DEP #2003-04/604

Sampling and Analysis Plan

South Coastal Basin Estuaries Monitoring

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Submitted to:

MA Department of Environmental Protection

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For:

Town of Kingston
Town of Duxbury
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MA DEP 604(b) Program

Sampling and Analysis Plan

South Coastal Basin Estuaries Monitoring

Submitted to: MA Department of Environmental Protection

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1.0 BACKGROUND AND OVERVIEW:

The project goal is to collect and analyze water samples and associated field parameters relevant to the nutrient related water quality of the Plymouth Harbor-Duxbury Harbor-Kingston Bay System and adjacent Ellisville Harbor. This water quality monitoring effort is a collaborative effort between the Towns of Kingston, Duxbury, and Plymouth whereby each Town fields a water sampling team trained and coordinated by University of Massachusetts – Dartmouth, School of Marine Science and Technology (SMAST), Coastal Systems Laboratory personnel under the direction of Paul Henderson (field oversight) or Dale Goehringer (logistics coordination). Each water sampling team is responsible for collection of water samples at assigned sampling stations with logistical support by SMAST. Personnel from the Coastal Systems Laboratory within SMAST is also involved in the field sampling in order to assist in the collection of samples and insure proper transport and delivery of samples to the Coastal Systems Laboratory. Upon delivery of water samples to the Coastal Systems Laboratory and processing and prior to any data reporting, water quality data will be reviewed for quality assurance and control by Dr. Brian Howes to assure that the data meets SMAST Quality Assurance requirements. At this stage, the source identity of blind duplicate samples will reside solely with Dr. David White, Project QA Officer. The resulting data will then be evaluated by Dr.s White and Howes to compare blind duplicate results with their source samples to assess the accuracy of the lab analyses.

This water quality data is required for application of the Linked Watershed-Embayment Approach of the Massachusetts Estuaries Project (MEP). All embayments undergoing MEP analysis require a minimum of three years of high-quality water chemistry and field data related to nitrogen dynamics. Although there is some existing water quality data that may be incorporated into the Estuaries Project approach, a complete water quality monitoring effort must be implemented in order to satisfy the full water quality monitoring data requirements of the MEP. In order to bring Plymouth Harbor, Duxbury Harbor, Kingston Bay, and Ellisville Harbor to the point where they can enter the Estuaries Project and receive the intensive scrutiny necessary for full evaluation of protective measures, the Towns received DEP 604(b) funding support for collection, processing and analyses of water samples from the overall embayment system. A locus map is provided as Figure 1.

Samples and field data will be collected from 15 marine and 4 stream sample stations in the Plymouth/Kingston/Duxbury system and 6 marine and 2 stream sample stations in the Ellisville Harbor system, during 6 sample rounds from June through mid-September, 2003 and 2004. The data will be incorporated into a report describing the sampling undertaken, data in tabular format, discussion of water quality trends, flow and nutrient loads from freshwater inputs, and a discussion of seasonal differences. A summary will be provided describing the general state of each system for which water quality data was collected. All lab analyses will be performed at the Coastal Systems Analytical Facility within the University of Massachusetts School of Marine Science and Technology (New Bedford, MA) under their laboratory SOP and Quality Assurance Plan procedures. This document is intended to provide specific details of the sampling locations, sample collection, handling and shipping procedures as well as the use of field equipment for collection of temperature, dissolved oxygen, specific conductivity and GPS locations. Additional

details are provided in the Massachusetts Estuaries Project (MEP) QAPP, approved 13 June 2003 in Appendix B-1 (Field Protocols and Data Sheets).

Marine stations will be sampled at approximately two-week intervals during the falling tide (targeting the 2 hours before and after mid-ebb) during the early morning hours (6-9 A.M.). Streams with tidal influence will be sampled at ebb slack tide, independent of time of day. Sampling is conducted June through mid-September in order to focus on what is typically the period of poorest nutrient related water quality. Sample stations will be located in the field with Global Positioning System (GPS, see detail below) and on-shore landmarks during an initial survey with SMAST staff. The GPS coordinates and visual references will be provided to each sampling team. Each sampling team will have a GPS unit. Locations will be selected by concensus between the Town representatives and SMAST personnel to insure that data coverage is sufficient for MEP numerical modeling.

