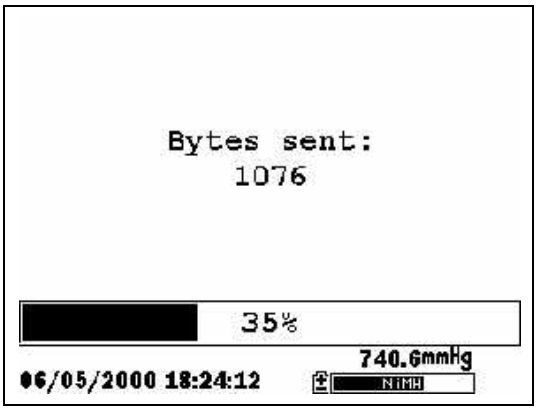
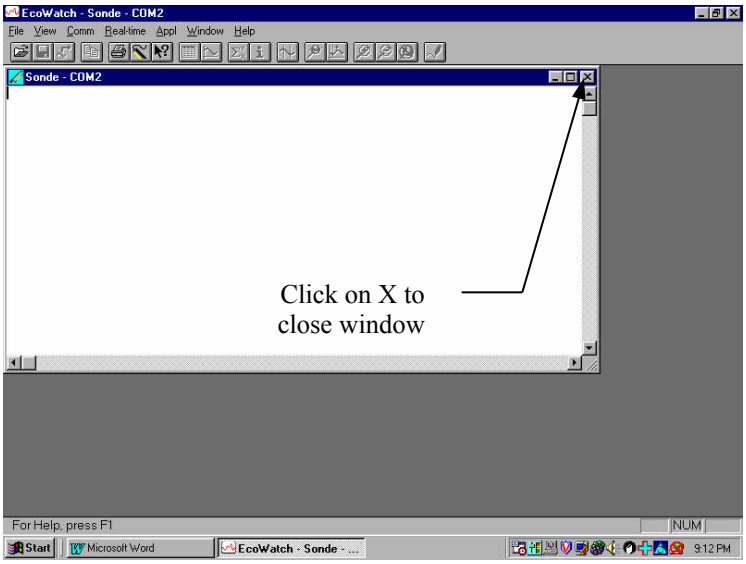


Figure 8.7 File Transfer Progress Screen

NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with a .DAT extension.

6. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the "X" at its upper right corner.



7. Press the **Escape** key on the YSI 556 MPS repeatedly to return to the main menu screen.

8.4.3 Uploading a Calibration Record (.glp) File

For more information on the calibration record, Refer to *Appendix H Calibration Record Information.*

1. Setup up the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section *8.1 Accessing the File Screen.*

3. Use the arrow keys to highlight the **Upload to PC** selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the calibration record file that you wish to transfer and press **Enter.**

6. You will then be given a choice of uploading the file in three formats; **Binary, Comma & "" Delimited, and ASCII Text**.

   NOTE: The binary format is reserved for future YSI software packages.

7. Choose an option and press **Enter,** both the YSI 556 and PC displays show the progress of the file transfer.

   NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with the appropriate file extension.

   NOTE: To view the Calibration Record data after upload, simply open the .txt file in a general text editor such as Wordpad or Notepad.

8. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the "X" at its upper right corner.

9. Press the **Escape** key repeatedly to return to the main menu screen.

8.5 File Memory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **File memory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file bytes used screen is displayed.

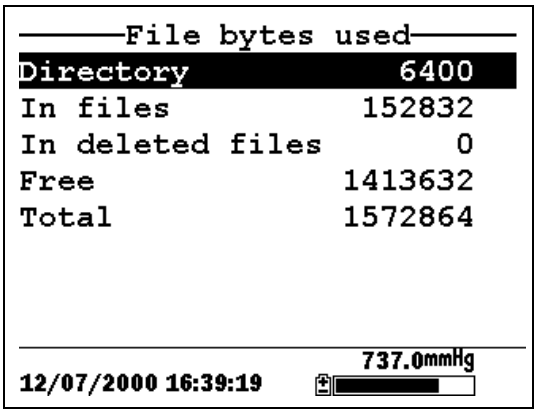


Figure 8.8 File Bytes Used Screen

4. The amount of free memory is listed in line 4 of the file bytes used screen.

   NOTE: If the amount of free memory is low, it may be time to delete all files (after first uploading all data to a PC). Refer to Section *8.6 Delete All Files*.

5. Press the **Escape** key repeatedly to return to the main menu screen.

8.6 Delete All Files

NOTE: It is not possible to delete individual files in order to free up memory. The only way to free up memory is to delete ALL files present. Take care to transfer all files to your computer (refer to Section *8.4 Upload to PC*) *before* deleting them.

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Delete all files** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The Delete all Files screen is displayed.

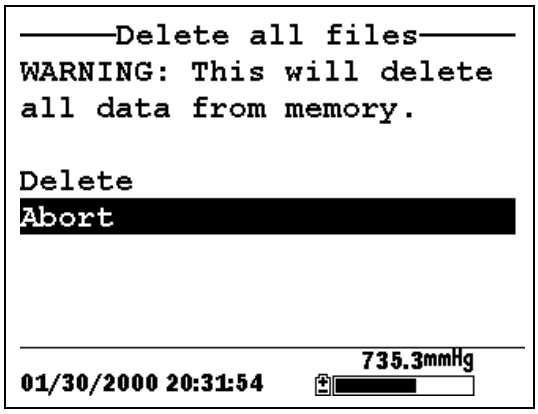


Figure 8.9 Delete All Files Screen

4. Use the arrow keys to highlight the **Delete** selection.

5. Press the **Enter** key.

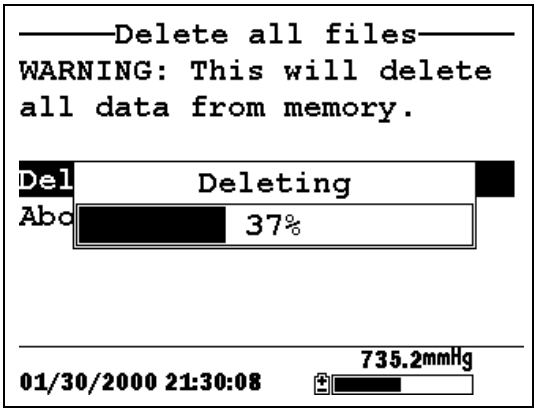


Figure 8.10 Deleting

The progress of file deletion is displayed in bar graph format.

NOTE: Deleting all files in the directory will not change any information in the site list.

6. Press the **Escape** key repeatedly to return to the main menu screen.

9. Logging

9.1 Accessing the Logging Setup Screen

1. Press the **On/off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.

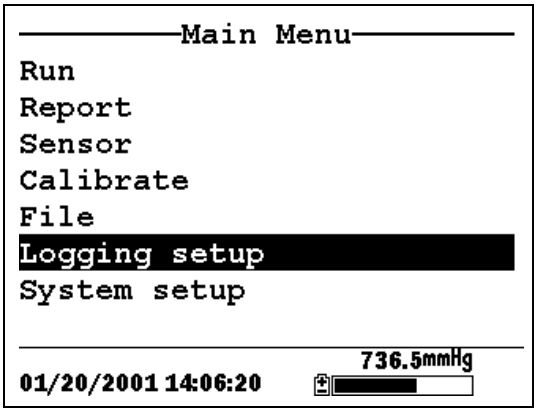


Figure 9.1 Main Menu

3. Use the arrow keys to highlight the **Logging setup** selection.
4. Press the **Enter** key. The logging setup screen is displayed.

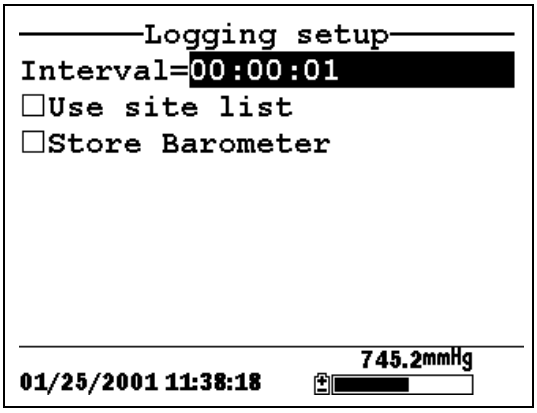


Figure 9.2 Logging Setup Screen

9.2 Setting Logging Interval

Follow steps below to set the interval for logging a data stream.

NOTE: If you do not specify an interval, the instrument will use a default interval setting of 1 second.

NOTE: It is not necessary to set a logging interval when logging a single sample.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the keypad to enter an interval between 1 second and 15 minutes. Refer to Section *2.9 Keypad Use*.

   NOTE: The interval field has hour, minute and second entry fields. Any entry over 15 minutes will change automatically to a 15-minute setting.

3. Press the **Enter** key. The data stream interval is set.

4. Press the **Escape** key repeatedly to return to the main menu screen.

9.3 Storing Barometer Readings

NOTE: The **Store barometer** option is only available on instruments that are equipped with the optional barometer.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Store barometer** selection. See Figure 9.2 Logging Setup Screen.

3. Press the **Enter** key until a check mark is entered in the box next to the store barometer selection if you want to log barometric readings.

   OR press the **Enter** key until the box next to the barometer selection is empty if you do not want to log barometric readings.

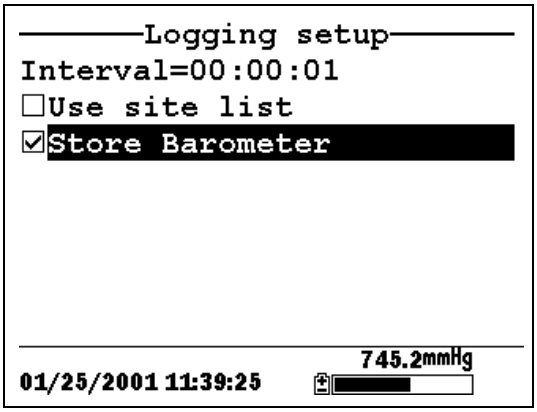


Figure 9.3 Store Barometer

4. Press the **Escape** key repeatedly to return to the main menu screen.

9.4 Creating a Site List

The site list option allows you to define file and site descriptions in the office or laboratory before moving to field logging studies. This is usually more convenient than entering the information at the site and is particularly valuable if you are visiting certain sites on a regular basis. The following section describes how to set up site lists which contain entries designated "Site Descriptions" that will be instantly available to the user in the field to facilitate the logging of data with pre-established naming of files and sites. There are two kinds of **Site Descriptions** available for use in Site lists:

- **Site Descriptions** associated with applications where data from a single site is always logged to a single file. This type is referred to as a "Single-Site Description" and is characterized by two parameters – a file name and a site name. Files logged to YSI 556 MPS memory under a **Single-Site Description** will be characterized primarily by the file name, but will also have the Site name attached, so that it is viewable in either the YSI 556 MPS **File directory** or in EcoWatch for Windows after upload to a PC
- **Site Descriptions** associated with applications where data from multiple sites are logged to a single file. This type is

referred to as a "Multi-site Description" and is characterized by three parameters – a file name, a site name, and a site number. Files logged to YSI 556 MPS memory under a **Multi-site Description** are characterized by a file name, but not a site name, since multiple sites are involved. However, each data point has a Site Number attached to it so that the user can easily determine the sampling site when viewing the data from the YSI 556 MPS **File** menu or processing the data in EcoWatch for Windows after upload to a PC.

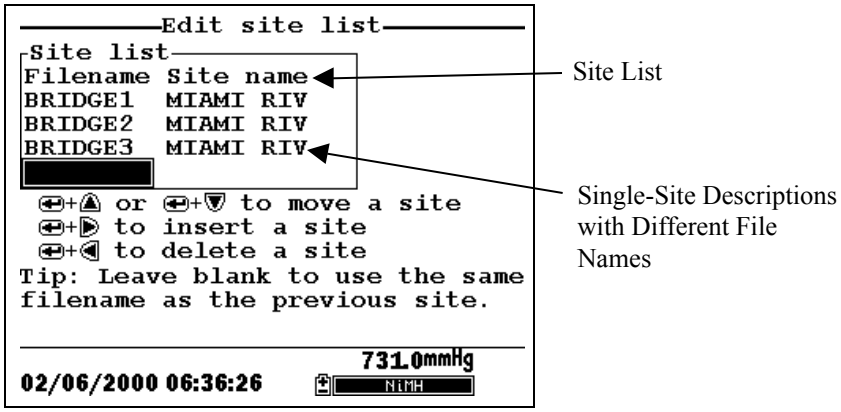


Figure 9.4 Single-Site Descriptions

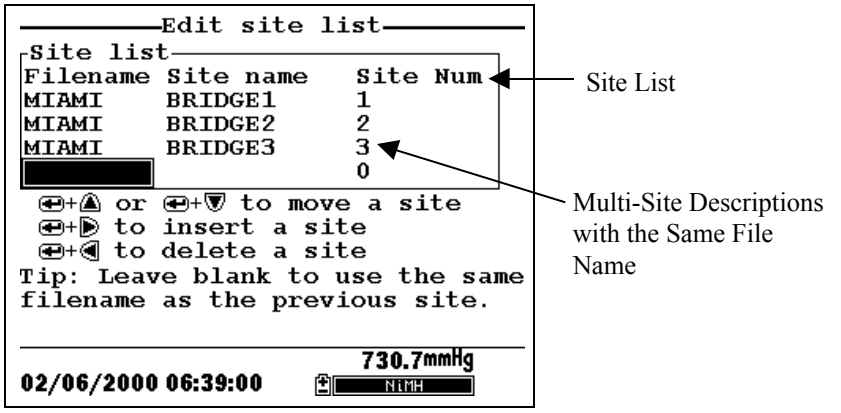


Figure 9.5 Multiple-Site Descriptions

NOTE: Site lists containing Single Site Descriptions are usually input with the designation **Store Site Number** INACTIVE in the YSI 556 MPS **Logging setup** menu. Thus, no site numbers

appear in the first **Site list** example. Conversely, **Site lists** containing **Multi-Site Descriptions** MUST be input with the **Store Site Number** selection ACTIVE as shown in the second example.