At each marine sampling location, a water sample will be collected for dissolved oxygen by Winkler titration (Hach or YSI 85 meter, see detail below), temperature and salinity/specific conductance. Sampling teams with SMAST Staff aboard will use the YSI for profiling of D.O.

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Towns of Plymouth, Kingston, and Duxbury

SMAST University of Massachusetts Dartmouth The School for Marine Science and Technology

Figure 1

and temperature and specific conductance (1 meter intervals), the other teams will collect water with a Niskin sampler for titration for D.O. and temperature by dial thermometer (Surface and Bottom). The Secchi disk will be used to determine light penetration at each site. Standard data sheets will be used for this information as well as to record weather conditions and the presence of any unusual natural phenomena such as jellyfish, rafts of algae, large numbers of waterfowl etc. Water samples will be collected using a 2.2 liter Niskin Sampler at mid water depth, generally 1.5 to 5 m in Plymouth/Duxbury Harbor System and 0.5 – 1.0 m in the Ellisville Harbor System. Both systems have significant tidal ranges relative to their high tide water depths, with the result that stratification is not anticipated. If stratification is encountered, then the sampling will shift to 0.15 m (surface) and 0.5 m above bottom, but this is unlikely. Whole water samples (1L) and filtered (0.45 um, Geotech) water (60 mL) are collected at each sampling site and immediately placed in a cooler on ice until arrival at the SMAST Laboratory, generally less than 6 hours (maximum).

At each stream sampling location, weekly water quality samples will be collected for the duration of stream gage deployment (approximately 16 months). Samples will be collected by SMAST staff at slack low tide based upon records at the nearest tide gage (Plymouth Harbor) will be used to determine the lag between the time of low tide in the harbor and zero tidal effect at the stream gauge. The time difference will be determined for each stream gauge placed by SMAST at each stream location (PDH 16-19, EVH 1-2). Whole water samples (1L) and filtered (0.45 um, Geotech) water (60 mL) are collected at each stream sampling site and immediately placed in a cooler on ice until arrival at the SMAST Laboratory, generally less than 6 hours (maximum). Additionally, one unfiltered 60 mL bottle of water is collected at each stream site for analysis of total phosphorous.

All water samples and data sheets will be transported by SMAST staff with a Chain of Custody Form to the Coastal Systems Analytical Facility at SMAST. Upon arrival to the laboratory samples will be checked in by the laboratory manager or his designee and the Chain of Custody signed off. The laboratory will conduct all of the chemical analyses: nitrate+ nitrite, ammonium, particulate and dissolved organic nitrogen, and ortho-phosphate, chlorophyll *a* and pheophytin, particulate carbon for all samples. Stream samples will also be assayed for total phosphorus. Responsibility for oversight of sample collection, processing, handling and shipping will be the responsibility of the Project Manager (Dale Goehringer), with training and field coordination by the Analytical Facility Manager (Paul Henderson). All chemical laboratory analyses will be performed at the School for Marine Science & Technology Coastal Systems Analytical Facility (Dr. Brian Howes, Program Manager and Paul Henderson, Analytical Facility Manager, 508-910-6352).

2.0 DATA TO BE COLLECTED:

Lab methodology is contained within the SMAST Laboratory SOP and Quality Assurance Plan, Section B.1 (Review of Nitrogen Related Water Quality Monitoring Data). Sample collection and processing methodology is described in detail in Sections 3.0, 5.0 and 6.0.

2.1 Lab analyses planned:

Marine (M) and stream (S) water samples collected under the 604(b) grant will be analyzed at the Coastal Systems Analytical Facility for the following constituents:

- Nitrate + Nitrite (M,S)
- Ammonium (M,S)
- Ortho-phosphate (M,S)
- Total phosphorus (S)
- Particulate Carbon (M,S)
- Particulate Nitrogen (M,S)
- Dissolved Organic Nitrogen (M,S)
- Chlorophyll *a* & pheophytin *a* (M,S)
- Specific Conductance (M,S)

2.2 Blind Duplicate Samples:

To assess lab performance and provide confidence in the results, a blind duplicate sample will be sent along to the lab for analysis with each batch of 20 samples. The blind sample will be drawn from, handled and processed as the source sample and numbered in sequence with the actual samples. A logbook will be kept identifying the actual source of each blind sample to allow comparison of the results. Additional details are provided in the MEP QAPP Section B.1.1 (Data Quality Objectives).