To create a site list:

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Use site list** selection.

3. Press the **Enter** key. A check mark is entered in the box next to the use site list selection *and* two new entries appear on the logging setup screen. See Figure 9.6 Logging Setup Screen.

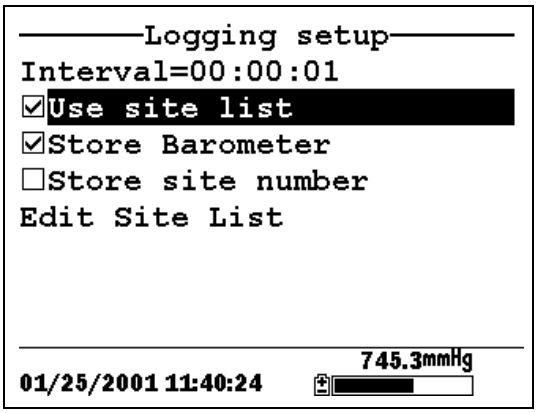


Figure 9.6 Logging Setup Screen

4. Use the arrow keys to highlight the **Store site number** selection.

5. If you are creating Multi-Site Descriptions (which require that the site **number** be stored in your data files), press the **Enter** key until a check mark appears in the box next to the store site number selection.

   OR Press the **Enter** key until the box next to the store site number selection is empty, to create Single-Site

Descriptions. The site **name** will be stored in the header of your data files.

6. Use the arrow keys to highlight the **Edit site list** selection.

7. Press the **Enter** key. The edit site list screen is displayed. See Figure 9.7 Edit Site List Screen. The **Filename** field is ready for input.

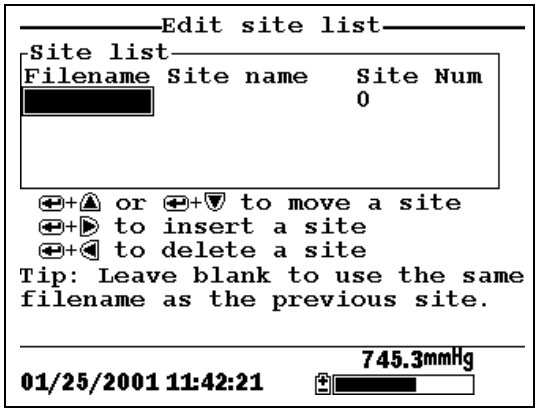


Figure 9.7 Edit Site List Screen

8. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.

9. Press the **Enter** key. The cursor moves to the right for the entry of a **Site name**.

10. Use the keypad to enter a site name up to 11 characters in length. Refer to Section *2.9 Keypad Use*.

    NOTE: If the store site number selection is *not* checked, skip to Step 13.

11. Press the **Enter** key. The cursor moves to the site number entry position.

12. Use the keypad to enter a site number up to 7 characters in length. Refer to Section *2.9 Keypad Use*.

13. Press **Enter**. The cursor moves to the next filename entry position.

14. Repeat Steps 8 to 13 until all filenames and sites have been entered.

15. Press **Escape** repeatedly to return to the main menu screen.

9.5 Editing a Site List

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Edit Site List** selection. See Figure 9.6 Logging Setup Screen.

3. Press the **Enter** key. The edit site list screen is displayed.

4. Edit the site list using the keystrokes described below.

   NOTE: Editing the site list will not have any effect on files stored in the instrument memory.

<u>To MOVE a site:</u>
Use the arrow keys to highlight a site. Press the Up or Down arrow key while holding down the Enter key.

<u>To INSERT a site above another site:</u>
Use the arrow keys to highlight the site. Press the Right **arrow key while holding down the** Enter **key. Use keypad to input letters. Refer to Section *2.9 Keypad Use*.**

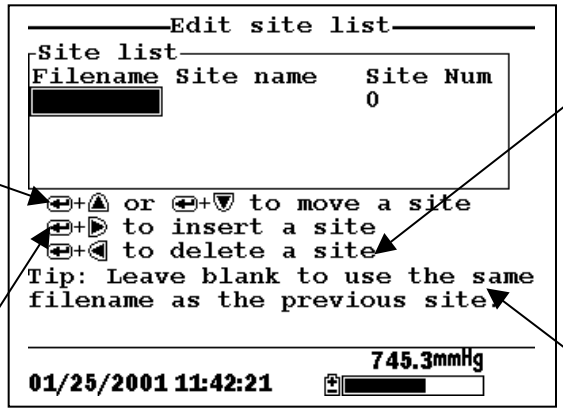


Figure 9.8 Keystrokes for Editing Site List

<u>To DELETE a site:</u>
Use the arrow keys to highlight a site. Press the Left arrow key while holding down the Enter key.

<u>To use the same file name as the previous site:</u> Leave the filename blank.

9.6 Logging Data Without a Site List

1. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

2. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

   OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged.

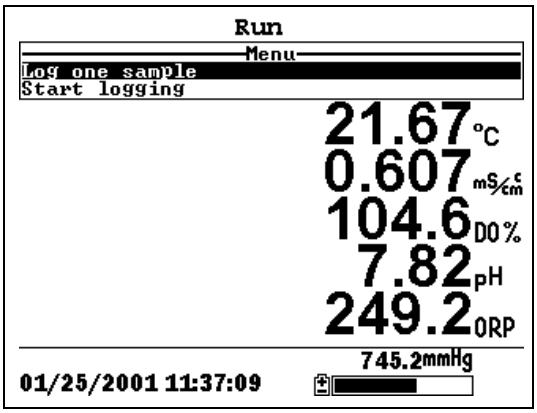


Figure 9.9 Run Screen

3. Press the **Enter** key. The Enter information screen is displayed.

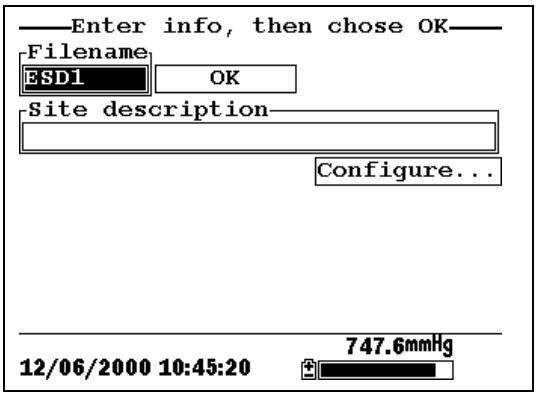


Figure 9.10 Enter Information Screen

NOTE: The last filename used will be displayed.

4. Use the keypad to enter a file name. Refer to Section *2.9 Keypad Use*.

   NOTE: The instrument will assign a default file name of NONAME if no file name is specified.

5. Press the **Enter** key to input the file name.

6. Use the arrow keys to highlight the **Site description** field in the enter information screen.

   NOTE: Entering a Site Description is optional. You may leave the Site Description blank and skip to Step 9.

7. Use the keypad to enter a site description name. Refer to Section *2.9 Keypad Use*.

8. Press the **Enter** key to input the site description.

   NOTE: If you want to change the logging setup, such as sampling interval or storing the barometer reading, use the arrow keys to highlight the **Configure** field, press the **Enter** key, then refer to Section *9.2 Setting Logging Interval* or *9.3 Storing Barometer Readings* for details.

9. Use the arrow keys to highlight the **OK** field in the center of the information screen.

10. Press the **Enter** key to start logging.

    NOTE: If the parameter mismatch screen is displayed, refer to Section *9.8 Adding Data to Existing Files*.

11. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. Skip to Step 13.

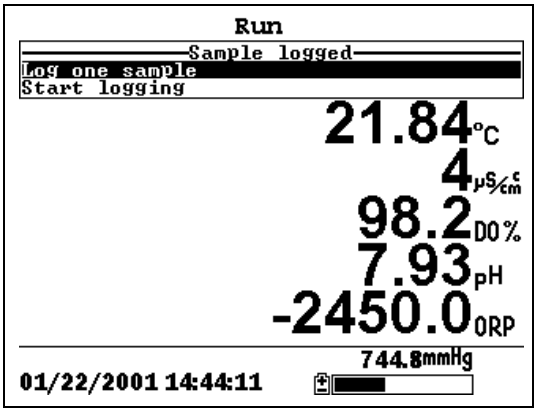


Figure 9.11 Sample Logged Screen

If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**.

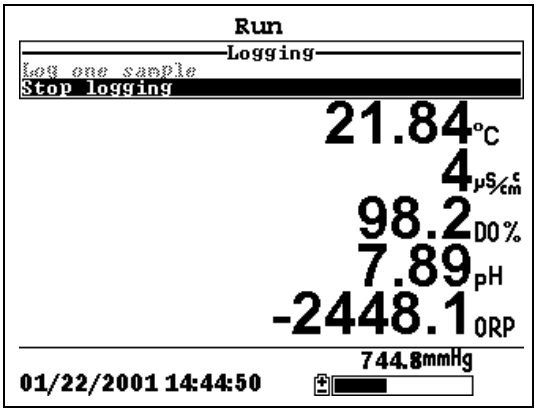


Figure 9.12 Logging Screen

12. At the end of the logging interval, press **Enter** to stop logging.

13. Refer to Section *8.3 View File* to view the data on the instrument display.

9.7 Logging Data With a Site List

1. If you have not already created a site list, refer to Section *9.4 Creating a Site List*.

2. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

3. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

   OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged. See Figure 9.9 Run Screen.

4. Press the **Enter** key. The Pick a site screen is displayed.

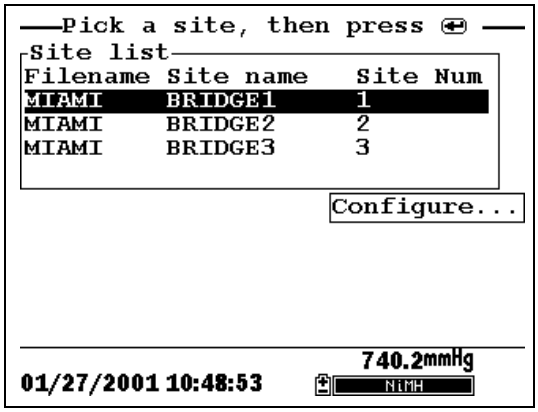


Figure 9.13 Pick a Site Screen

5. Use the arrow keys to highlight the **site** of your choice.

   NOTE: If the site of your choice is grayed out in the site list, refer to Section *9.8 Adding Data to Existing Files*.

   NOTE: Refer to Section *9.5 Editing a Site List* if you want to edit the site list.

6. Press the **Enter** key to start logging.

NOTE: If the parameter mismatch screen is displayed, refer to Section *9.8 Adding Data to Existing Files*.

7. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. See Figure 9.11 Sample Logged Screen. Skip to Step 9.

   If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**. See Figure 9.12 Logging Screen.

8. At the end of the logging interval, press **Enter** to stop logging.

9. Refer to Section *8.3 View File* to view the data on the instrument display.

9.8 Adding Data to Existing Files

In order to add new data to an existing file, the current logging and sensor setup must be *exactly* the same as when the file was created. The following settings must be the same:

- **Sensors enabled** (refer to Section *4 Sensors*)
- **Store Barometer** (refer to Section *9.3 Storing Barometer Readings*)
- **Store Site Number** (refer to Section *9.4 Creating a Site List*)

If the current logging setup is not exactly the same as when the file was created, a parameter mismatch screen is displayed.

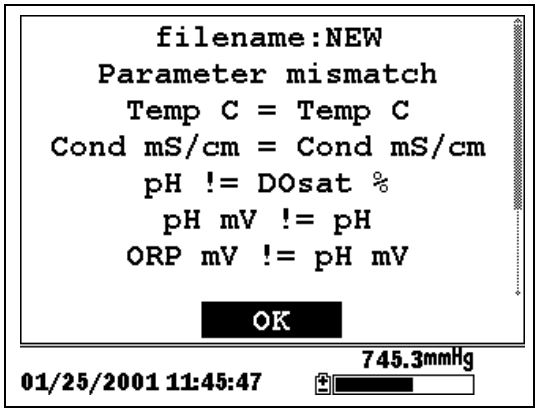


Figure 9.14 Parameter Mismatch Screen

NOTE: The right column shows parameters used when the file was created. The left column shows current parameters.

1. Press the **Down Arrow** key to scroll down and find the mismatch(es).

2. Use the following chart to resolve the mismatch(es).

Mismatch	Action	Reference
Sensor(s) missing from left column	Enable the missing sensor(s)	Section *4 Sensors*
Extra sensor(s) listed in left column	Disable the extra sensor(s)	Section *4 Sensors*
Barometer missing from left column, but present in right column	Enable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Barometer present in left column, but missing from right column	Disable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Store Site Number missing from left column, but present in right column	Enable the Store Site Number setting	Section *9.4 Creating a Site List*
Store Site Number present in left column, but missing from right column	Disable the Store Site Number setting	Section *9.4 Creating a Site List*

3. Return to Section *9.6 Logging Data Without a Site List* or *9.7 Logging Data With a Site List*.

10.System Setup

The YSI 556 MPS has a number of features that are user-selectable or can be configured to meet the user's preferences. Most of these choices are found in the **System setup** menu.

10.1 Accessing the System Setup Screen

1. Press the **On/off** key to display the run screen. See Figure 2.1 Front View of YSI 556 MPS.

2. Press the **Escape** key to display the main menu screen.

3. Use the arrow keys to highlight the **System setup** selection.

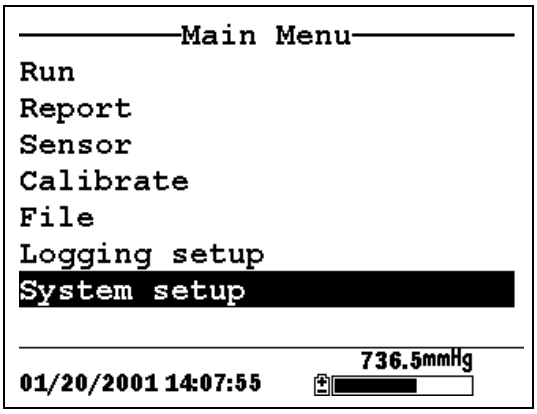


Figure 10.1 Main Menu

4. Press the **Enter** key. The system setup screen is displayed.

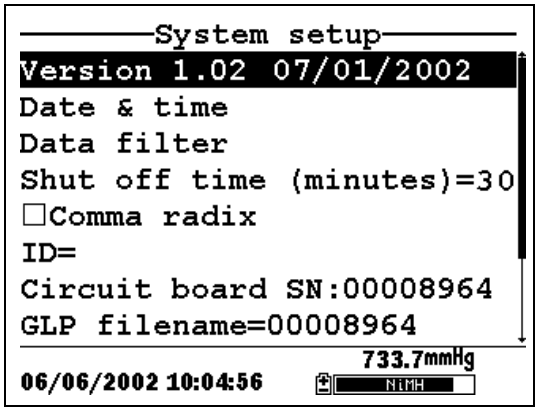


Figure 10.2 System Setup Screen

NOTE: The first line of the **System setup** menu shows the current software version of your YSI 556 MPS. As software enhancements are introduced, you will be able to upgrade your YSI 556 MPS from the YSI Web site. Refer to Section *11.2 Upgrading YSI 556 MPS* Software for details.

10.2 Date and Time Setup

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Date & time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press **Enter**. The date and time setup screen is displayed.

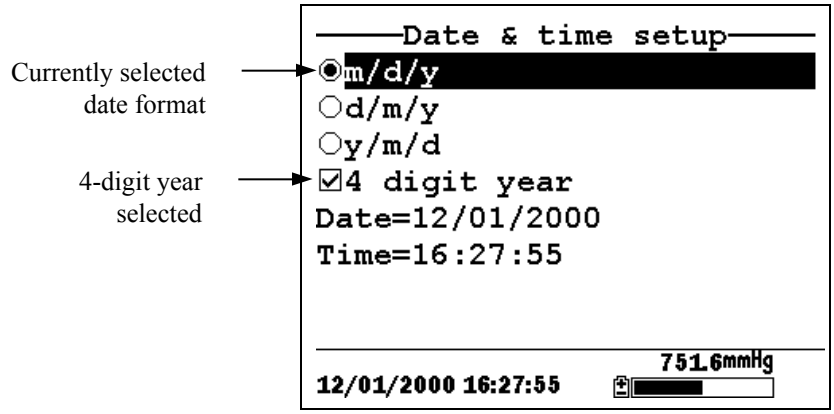


Figure 10.3 Date Setup Screen

NOTE: A black dot to the left of a date format indicates that format is selected.

4. Use the arrow keys to highlight your desired date format.

5. Press **Enter**.

6. Use the arrow keys to highlight the 4-digit year selection.

7. Press **Enter**. A check mark appears in the check box next to the 4-digit year selection.

NOTE: If unchecked, a 2-digit year is used.

8. Use the arrow keys to highlight the **Date** selection.

9. Press **Enter**. A cursor appears over the first number in the date.

10. Enter the proper number from the keypad for the highlighted date digit. The cursor moves automatically to the next date digit. Refer to Section *2.9 Keypad Use* for more keypad information.

11. Repeat Step 10 until all date digits are correct.

12. Press **Enter** to input the specified date.

13. Use the arrow keys to highlight the **Time** selection.

14. Press **Enter**. A cursor appears over the first number in the time selection.

15. Enter the proper number from the keypad for the highlighted time digit. The cursor moves automatically to the next time digit.

    NOTE: Use military format when entering time. For example, 2:00 PM is entered as 14:00.

16. Repeat Step 15 until all time digits are correct.

17. Press **Enter** to input the correct time.

18. Press the **Escape** key repeatedly to return to the Main menu screen.

10.3 Data Filter

The Data Filter is a software filter that eliminates sensor noise and provides more stable readings.

NOTE: YSI recommends using the default values for the data filter for most field applications.

However, users who are primarily interested in a fast response from their dissolved oxygen sensor should consider a change of the default time constant setting of 8 seconds to one of 2 seconds. This change can be made according to the instructions in Section *10.3.1 Changing the Data Filter Settings* below. The disadvantage of lowering the time constant is that field pH readings may appear somewhat noisy if the cable is in motion.

10.3.1 Changing the Data Filter Settings

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Data filter** selection. See Figure 10.1 Main Menu.

3. Press the **Enter** key. The Data filter setup screen is displayed.

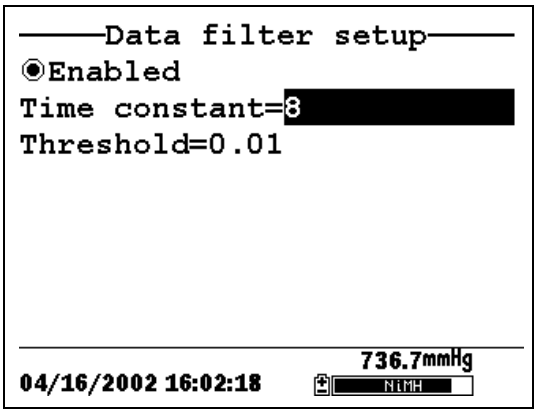


Figure 10.4 Data Filter Screen

4. With Enabled highlighted, press the **Enter** key to Enable or Disable the data filter. A black dot to the left of the selection indicates the data filter is enabled.

5. Use the arrow keys to highlight the **Time constant** field.

   NOTE: This value is the time constant in seconds for the software data filter. Increasing the time constant will result in greater filtering of the data, but will also slow down the apparent response of the sensors.

6. Use the keypad to enter a value. The default value is 8 and this value is ideal for most 556 field applications. As described in Section *10.3 Data Filter* above, users who wish to decrease the response time of the DO readings at the expense of some noise for the pH readings determined concurrently, should change the Time Constant to a value of 2.

7. Press the **Enter** key to enter the time constant.

8. Use the arrow keys to highlight the **Threshold** field.

   NOTE: This value determines when the software data filter will engage/disengage, speeding the response to large changes in a reading. When the difference between two consecutive readings is larger than the threshold, then the reading is displayed unfiltered. When the difference between two consecutive readings drops below the threshold, readings will be filtered again.

9. Use the keypad to enter a value. The default value is 0.01.

10. Press the **Enter** key to enter the threshold.

11. Press the **Escape** key repeatedly to return to the Main menu screen.

10.4 Shutoff Time

The YSI 556 MPS shuts off automatically after 30 minutes of inactivity. The shut off time may be changed as described below.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Shutoff time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Use the keypad to enter a value from 0 to 60 minutes. The default value is 30.

   NOTE: To disable the automatic shutoff feature, enter a zero (0).

4. Press the **Enter** key to enter the correct shutoff time.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.5 Comma Radix

The user can toggle between a period (default) and comma for the radix mark by selecting this item and pressing the **Enter** key as follows:

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.
2. Use the arrow keys to highlight the **Comma radix** selection on the system setup screen. See Figure 10.2 System Setup Screen.
3. Press the **Enter** key. A check mark appears in the check box next to the comma radix selection indicating that the radix mark is a comma.

10.6 ID

This selection allows you to enter an identification name/number for your YSI 556 MPS. This ID name/number is logged in the header of each file.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.
2. Use the arrow keys to highlight the **ID** selection. See Figure 10.1 Main Menu.
3. Use the keypad to enter an alphanumeric ID up to 15 characters in length. Refer to Section *2.9 Keypad Use*.
4. Press the **Enter** key to enter the ID.
5. Press the **Escape** key repeatedly to return to the main menu screen.

10.7 GLP Filename

This selection allows you to enter a different filename for the YSI 556 MPS Calibration Record file.

NOTE: The default filename is the "556 PC board Serial Number.glp."

6. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

7. Use the arrow keys to highlight the **GLP Filename** selection. See Figure 10.1 Main Menu.

8. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.

9. Press the **Enter** key to enter the new filename.

Press the **Escape** key repeatedly to return to the main menu screen.

10.8 TDS Constant

This selection allows you to set the constant used to calculate Total Dissolved Solids (TDS). TDS in g/L is calculated by multiplying this constant times the specific conductance in mS/cm.

10.8.1 Changing the TDS Constant

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **TDS Constant** selection. See Figure 10.1 Main Menu.

3. Use the keypad to enter a value. Refer to Section *2.9 Keypad Use*. The default value is 0.65.

4. Press the **Enter** key to enter the correct TDS constant.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.9 Barometer Units

The following information is only for instruments with the barometer option.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Barometer units** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press the **Enter** key. The Barometer units screen will appear.

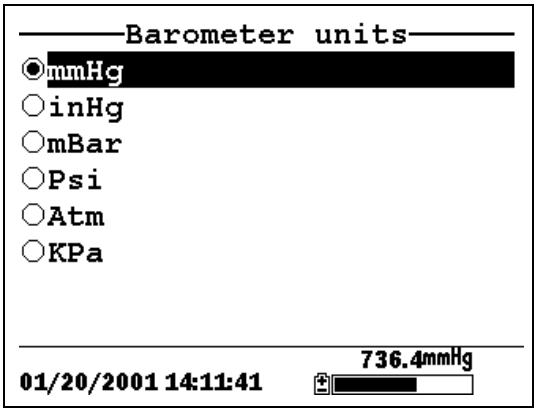


Figure 10.5 Barometer Units Screen

A black dot indicates the currently selected units.

4. Use the arrow keys to highlight your desired barometric unit.

5. Press the **Enter** key to select your choice. A black dot will appear in the circle next to your selected units.

6. Press the **Escape** key repeatedly to return to the main menu screen.

10.10 Calibrate Barometer

The optional barometer has been factory calibrated to provide accurate readings. However, some sensor drift may occur over time, requiring occasional calibration by the user, as follows:

1. Determine your local barometric pressure from an independent laboratory barometer or from your local weather service.

2. If the barometric pressure (BP) reading is from your local weather station, reverse the equation that corrects it to sea level.

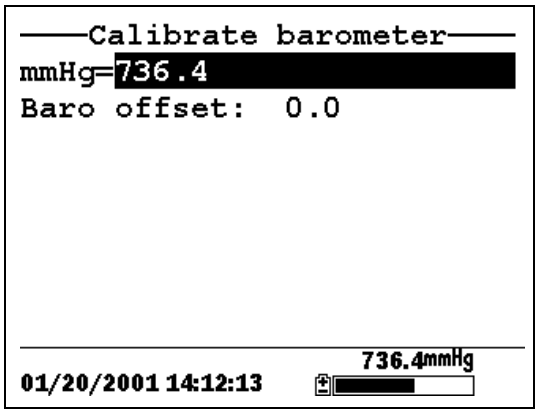
   NOTE: For this equation to be accurate, the barometric pressure units must be in mm Hg.

   True BP = (Corrected BP) – [2.5 * (Local Altitude/100)]

3. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

4. Use the arrow keys to highlight the **Calibrate barometer** selection on the system setup screen. See Figure 10.2 System Setup Screen.

5. Press the **Enter** key. The Calibrate Barometer screen is displayed.



6. Use the keypad to input the known barometric pressure value as determined in Step 2.

7. Press the **Enter** key. The new barometer reading is displayed as well as the approximate offset from the factory reading.

   NOTE: To return the sensor to the factory setting, subtract the offset amount from the current setting and repeat Steps 5 to 7.

8. Press the **Escape** key repeatedly to return to the main menu screen.

11.Maintenance

11.1 Sensor Care and Maintenance

Once the sensors have been properly installed, remember that periodic cleaning and DO membrane changes are required.

11.1.1 DO Sensor

For best results, we recommend that the KCl solution and the membrane cap be changed at least once every 30 days.

1. It is important to recognize that oxygen dissolved in the sample is consumed during sensor operation. It is therefore essential that the sample be continuously stirred at the sensor tip. If stagnation occurs, your readings will be artificially low. Stirring may be accomplished by mechanically moving the sample around the sensor tip, or by rapidly moving the sensor through the sample. The rate of stirring should be at least 1 foot per second.

2. Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes, or from large (more than 1/8" diameter) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, you should replace the membrane and the electrolyte solution. The average replacement interval is two to four weeks.

3. If the membrane is coated with oxygen consuming (e.g. bacteria) or oxygen producing organisms (e.g. algae), erroneous readings may occur.

4. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the sensor. If you suspect erroneous readings, it may be necessary to determine if these gases are the cause.

5. Avoid any environment that contains substances that may attack the probe module and sensor materials. Some of these substances are concentrated acids, caustics, and strong solvents. The sensor materials that come in contact with the

sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the PVC cable covering.

6. It is possible for the silver anode, which is the entire silver body of the sensor, to become contaminated. This will prevent successful calibration. To restore the anode, refer to Section *11.1.1 DO Sensor, Silver Anode Cleaning.*

7. For correct sensor operation, the gold cathode must always be bright. If it is tarnished (which can result from contact with certain gases), or plated with silver (which can result from extended use with a loose or wrinkled membrane), the gold surface must be restored. To restore the cathode, refer to Section *11.1.1 DO Sensor, Gold Cathode Cleaning.*

8. To keep the electrolyte from drying out, store the sensor in the transport/calibration cup with at least 1/8″ of water.

Silver Anode Cleaning

After extended use, a thick layer of AgCl builds up on the silver anode reducing the sensitivity of the sensor. The anode must be cleaned to remove this layer and restore proper performance. The cleaning can be chemical or mechanical:

Chemical Cleaning: Remove the membrane cap and soak the entire anode section in a 14% ammonium hydroxide solution for 2 to 3 minutes, followed by a thorough rinsing with distilled or deionized water. The anode should then be thoroughly wiped with a wet paper towel to remove the residual layer from the anode.

Mechanical Cleaning: Sand off the dark layer from the silver anode with 400 grit wet/dry sandpaper. Wrap the sandpaper around the anode and twist the sensor. Rinse the anode with clean water after sanding, followed by wiping thoroughly with a wet paper towel.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation***.**

Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are still unable to calibrate, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

Gold Cathode Cleaning

For correct sensor operation, the gold cathode must be textured properly. It can become tarnished or plated with silver after extended use. The gold cathode can be cleaned by using the adhesive backed sanding disc and tool provided in the YSI 5238 Probe Reconditioning Kit.

Using the sanding paper provided in the YSI 5238 Probe Reconditioning Kit, wet sand the gold with a twisting motion about 3 times or until all silver deposits are removed and the gold appears to have a matte finish. Rinse the cathode with clean water after sanding, followed by wiping thoroughly with a wet paper towel. If the cathode remains tarnished, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation***.**

11.1.2 DO Sensor Replacement

1. Remove the probe sensor guard.

⚠ **CAUTION:** Thoroughly dry the sensor so that no water enters the probe module sensor port when the sensor is removed.

2. Insert the long end of the hex key wrench into the small hole in the side of the probe module bulkhead. Turn the wrench counterclockwise and remove the screw. (You do not have to remove the screw all the way to release the sensor.)

3. Pull the old DO sensor module straight out of the probe module body.

   NOTE: The DO sensor is not threaded, it is keyed, so it cannot be removed by twisting.

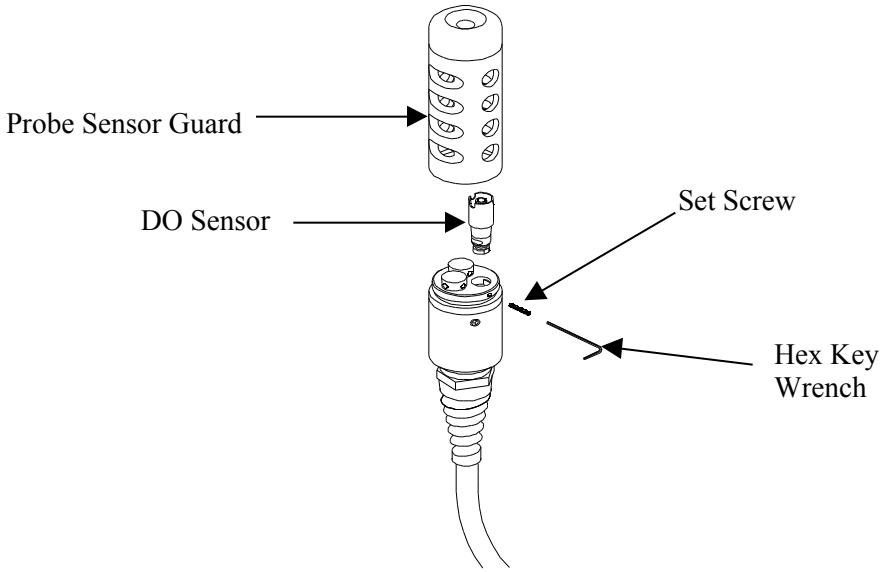


Figure 11.1 DO Sensor Replacement

4. Insert the new DO sensor module. Make sure that the inside of the probe module sensor port and the o-ring on the sensor are clean, with no contaminants, such as grease, dirt, or hair. The DO sensor is keyed, or has a flat side, so that it cannot be aligned improperly.

NOTE: Make sure the DO sensor bottoms out before the set screw is inserted.

5. Insert the set screw into the small hole in the side of the probe module bulkhead, and turn clockwise to rethread.

⚠ **CAUTION:** Make sure that you do not cross-thread the set screw. Use the hex key wrench to tighten the screw in properly, making sure that the screw does not stick out of the side of the probe module bulkhead. The probe sensor guard will not thread

on properly and damage may result if the screw is allowed to stick out.

NOTE: The YSI 5563 DO sensor is shipped dry. A shipping membrane was installed to protect the electrode. A new membrane cap must be installed before the first use. Refer to Section *3.4.1 Sensor Installation.*

11.1.3 YSI 5564 pH and 5565 Combination pH/ORP Sensor Cleaning

Cleaning is required whenever deposits or contaminants appear on the glass and/or platinum surfaces of these sensors or when the response of the sensor becomes slow.

1. Remove the sensor from the probe module.

2. Initially, simply use clean water and a soft clean cloth, lens cleaning tissue, or cotton swab to remove all foreign material from the glass bulb (YSI 5564 and YSI 5565) and platinum button (YSI 5565). Then use a moistened cotton swab to carefully remove any material that may be blocking the reference electrode junction of the sensor.

⚠ **CAUTION:** When using a cotton swab with the YSI 5564 or YSI 5565, be careful NOT to wedge the swab tip between the guard and the glass sensor. If necessary, remove cotton from the swab tip, so that the cotton can reach all parts of the sensor tip without stress.

NOTE: If good pH and/or ORP response is not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 10-15 minutes in clean water containing a few drops of commercial dishwashing liquid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the cleaning solution.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water.

NOTE: If good pH and/or ORP response is still not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 30-60 minutes in one molar (1 M) hydrochloric acid (HCl). This reagent can be purchased from most distributors. Be sure to follow the safety instructions included with the acid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the acid.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water. To be certain that all traces of the acid are removed from the sensor crevices, soak the sensor in clean water for about an hour with occasional stirring.

NOTE: If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following additional cleaning step:

1. Soak the sensor for approximately 1 hour in a 1 to 1 dilution of commercially available chlorine bleach.

2. Rinse the sensor with clean water and then soak for at least 1 hour in clean water with occasional stirring to remove residual bleach from the junction. (If possible, soak the sensor for period of time longer than 1 hour in order to be certain that all traces of chlorine bleach are removed.) Then re-rinse the sensor with clean water and retest.`

11.1.4 Temperature/Conductivity Sensor Cleaning

The single most important requirement for accurate and reproducible results in conductivity measurement is a clean cell. A dirty cell will change the conductivity of a solution by contaminating it. The small cleaning brush included in the YSI 5511 Maintenance Kit is ideal for this purpose.

To clean the conductivity cell:

1. Dip the brush in clean water and insert it into each hole 15-20 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

NOTE: In the event that deposits have formed on the electrodes, perform the following additional procedure:

1. Use a mild detergent solution in combination with the brush. Dip the brush in the solution and insert it into each hole 15-20 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

   NOTE: After cleaning, check the response and accuracy of the conductivity cell with a calibration standard.

   NOTE: If this procedure is unsuccessful, or if sensor performance is impaired, it may be necessary to return the sensor to a YSI authorized service center for service, Refer to *Appendix E Customer Service*.

   The temperature portion of the sensor requires no maintenance.

11.2 Upgrading YSI 556 MPS Software

1. Access the YSI Environmental Software Downloads page as described in *Appendix G EcoWatch* Step 1 through 3.

2. Click on the **YSI Instruments Software Updates** link (or scroll down until you see YSI 556 MPS).

3. Click on the file icon to the right of the **YSI 556 MPS** listing and save the file to a temporary directory on your computer.

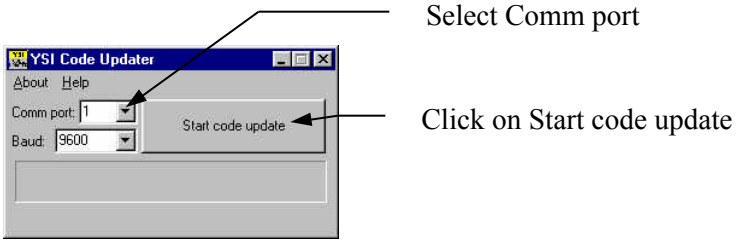
4. After the download is complete, run the file (that you just downloaded) and follow the on screen instructions to install the YSI Code Updater on your computer. If you encounter difficulties, contact YSI customer service for advice. Refer to *Appendix E Customer Service*.

5. If necessary, disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

6. Connect the YSI 556 MPS to a serial port of your computer via the 655173 PC interface cable. See Figure 8.6 Computer/Instrument Interface.

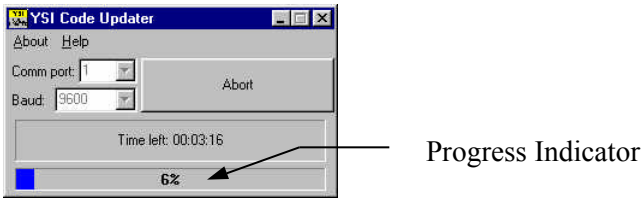
7. Press the **On/off** key on the YSI 556 MPS to display the run screen.

8. Run the YSI Code Updater software that you just installed on your computer. The following window will be displayed:

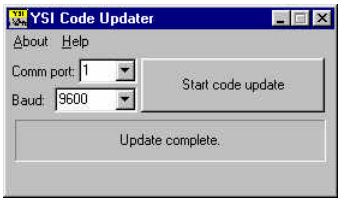


9. Set the Comm port number to match the port that you connected the 655173 PC Interface Cable to, then click on the **Start Code Update button**.

The YSI 556 MPS screen will blank out and a progress indicator will be displayed on the PC.



When the update is finished (indicated on the PC screen), the YSI 556 MPS will return to the Run screen. See Figure 7.1 Run Screen.



10. Close the YSI Code Updater window (on the PC) by clicking on the "X" in the upper right corner of the window.

11. Disconnect the YSI 556 MPS from the 655173 PC interface cable and reconnect it to the YSI 5563 Probe Module. Refer to Section *3.6 Instrument/Cable Connection*.

12.Storage

Proper storage between periods of usage will not only extend the life of the sensors, but will also ensure that the unit will be ready to use as quickly as possible in your next application.

12.1 General Recommendations for Short Term Storage

No matter what sensors are installed in the instrument, it is important to keep them moist without actually immersing them in liquid. Immersing them could cause some of them to drift or result in a shorter lifetime.

YSI recommends that short term storage of all multi-parameter instruments be done by placing approximately 1/2 inch of tap water in the transport/calibration cup that was supplied with the instrument, and by placing the probe module with all of the sensors installed into the cup. The use of a moist sponge instead of a 1/2 inch of tap water is also acceptable, as long as its presence does not compromise the attachment of the cup to the probe module. The transport/calibration cup should be sealed to prevent evaporation.

NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

NOTE: If the storage water (tap water) is accidentally lost during field use, environmental water can be used.

12.2 General Recommendations for Long Term Storage

12.2.1 Probe Module Storage

1. Remove the pH or pH/ORP sensor from the probe module and store according to the individual sensor storage instructions found in Section *12.2.2 Sensor Storage*.

2. Seal the empty port with the provided port plug.

NOTE: Leave the conductivity/temperature sensor and dissolved oxygen sensor, with membrane cap still on, in the probe module.

3. Place 1/2″ of water, deionized, distilled or tap, in the transport/calibration cup.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

4. Insert the probe module into the cup.

NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

12.2.2 Sensor Storage

Temperature/Conductivity Sensor

No special precautions are required. Sensor can be stored dry or wet, as long as solutions in contact with the thermistor and conductivity electrodes are not corrosive (for example, chlorine bleach). However, it is recommended that the sensor be cleaned with the provided brush prior to long term storage. Refer to Section *11.1.4 Temperature/Conductivity Sensor Cleaning*.

pH and Combination pH/ORP Sensor

The key to sensor storage is to make certain that the reference electrode junction does not dry out. Junctions which have been allowed to dry out due to improper storage procedures can usually be rehydrated by soaking the sensor for several hours (overnight is recommended) in a solution which is 2 molar in potassium chloride. If potassium chloride solution is not available, soaking the sensor in tap water or commercial pH buffers may restore sensor function. However in some cases the sensor may have been irreparably damaged by the dehydration and will require replacement.

⚠ **CAUTION:** Do not store the sensor in distilled or deionized water as the glass sensor may be damaged by exposure to this medium.

1. Remove the pH or pH/ORP sensor from the probe module.

2. Seal the empty port with the provided port plug.

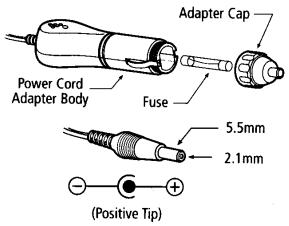
3. Place the sensor in the storage vessel (plastic boot or bottle) which was on the sensor at delivery. The vessel should contain a solution which is 2 molar in potassium chloride.

   NOTE: Make certain that the vessel is sealed to prevent evaporation of the storage solution.

13.Troubleshooting

The following sections describe problems you may encounter when using the YSI 556 MPS and provides suggestions to overcome the symptom.

PROBLEM	POSSIBLE SOLUTION
Display Problems	
No display is visible after pressing the on/off key.	If C cells are used, make certain that they are installed properly with regard to polarity and that good batteries are used. If a rechargeable battery pack is used, place the pack in the instrument and charge for 30 minutes.
Instrument software appears to be locked up as evidenced by no response to keypad entries or display not changing.	First, attempt to reset the instrument by simply turning off and then on again. If this fails, remove battery power from the instrument for 30 seconds and then reapply power. When using C cells, remove the battery lid and one of the batteries; when using the rechargeable battery pack, remove the pack completely from the instrument. After 30 seconds replace the battery or battery pack and check for instrument function.
The 556 display flashes and the instrument speaker makes a continuous clicking sound.	The battery voltage is low. Change to new C cells or recharge the 6117 battery pack.
Water Damage to Instrument	
Leakage detected in battery compartment when using C cells	Dispose of batteries properly. Dry the battery compartment using compressed air if possible. If corrosion is present on battery terminals, contact YSI Customer Service.
Water has contacted rechargeable battery pack	Remove battery pack immediately. Send battery pack to YSI Product Service for evaluation. **CAUTION**: DO NOT REUSE BATTERY PACK UNTIL YSI PRODUCT SERVICE HAS EVALUATED IT.
Leakage suspected into the main cavity of the instrument case	Remove the batteries immediately. Return the instrument to YSI Product Service.

PROBLEM	POSSIBLE SOLUTION
Optional Cigarette Lighter Charger	
Power cord fuse blown 	1. Unscrew adapter's cap, remove tip and pull out fuse. 2. Replace fuse with a new 2-amp fast-blow fuse from an electronics store such as Radio Shack. 3. Reassemble the adapter and securely screw the cap back onto the adapter body.
File Problems	
Upload of files from YSI 556 MPS to PC fails	1. Make sure that cable is connected properly to both 556 and PC. 2. Make certain that the proper Comm port is selected in EcoWatch for Windows.
Barometer data is not stored with sensor data file.	Make sure **Store barometer** is active in the 556 **Logging setup** menu.
Site Descriptions in the **Site List** are "grayed-out" and not available for appending files with additional data.	There is a parameter mismatch between the current 556 setup and that initially used. Change the current logging and sensor setup to match the setup that was initially used to create the file.
Sensor Problems	
Dissolved Oxygen reading unstable or inaccurate. Out of Range message appears during calibration.	Sensor not properly calibrated. Follow DO cal procedures.
	Membrane not properly installed or may be punctured. Replace membrane cap.
	DO sensor electrodes require cleaning. Follow DO cleaning procedure. Use 5511 Maintenance kit.
	Water in sensor connector. Dry connector; reinstall sensor.
	Algae or other contaminant clinging to DO sensor. Rinse DO sensor with clean water.
	Barometric pressure entry is incorrect. Repeat DO cal procedure.
	Calibrated at extreme temperature. Recalibrate at (or near) sample temperature.
	DO sensor has been damaged. Replace sensor.
	Internal failure. Return probe module for service.

PROBLEM	POSSIBLE SOLUTION
Sensor Problems	
pH or ORP readings are unstable or inaccurate. Out of Range message appears during calibration.	Sensor requires cleaning. Follow sensor cleaning procedure.
	Sensor requires calibration. Follow cal procedures.
	pH sensor reference junction has dried out from improper storage. Soak sensor in tap water or buffer until readings become stable.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace sensor.
	Calibration solutions out of spec or contaminated with other solution. Use new calibration solutions.
	ORP fails Zobell check. Take into account temperature dependence of Zobell solution readings.
	Internal failure. Return probe module for service.
Conductivity unstable or inaccurate. Out of Range message appears during calibration.	Conductivity improperly calibrated. Follow calibration procedure.
	Conductivity sensor requires cleaning. Follow cleaning procedure.
	Conductivity sensor damaged. Replace sensor.
	Calibration solution out of spec or contaminated. Use new calibration solution.
	Internal failure. Return probe module for service.
	Calibration solution or sample does not cover entire sensor. Immerse sensor fully.
Temperature, unstable or inaccurate	Water in connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace the 5560 sensor.
Installed sensor has no reading	The sensor has been disabled. Enable sensor.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace the sensor.
	Report output improperly set up. Set up report output.
	Internal failure. Return probe module for service.

If these guidelines and tips fail to correct your problem or if any other symptoms occur, contact YSI Customer Service for Advice. Refer to *Appendix E Customer Service*.

14. Appendix A YSI 556 MPS Specifications

14.1 Sensor Specifications

Dissolved Oxygen		
Sensor Type		Steady state polarographic
Range:	*% air sat'n*	_ 0 to 500% air saturation
	mg/L	_ 0 to 50 mg/L
Accuracy:	*% air sat'n*	_ 0 to 200% air saturation: ±2% of the reading or 2% air saturation; whichever is greater _ 200 to 500% air saturation: ±6% of the reading
	mg/L	_ 0 to 20 mg/L: ±2% of the reading or 0.2 mg/L; whichever is greater _ 20 to 50 mg/L: ±6% of the reading
Resolution:	*% air sat'n*	_ 0.1% air saturation
	mg/L	_ 0.01 mg/L
Temperature		
Sensor Type:		YSI Precision™ thermistor
Range:		-5 to 45°C
Accuracy:		±0.15°C
Resolution:		0.01°C
Conductivity		
Sensor Type:		4-electrode cell with auto-ranging
Range:		0 to 200 mS/cm
Accuracy:		±0.5% of reading or ±0.001 mS/cm; whichever is greater–4 meter cable ±1.0% of reading or ±0.001 mS/cm; whichever is greater–20 meter cable
Resolution:		0.001 mS/cm to 0.1 mS/cm (range-dependent)
Salinity		
Sensor Type:		Calculated from conductivity and temperature
Range:		0 to 70 ppt
Accuracy:		±1.0% of reading or 0.1 ppt; whichever is greater
Resolution:		0.01 ppt

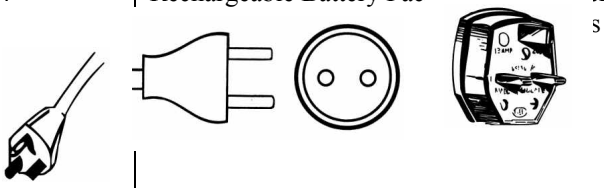
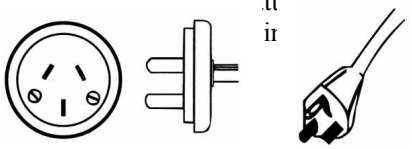
pH (optional)	
Sensor Type:	Glass combination electrode
Range:	0 to 14 units
Accuracy:	±0.2 units
Resolution:	0.01 units
ORP (optional)	
ORP Sensor Type:	Platinum button
Range:	-999 to +999 mV
Accuracy:	±20 mV
Resolution:	0.1 mV

Barometer (optional)	
Range:	500 to 800 mm Hg
Accuracy:	±3 mm Hg within ±15°C temperature range from calibration point
Resolution:	0.1 mm Hg

14.2 Instrument Specifications

Memory Size:	1.5 MB Flash Memory 49,000 data sets (@ 6 parameters per set plus time stamp) 100 Sites
Size:	11.9 cm width x 22.9 cm length (4.7 in. x 9 in.)
Weight with batteries:	0.92 kg (2.1 lbs)
Power:	4 alkaline C-cells; optional rechargeable pack
Cables:	4, 10, and 20 m (13.1, 32.8, 65.6 ft.) lengths
Warranty:	3-Years for the instrument; 1-Year for the probe modules and cable

15. Appendix B Instrument Accessories

ITEM #	ACCESSORY
5563-4	4m Cable with DO/temp/conductivity
5563-10	10m Cable with DO/temp/conductivity
5563-20	20m Cable with DO/temp/conductivity
5564	pH Kit
5565	pH/ORP Kit
6118	Rechargeable Battery Pack Kit for use in US
5094	Rechargeable Battery Pack Kit with universal charger and three adapter s 
5095	with universal charger and two adapter plications 
5083	Flow Cell – probe module is secured in the flow cell and groundwater is pumped through it
616	Charger, Cigarette Lighter – used to power up the instrument from a car's cigarette lighter
4654	Tripod
614	Ultra Clamp, C Clamp –used to clamp the instrument to a table top or car dashboard
6081	Large Carrying Case, Hard-sided
5085	Hands-free Harness
5065	Carrying Case, Form-fitted, for use in the field – has a clear vinyl window, shoulder strap, belt loop strap and hand strap

16. Appendix C Required Federal Communications Notice

The Federal Communications Commission defines this product as a computing device and requires the following notice.

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class A or Class B computing device in accordance with the specification in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer away from the receiver
- Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No.0004-000-00345-4.

YSI Conductivity solutions: 3161, 3163, 3165, 3167, 3168, 3169

INGREDIENTS:
- Iodine
- Potassium Chloride
- Water

WARNING: INHALATION MAY BE FATAL.

⚠ ***CAUTION*: AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY EVOLVE TOXIC FUMES IN FIRE.**

Harmful if ingested or inhaled. Skin or eye contact may cause irritation. Has a corrosive effect on the gastro-intestinal tract, causing abdominal pain, vomiting, and diarrhea. Hyper-sensitivity may cause conjunctivitis, bronchitis, skin rashes etc. Evidence of reproductive effects.

FIRST AID:
INHALATION: Remove victim from exposure area. Keep victim warm and at rest. In severe cases seek medical attention.
SKIN CONTACT: Remove contaminated clothing immediately. Wash affected area thoroughly with large amounts of water. In severe cases seek medical attention.
EYE CONTACT: Wash eyes immediately with large amounts of water, (approx. 10 minutes). Seek medical attention immediately.
INGESTION: Wash out mouth thoroughly with large amounts of water and give plenty of water to drink. Seek medical attention immediately.

YSI pH 4.00, 7.00, and 10.00 Buffer Solutions: 3821, 3822, 3823

pH 4 INGREDIENTS:
- Potassium Hydrogen Phthalate
- Formaldehyde
- Water

pH 7 INGREDIENTS:
- Sodium Phosphate, Dibasic
- Potassium Phosphate, Monobasic
- Water

pH 10 INGREDIENTS:
- Potassium Borate, Tetra
- Potassium Carbonate
- Potassium Hydroxide
- Sodium (di) Ethylenediamine Tetraacetate
- Water

⚠ ***CAUTION*** **- AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

Inhalation may cause severe irritation and be harmful. Skin contact may cause irritation; prolonged or repeated exposure may cause Dermatitis. Eye contact may cause irritation or conjunctivitis. Ingestion may cause nausea, vomiting and diarrhea.

FIRST AID:

INHALATION - Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

YSI Zobell Solution: 3682

INGREDIENTS:
- Potassium Chloride
- Potassium Ferrocyanide Trihydrate
- Potassium Ferricyanide

⚠ ***CAUTION*** **- AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

May be harmful by inhalation, ingestion, or skin absorption. Causes eye and skin irritation. Material is irritating to mucous membranes and upper respiratory tract. The chemical, physical, and toxicological properties have not been thoroughly investigated.

Ingestion of large quantities can cause weakness, gastrointestinal irritation and circulatory disturbances.

FIRST AID:

INHALATION - Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

18.Appendix E Customer Service

For information on Customer Service Centers, refer to *Authorized Service Centers* in this appendix.

Equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected before being returned or presented for service. A cleaning certificate must accompany the equipment. Refer to *18.2 Cleaning Instructions* in this appendix.

18.1 YSI Environmental Authorized Service Centers

International Service Centers

YSI Incorporated · Repair Center · 1725 Brannum Lane
Yellow Springs, Ohio · 45387 · Phone: (937) 767-7241
E-Mail: support@ysi.com

Hydrodata Services (UK) Ltd. · Unit 8 · Business Centre West Avenue One · Letchworth · Herts · SG6 2HB
Phone: (44-1462) 673581 · Fax: (44-1462) 673582
Email: hydrodatauk@cs.com

YSI Nanotech · Kaizuka 1-15-4, Kawasaki-Ku · Kawaskaki City · Japan · 210-0014 · Phone: 011-814-4222-0009
Fax: 011-81-44-221102 · E-mail: Nanotech@ysi.com

Nortech GSI · 1131 Derry Road East · Mississauga, ONT L5T 1P3 · Canada · Phone: 800-263-3427 · Fax: 905-564-4700

US Service Centers for Water Quality and 6-Series Instruments

Ohio
YSI Incorporated · Repair Center · 1725 Brannum Lane
Yellow Springs, Ohio · 45387 · Phone: (800) 765-4974
(937) 767-7241· E-Mail: info@ysi.com

California
EQUIPCO Sales and Service · 1110 Burnett Avenue, Suite D
Concord, CA · 94520 · Phone: (800)550-5875
Fax: (510)674-8655

Colorado
Ted D. Miller Associates, Inc. · 2525 S. Wadsworth Blvd., Suite 300 · Lakewood, CO · 80227 · Phone: (303) 989-7737 Fax: (303) 989-8875 · E:mail: tdma@earthlink.net

Mississippi
C.C. Lynch & Associates, Inc. · P.O. Box 456 · 300 Davis Street · Pass Christian, MS · 39571 Phone: (800) 333-2252 (228) 452-4612 · Fax (228) 452-2563

US Service Centers for Water Quality Instruments Only

Florida
Aquatic Eco Systems, Inc. · 1767 Benbow Court · Apopka, Florida · Phone: (407) 886-3939 · Fax: (407) 886-6787

Maine
Q.C. Services · P.O. Box 68 · Harrison, Maine · 04040 Phone: (207) 583-2980

Mississippi
Aquacenter · 166 Seven Oaks Road · Leland, Mississippi 38756 · Phone: (601) 378-2861 · Fax: (601) 378-2862

Oregon
Q.C. Services · P.O. Box 14831 · Portland, Oregon · 97293 Phone: (503) 236-2712

Wisconsin
North Central Labs · 400 Lyons Road · Birnamwood, Wisconsin · Phone: (800) 648-7836 · Fax: (715) 449-2454

18.2 Cleaning Instructions

Equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected before being serviced. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, or with wastewater. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification has been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at a YSI Service Center, the following steps must be taken to ensure the safety of service personnel.

- In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4-cup bleach to 1-gallon tap water is suitable for most disinfecting. Instruments used with wastewater may be disinfected with .5% Lysol if this is more convenient to the user.
- The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.
- If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.
- Any product being returned to the YSI Repair Center should be packed securely to prevent damage.
- Cleaning must be completed and certified on any product before returning it to YSI.

18.3 Packing Procedure

- Clean and decontaminate items to ensure the safety of the handler.
- Complete and include the Cleaning Certificate.
- Place the product in a plastic bag to keep out dirt and packing material.
- Use a large carton, preferably the original, and surround the product completely with packing material.
- Insure for the replacement value of the product.

18.4 Cleaning Certificate

Organization _____

Department _____

Address _____

City _____ State __ Zip _____

Country _____ Phone _____

Model No. of Device __ Lot Number _____

Contaminant (if known) _____

Cleaning Agent(s) used _____

Radioactive Decontamination Certified?

(Answer only if there has been radioactive exposure)

_____ Yes _____ No

Cleaning Certified By _____

Name Date

18.5 Warranty

The instrument is warranted for three years against defects in workmanship and materials when used for its intended purposes and maintained according to instructions. The probe module and cables are warranted for one year. The dissolved oxygen, temperature/conductivity, pH, and pH/ORP combination sensors are warranted for one year. Damage due to accidents, misuse, tampering, or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI'S LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

19. Appendix F Ferrite Bead Installation

⚠ **WARNING:** If you are using your YSI 556 in a European Community (CE) country or in Australia or New Zealand, you must attach a ferrite bead to the 655173 PC Interface Cable and the YSI 6117 Charger Adapter Cable in order to comply with the Residential, Commercial and Light Industrial Class B Limits for radio-frequency emissions specified in EN55011 (CISPR11) for Industrial, Scientific and Medical laboratory equipment. These ferrite assemblies are supplied as part of cable kits.

1. Make a small loop (approximately 5 cm in diameter) in the cable near the YSI 556 MS-19 connector.

2. Lay the open ferrite bead assembly under the loop with the cable cross-over position within the cylinder of the ferrite bead.

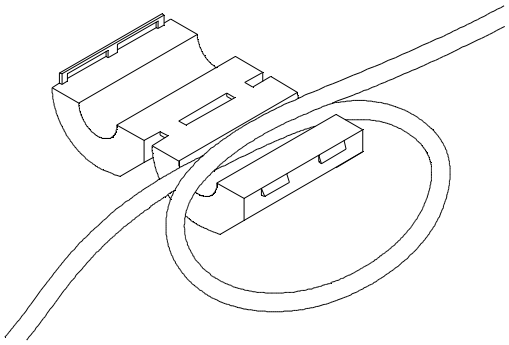


Figure 19.1 Ferrite Bead Installation

3. Snap the two pieces of the bead together making certain that the tabs lock securely.

4. When the installation is complete, the 655173 and YSI 6117 cables should resemble the following drawings.

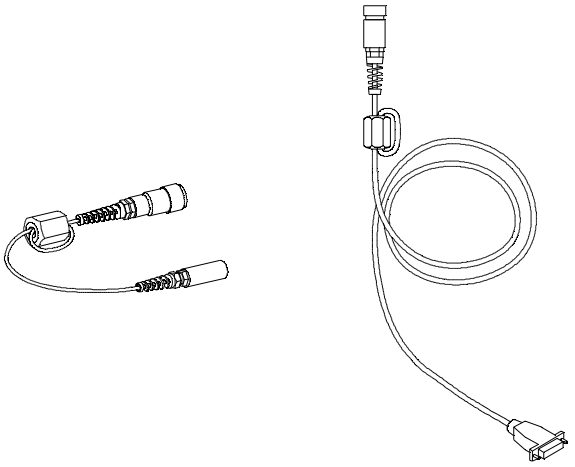


Figure 19.2 Cables with Ferrite Beads

20.Appendix G EcoWatch

EcoWatch™ for Windows™ must be used as the PC software interface to the YSI 556 MPS. EcoWatch is a powerful tool that can also be used with YSI 6-series sondes. Many features of the software will only be utilized by advanced users or are not relevant to the 556 MPS at all. This section is designed in tutorial format to familiarize you with the commonly used features of EcoWatch so that it will be possible to:

- Upload data from a 556 MPS to a PC
- Assemble plots and reports of your data
- Zoom in on certain segments of the plots of your data to facilitate analysis
- Show statistical data for your studies
- Export data in spreadsheet-compatible formats
- Print plots and reports

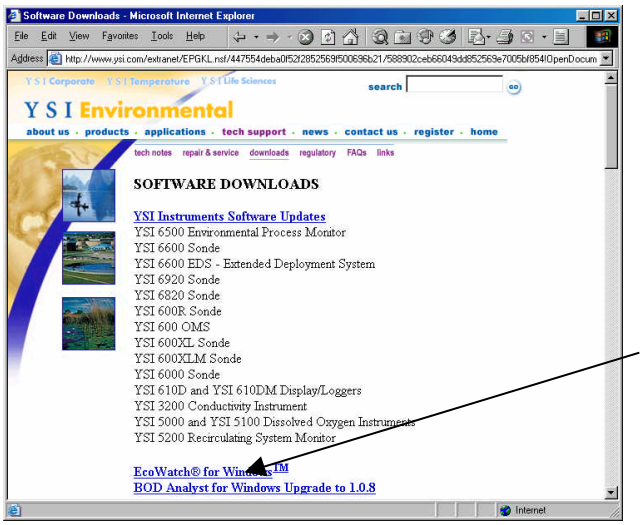
The advanced features of EcoWatch can be explored by downloading a 6-series manual from the YSI Web Site (www.ysi.com), purchasing a hard copy of the manual through YSI Customer Service (Item # 069300), or utilizing the on-line help feature of the software.

20.1 Installing EcoWatch for Windows

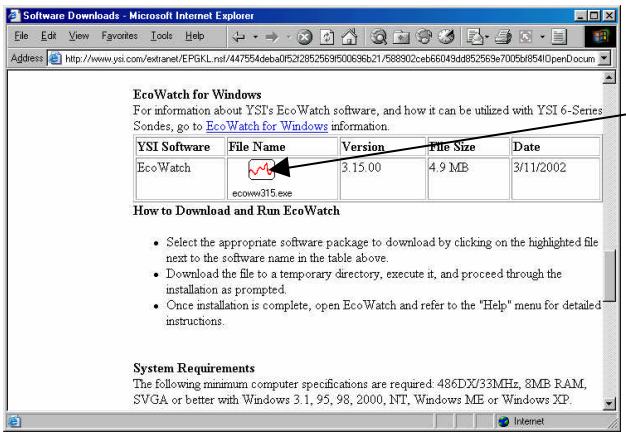
EcoWatch for Windows is available at no cost via a download from the YSI Web Site.

1. Access the YSI Environmental Web Site at www.ysi.com/edownloads.

2. Click on the **EcoWatch for Windows** link (or scroll down until you see the EcoWatch for Windows icon).



3. Click on the EcoWatch for Windows icon and save the file to a temporary directory on your computer.



4. After the download is complete, run the EcoWatch file (that you just downloaded) and follow the on screen instructions to install the software on your computer.

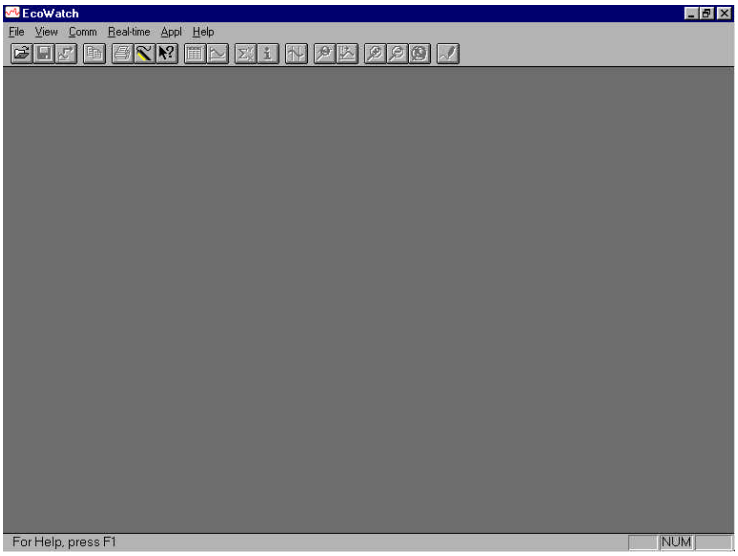
If you encounter difficulties in the download procedure, contact YSI Customer Service. Refer to ***Appendix E Customer Service***. Alternatively, you may purchase the software on CD ROM (Item #006075) by contacting YSI Customer Service.

20.2 EcoWatch Tutorial

This EcoWatch tutorial is designed to teach you the commonly used operations associated with the software when used with your 556 MPS.

After you have uploaded a file, Refer to Section 8.4 Upload to PC, you will see two files in the C:\ECOWWIN\DATA directory; the file you transferred and a file supplied by YSI designated SAMPLE.DAT. This SAMPLE.DAT file is referred to in the remainder of this tutorial section. After following the instructions below for the analysis of SAMPLE.DAT, you apply the same analysis to the data file which was uploaded from your 556 MPS to assure that you are familiar with the basic features and capabilities of EcoWatch for Windows.

To start the analysis of the SAMPLE.DAT file, note that a shortened menu bar is visible and many of the tools in the toolbar appear dimmed or “grayed out” before any file is opened (see below).



Full activation of EcoWatch features will be realized after a file is opened.

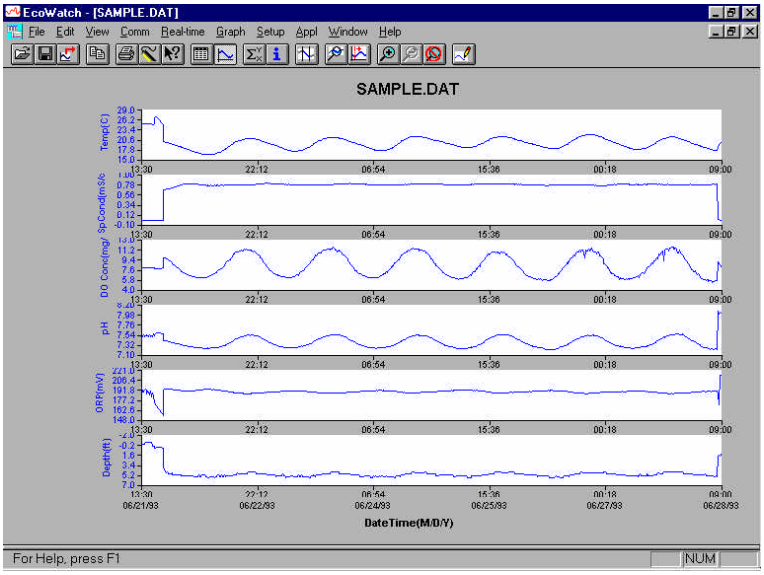
To open the sample data file:

5. 1. Click the **File** menu  button in the toolbar.

6. 2. Select the **SAMPLE.DAT** file.

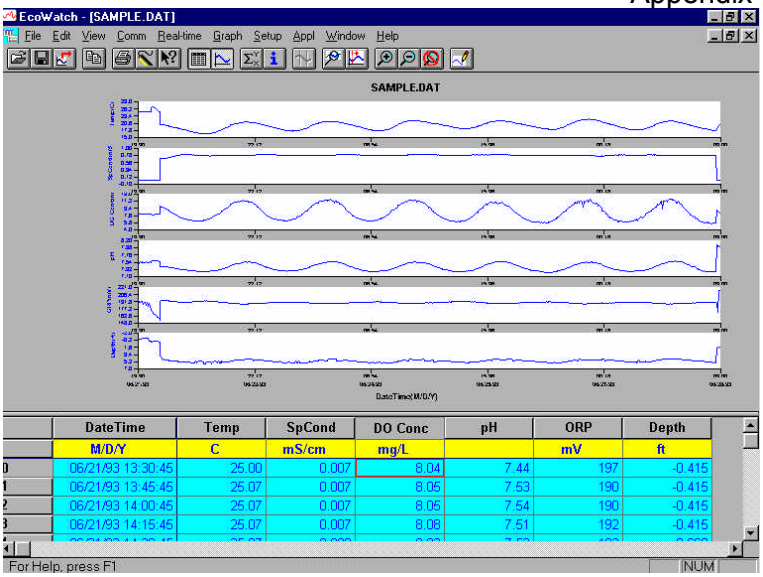
7. 3. Click **OK** to open the file.

The following display will appear:

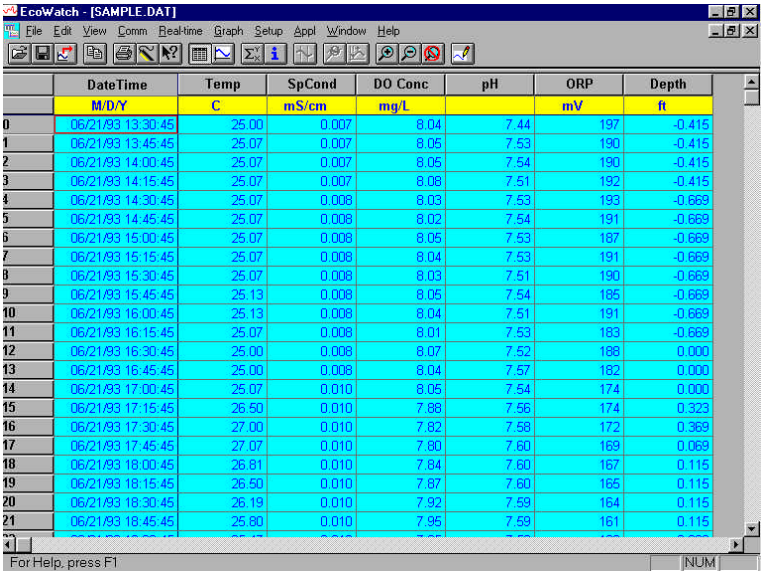


Note that the data in this file appears as a graph of temperature, specific conductance, dissolved oxygen, pH, ORP, and depth, all versus time. The graphs are scaled automatically so that all data fits comfortably on the computer screen. Note also that this data file was obtained with a 6-series sonde for which a depth sensor is available. Depth is NOT a current parameter for the 556 MPS.

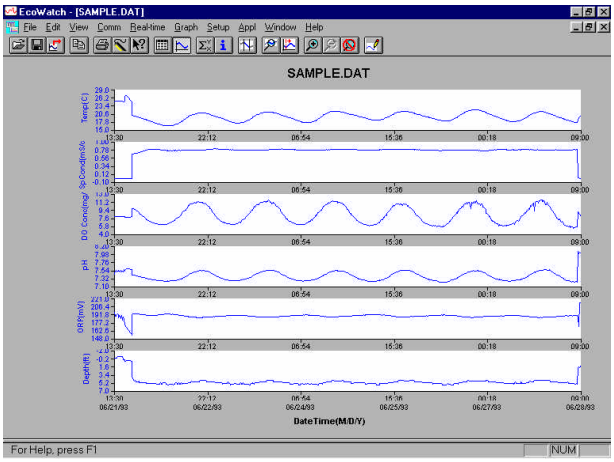
The **Table**  and **Graph**  buttons on the toolbar are on/off switches that are used to display or hide the graph and table pages respectively. When displaying a graph and a table at the same time, you can control the relative size of the two pages by placing the cursor over the small bar that separates them and then dragging it to the desired location. Click the **Table**  button to generate the following dual display of data.



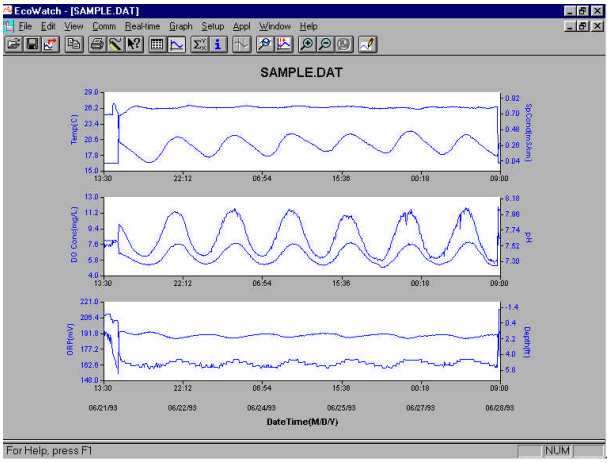
Now click the **Graph** button (turn it off) to display only a report of your data as shown below. Note that the size of the report can be varied by clicking on the and buttons in the Toolbar.



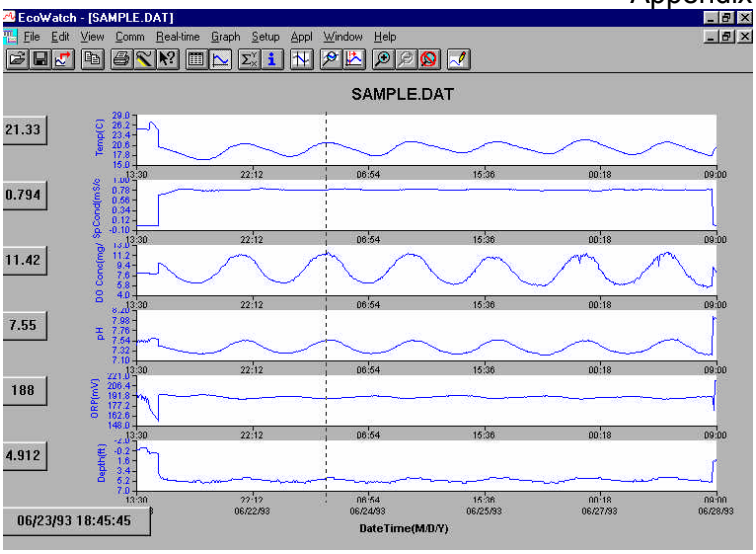
Now return to the original graphic display by toggling the **Table** button "off" and **Graph** button "on".



From the **Setup** menu, click **Graph**. Click **2 Traces per Graph** and notice that the parameters are now graphed in pairs for easy comparison of parameters.

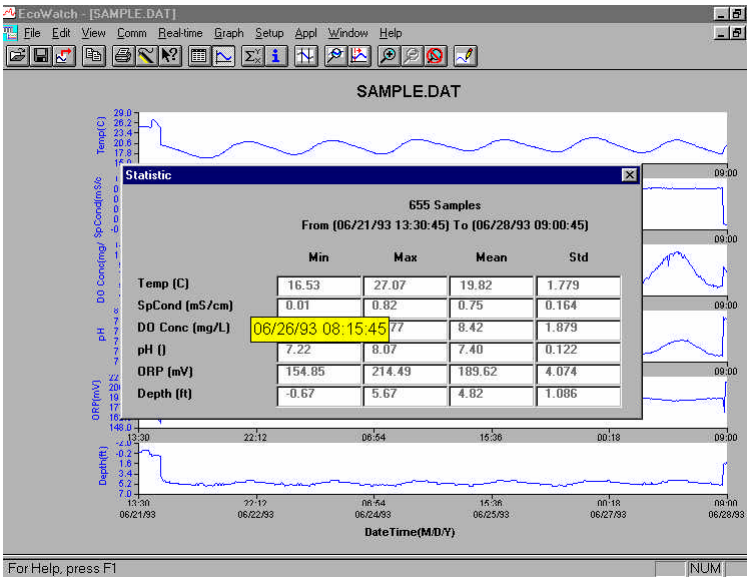


Click **1 Trace per Graph** to return the display to the original setting. Move the cursor to any position in the graph, then click and hold the right mouse button.



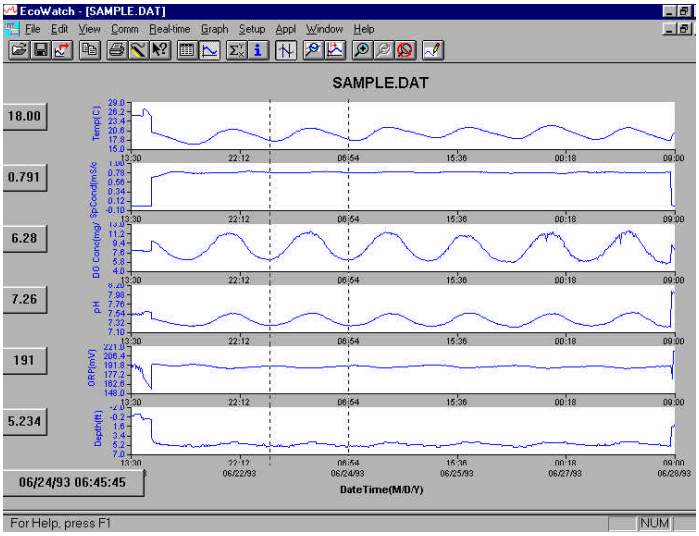
Note that the exact measurements for this point in time are displayed to the left of the graph. While holding down the right mouse button, move to another area on the graph. Notice how the measurements change as you move. When you release the mouse button, the display returns to normal.

To view statistical information for the study, click the **Statistics**  button on the toolbar. On the statistics window, click on any min or max value to display the time when it occurred.

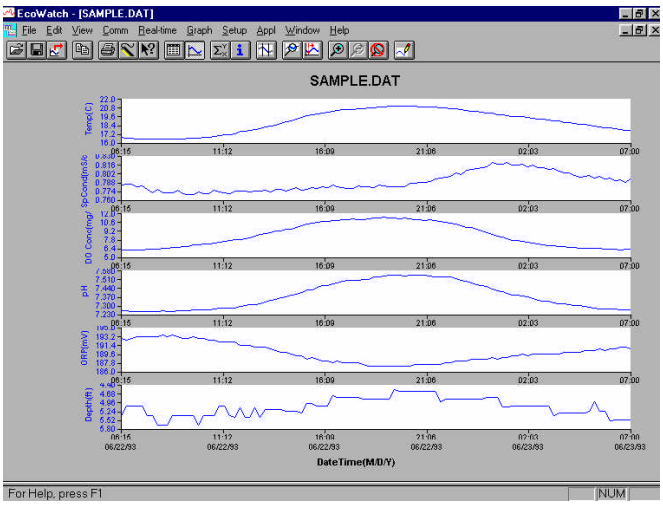


After viewing statistics, click the "x" at the upper right to close the window and return to the normal display.

Now click on the delimiter  icon in the toolbar and then move the displayed icon to the graph. Click at the two points shown by dotted lines in the display below, being sure that the first click is to the left of the second.

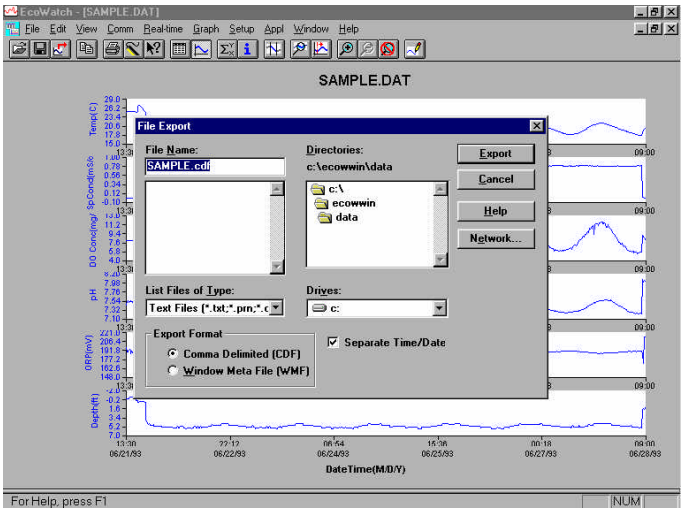


The data between the two selected points will then be graphed in higher resolution as shown below.

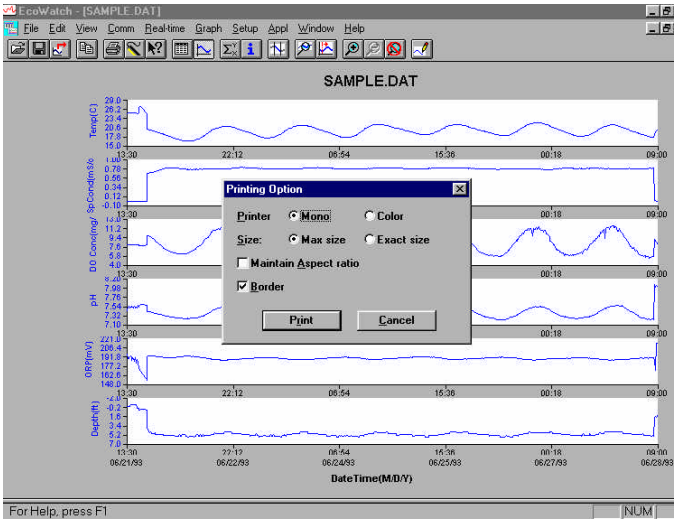


To return to the complete data set, select **Graph** from the toolbar and then click **Cancel Limits**.

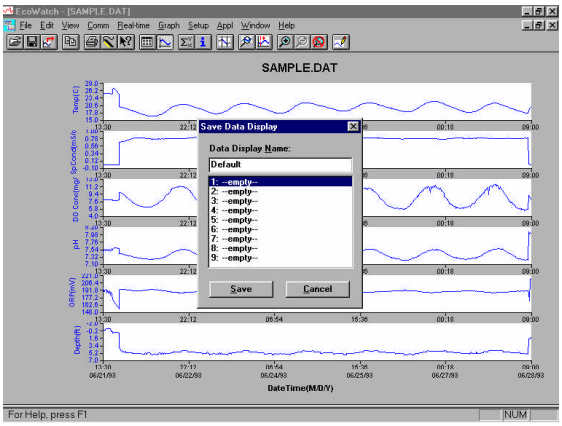
Now select the  icon from the Toolbar to create a new data file which will allow your data to be imported into spreadsheets. Select the default export settings for a Comma Delimited File (.CDF) and click OK. A new spreadsheet-importable file (SAMPLE.CDF) is now present in the same folder as the SAMPLE.DAT file.



Now select the  icon from the toolbar to print the plot. Accept the default settings and click OK to complete the printing operation.



Finally, end the tutorial by saving the **Data Display** in the format shown. From the **File** menu, click **Save Data Display**.



Then type “Default” for the file name and click **Save**. The parameters, colors, format, and x-axis time interval associated with the current display are now saved and can be accessed any time in the future. Nine different data displays may be saved for any data file. You can easily switch between various displays of the data. The data files can be accessed by clicking **Load Data Display** from the file menu and then selecting the desired presentation.

20.2.1 Summary of Toolbar Capability

The EcoWatch toolbar includes buttons for some of the most common commands in EcoWatch, such as **File Open**. To display or hide the toolbar, open the **View** menu and click on the **Toolbar** command. A check mark appears next to the menu item when the toolbar is displayed.

The toolbar is displayed across the top of the application window, below the menu bar.

Click To:

Open an existing data file (.DAT). EcoWatch displays the **Open** dialog box, in which you can locate and open the desired file.

 Save the working Data Display of the active data file. EcoWatch displays the **Save Data Display** dialog box in which you can overwrite existing Data Display or save to a new one.

 Export data as a graph in Window Meta File (.WMF) format or as data in Comma Delimited (.CDF) format.

 Copy the whole graph page or data from the selection on the table to the clipboard.

 Print the active graph page or table page depending on which one is currently active.

 Open a new terminal window to communicate with the sonde.

 Access context sensitive help (Shift+F1).

 Toggle table window during file processing.

 Toggle graph window during file processing.

 Display study statistics.

 Display study info.

 Limit the data to be processed in a study.

 Enlarge a selective portion of graph.

 Center the graph under the cursor.

 Enlarge graph or table 20%.

 Reduce graph or table 20%.

 Return graph or table to its normal state (unzoom)

 Redraw the graph.

20.2.2 Other Capabilities

The above tutorial and function list for the toolbar provide basic information to allow you to view and analyze the field data which was stored in your 556 MPS. Some of the other commonly used capabilities of EcoWatch which the user may want to explore are listed below:

- Customize the units for each parameter, e.g., report uS/cm instead of mS/cm for conductivity.
- Customize the order of parameters in each plot or report.
- Customize the colors and fonts of each data display.
- Manually scale the y-axis sensitivity for each parameter.
- Merging of two or more data files with compatible parameter formats
- View information about the study such as number of points, instrument serial number, etc. which was stored in the 556 with the data.
- Print data reports in different statistical formats.
- Create plots of parameter vs. parameter rather than parameter vs. time.

These additional features of EcoWatch for Windows are explained in detail in the YSI 6-series manual (which can be downloaded at no cost from the YSI Web Site as described above) and the Help selection in the EcoWatch menubar. To purchase a hard copy of the 6-series manual, contact YSI Customer Service using the contact information in *Appendix E Customer Service*.

21.Appendix H Calibration Record Information

When your YSI 556 MPS sensors are initially calibrated, relevant information about the sensors will be stored in a separate file in the YSI 556 MPS memory.

NOTE: This file, by default, will have the name "556 Circuit Board Serial Number.glp." The circuit board serial number is assigned at the factory and has a hexadecimal format such as 000080A4. Thus the default calibration record file would be designated 00080A4.glp. Refer to Section *10.7 GLP Filename* to change the filename.

The information in the calibration record will track the sensor performance of your instrument and should be particularly useful for programs operating under Good Laboratory Practices (GLP) protocols.

21.1 Viewing the Calibration Record (.glp) File

NOTE: Make certain that you have performed a calibration on at least one of the sensors associated with your YSI 556 MPS.

1. Follow the procedures outlined in Section *8.3 View File*.

21.2 Uploading the Calibration Record (.glp) File

NOTE: Make certain that you have performed a calibration on at least one of the sensors associated with your YSI 556 MPS.

1. Follow the procedures outlined in Section *8.4 Upload to PC*.

21.3 Understanding the Calibration Record (.glp) File

1. Open a calibration record file. Refer to Section *8.3 View File*.

2. Use the arrow keys to scroll horizontally and/or vertically to view all the data.

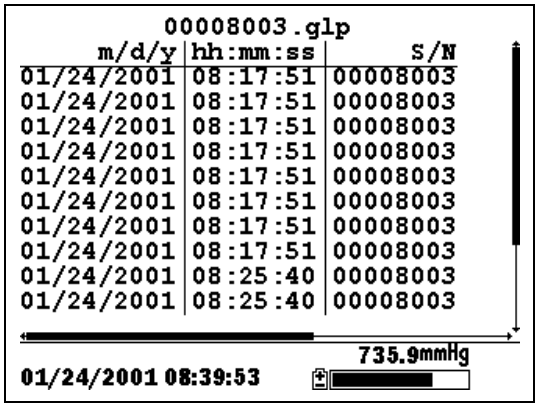


Figure 21.1 Calibration Record Screen 1

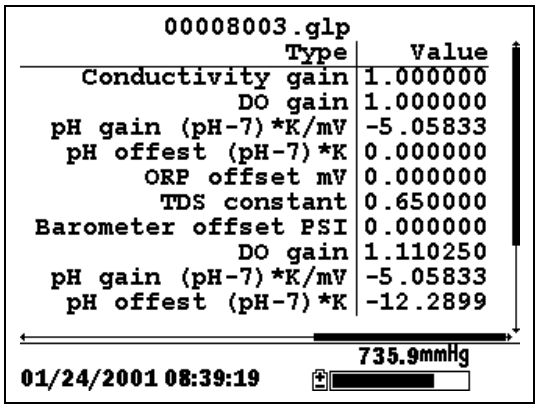


Figure 21.2 Calibration Record Screen 2

NOTE: Each sensor (not parameter) is characterized by either 1 line (Conductivity, Dissolved Oxygen, ORP, TDS, or Barometer (Optional)) or 2 lines (pH) of calibration documentation.

The left hand portion of each calibration entry shows the date and time that a calibration of a particular sensor was performed. In addition, each calibration entry is characterized by the instrument serial number, as defined by YSI. See Figure 21.1 Calibration Record Screen 1. The right hand portion shows the YSI designation of the calibration constants and their values after their calibration has been performed. A more detailed description of the calibration constants is provided below:

- **Conductivity Gain** – A relative number which describes the sensitivity of the sensor. Basically, the value represents the calculated cell constant divided by the typical value of the cell constant (5 cm^{-1}).

- **DO Gain** – A relative number which describes the sensitivity of the sensor. Basically, the value represents the sensor current at the time of calibration divided by the typical value of the sensor current (15 uA).

- **pH Gain** – A number which basically represents the sensitivity of the pH sensor. To remove the effect of temperature on the slope of the relationship of probe output in mv versus pH, the value of pH/mv is multiplied by the temperature in degrees Kelvin (K).

- **pH Offset** – A number which basically represents the offset (or intercept) of the relationship of probe output in mv versus pH, the value of pH is multiplied by the temperature in degrees Kelvin (K).

Anytime you perform a calibration, information concerning the calibration constants will be logged to the Calibration Record file (.glp file). However, if the **Delete All Files** command is used, Refer to Section *8.6 Delete All Files*, the Calibration Record file will also be lost. It is critical that this file should be uploaded to your PC prior to issuing a **Delete All Files** command. Refer to Section *8.4 Upload to PC*.

YSI *incorporated*

YSI Environmental
1700/1725 Brannum Lane
Yellow Springs, OH
45387 USA
937.767.7241
937.767.9353 fax
support@YSI.com
www.YSI.com

YSI Massachusetts
508.748.0366
508.748.2543 fax
support@YSI.com

YSI Environmental Products
European Support Centre
44.1252.541.164
44.1252.371.476 fax
europe@YSI.com

YSI (Hong Kong) Limited
852.2891.8154
852 2834.0034 fax
hongkong@YSI.com

YSI/Nanotech (Japan)
011.81.443.222.0009
011.81.344.221.1102 fax
nanotech@YSI.com

www.YSI.com

A655279B
655279
May 2002

Appendix J

YSI 556MPS Calibration SOP

YSI 556 MULTI-METER QUICK CALIBRATION GUIDE

1.0 GETTING READY TO CALIBRATE

All of the sensors, except temperature, require periodic calibration to assure high performance. Specific calibration procedures for all sensors that require calibration are as follows.

1.1 Containers Needed to Calibrate the Probe Module

The transport/calibration cup that comes with your probe module serves as a calibration chamber for all calibrations and minimizes the volume of calibration reagents required. Instead of the transport/calibration cup, you may use laboratory glassware to perform calibrations. If you do not use the transport/calibration cup that is designed for the probe module, you are cautioned to do the following:

1. Perform all calibrations with the Probe Sensor Guard installed. This protects the sensors from possible physical damage.
2. Use a ring stand and clamp to secure the probe module body to prevent the module from falling over. Most laboratory glassware has convex bottoms.
3. Ensure that all sensors are immersed in calibration solutions. Many of the calibrations factor in readings from other sensors (e.g., temperature sensor). The top vent hole of the conductivity sensor must also be immersed during some calibrations.

1.2 Calibration Tips

1. If you use the Transport/Calibration Cup for dissolved oxygen (DO) calibration, make certain to loosen the seal to allow pressure equilibration before calibration. The DO calibration is a water-saturated air calibration.
2. For maximum accuracy, use a small amount of previously used calibration solution to pre-rinse the probe module. You may wish to save old calibration standards for this purpose.
3. Fill a bucket with ambient temperature water to rinse the probe module between calibration solutions.
4. Have several clean, absorbent paper towels or cotton cloths available to dry the probe module between rinses and calibration solutions. Shake the excess rinse water off of the probe module, especially when the probe sensor guard is installed. Dry off the outside of the probe module and probe sensor guard. Making sure that the probe module is dry reduces carry-over contamination of calibrator solutions and increases the accuracy of the calibration.

1.3 Recommended Volumes

Follow these instructions to use the transport/calibration cup for calibration procedures.

1. Ensure that an o-ring is installed in the o-ring groove of the transport/calibration cup bottom cap, and that the bottom cap is securely tightened.
2. Remove the probe sensor guard, if it is installed.
3. Remove the o-ring, if installed, from the probe module and inspect the installed o-ring on the probe module for obvious defects and, if necessary, replace it with the extra o-ring supplied.

4. Some calibrations can be accomplished with the probe module upright or upside down. A separate clamp and stand, such as a ring stand, is required to support the probe module in the inverted position.
5. To calibrate, follow the procedures in the next section, Calibration Procedures. The approximate volumes of the reagents are specified below for both the upright and upside down orientations.
6. When using the Transport/Calibration Cup for dissolved oxygen % saturation calibration, make certain that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly and that approximately 1/8" of water is present in the cup.

Table 1.3-1 Calibration Volumes

Sensor to Calibrate	**Upright**	**Upside Down**
Conductivity	55ml	55ml
pH	30ml	60ml

2.0 CALIBRATION PROCEDURES

2.1 Accessing the Calibrate Screen

1. Press the **On/off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.
3. Use the arrow keys to highlight the **Calibrate** selection.
4. Press the **Enter** key. The Calibrate screen is displayed.

2.2 Conductivity Calibration

This procedure calibrates specific conductance (recommended), conductivity and salinity. Calibrating any one option automatically calibrates the other two.

1. Go to the calibrate screen as described in Section 2.1 Accessing the Calibrate Screen.
2. Use the arrow keys to highlight the **Conductivity** selection.
3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed.
4. Use the arrow keys to highlight the Specific Conductance selection.
5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed.
6. Place the correct amount of conductivity standard (see Table 1.3-1 Calibration Volumes) into a clean, dry or pre-rinsed transport/calibration cup. For fresh water use a 1 mS/cm conductivity standard **.** Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Be certain that you avoid cross-contamination of solutions. Make certain that there are no salt deposits around the oxygen and pH/ORP sensors, particularly if you are employing standards of low conductivity.
7. Carefully immerse the sensor end of the probe module into the solution.
8. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell. The sensor must be completely immersed past its vent hole. Using the recommended volumes from Table 1.3-1 Calibration Volumes, should ensure that the vent hole is covered.
9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

10. Use the keypad to enter the calibration value of the standard you are using. Be sure to enter the value in **mS/cm at 25 C**.
11. Press **Enter**. The Conductivity Calibration Screen is displayed.
12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
13. Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
14. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen,
15. Press **Escape** to return to the calibrate menu.
16. Rinse the probe module and sensors in tap or purified water and dry.

2.3 Dissolved Oxygen Calibration

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

1. Go to the calibrate screen as described in Section *2.1 Accessing the Calibrate Screen.* The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating.
2. Use the arrow keys to highlight the **DO mg/L** selection.
3. Press **Enter**. The DO mg/L Entry Screen is displayed.
4. Place the probe module in water with a known DO concentration. Be sure to completely immerse all the sensors.
5. Use the keypad to enter the known DO concentration of the water.
6. Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.
7. Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.
8. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
9. Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
10. Press **Enter**. This returns you to the DO calibration screen.
11. Press **Escape** to return to the calibrate menu.
12. Rinse the probe module and sensors in tap or purified water and dry.
13. Using a saturated solution of sodium sulfite, verify that the DO meter reads less than 0.5 mg/L.

2.4 pH Calibration

1. Go to the calibrate screen as described in *Section 2.1 Accessing the Calibrate Screen.*
2. Use the arrow keys to highlight the **pH** selection.
3. Press **Enter**. The pH calibration screen is displayed.
    a. Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this

calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.

b. Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.

c. Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.

4. Use the arrow keys to highlight the **2-point** selection.
5. Press **Enter**. The pH Entry Screen is displayed.
6. Place the correct amount (see Table 1.3-1 Calibration Volumes) of pH buffer into a clean, dry or pre-rinsed transport/calibration cup. For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample. Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.
7. Carefully immerse the sensor end of the probe module into the solution.
8. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor. The sensor must be completely immersed. Using the recommended volumes from Table 1.3-1 Calibration Volumes, should ensure that the sensor is covered.
9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
10. Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**. pH vs. temperature values are printed on the labels of all YSI pH buffers.
11. Press **Enter**. The pH calibration screen is displayed.
12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
13. Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
14. Press **Enter**. This returns you to the Specified Ph Calibration Screen, See
15. Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.
16. Repeat steps 6 through 13 above using a second pH buffer.
17. Press **Enter**. This returns you to the pH Calibration Screen,
18. Press **Escape** to return to the calibrate menu.
19. Rinse the probe module and sensors in tap or purified water and dry.