2.3 In the field:

Field teams with SMAST Staff will use an YSI 85 meter and probes for collection of profile data at 1-meter intervals for dissolved oxygen and temperature and specific conductance. Other field teams will assay water samples collected by Niskin sampler from surface (0.15 m depth) and bottom waters (0.5 m off bottom) for dissolved oxygen by Winkler titration (Hach, 0.5 mg/L) and temperature using a dial thermometer. Though the YSI 85 meter is capable of measuring specific conductance and salinity, this parameter is not measured in the field but rather, specific conductance and salinity of samples are measured in the lab. Additionally, sampling teams will make secchi depth measurements as described in section 5.0 (MEP Field Sampling Protocols) of this SAP.

3.0 SAMPLE COLLECTION:

3.1 Personnel:

Samples and field data will be collected by designated teams of samplers from the Towns of Plymouth, Kingston and Duxbury. The sampling teams will be trained and supervised by SMAST personnel under the direction of Paul Henderson (field oversight) or Dale Goehringer (logistics coordination). Each Town has assigned a point of contact responsible for coordinating a team of samplers tasked to sample designated stations as follows:

- Town of Duxbury – Ron Maribett (with field assistance from Jen Antosca - SMAST)
- Town of Kingston – Pine DuBois
- Town of Plymouth – Wendy Garpow (with field assistance from Paul Henderson, SMAST)

All sampling personnel will be trained by, SMAST Technical Staff assisting Dr. Brian Howes to assure that the sample collection and handling procedures are followed. All personnel will be provided with a copy of the relevant pages from this document that describe the methodology to be followed.

3.2 Materials:

One liter high density polyethylene (HDPE) bottles for initial sample acquisition and for particulate and chlorophyll *a* assays and 60 milliliter dissolved nutrient sample bottles will be provided by the SMAST lab. Carbon-clean glass fiber filters for particulate analysis and nitrocellulose filters for chlorophyll *a* analysis will also be provided by SMAST. Cellulose acetate filters required by SMAST for preparing dissolved nutrient samples will be provided by SMAST. YSI 85 meters will be provided by SMAST and will be calibrated and maintained by SMAST.

4.0 EMBAYMENT-WIDE SAMPLING:

All portions of the overall Plymouth/Kingston/Duxbury embayment system, including Ellisville Harbor, proposed for sampling within this project are tidal except for associated stream gauging/water quality sampling stations. All portions of the embayment system will be sampled from a boat except for streams that will be waded from downstream direction. The sample station locations shown in Figures 2 and 3 are approximate until they are refined with GPS in the field to obtain exact locations. The location of two stations is meant to coincide with sample sites used in previous studies (PDH1, PDH3). However, most of these stations were located without benefit of GPS and for those two stations, this study will utilize USGS maps or other paper maps within reports to identify and duplicate previous stations. All stations identified will be sampled for the parameters outlined in items 2.1 and 2.3.

4.1 Plymouth Harbor:

Samples collected from this embayment will be labeled with the identifier “PDH”. This is a unique identifier for an embayment within the Coastal Systems Program Analytical Facility. This portion of the overall embayment system is separated to the east from Plymouth Bay by a barrier beach (Plymouth Beach). In addition, Plymouth Harbor has a direct connection to Kingston and Duxbury bays via a tidal channel. Plymouth Harbor receives ebb tidal waters from Plymouth Bay, Duxbury Bay and Kingston Bay. The pond has a tide range of 8 to 10 feet.

The bathymetry of the bay as depicted in the USGS topographic map shows a maximum depth of 14 feet at mean low water. Five sample stations are proposed and are shown in Figure 2 including:

- The head of Plymouth Harbor: PDH-1

- Within the breakwater: PDH-2
- The main channel to the breakwater: PDH-3
- Between High Cliff and White Flat: PDH-4
- The entrance to Goose Point Channel: PDH-5

The Eel River is being gauged at the mouth just prior to discharging into Plymouth Harbor. The gauging location is non tidal and also being used as a weekly water quality sampling station. The gauging station identification name is PDH-18. There is a second gauging location further up in the Eel River watershed down gradient of Russell Mill Pond where the Eel River crosses under Old Sandwich Road. This gauging location is operated by the Massachusetts Riverways Program and is being referred to as PDH-19 for the purposes of this project. Weekly water quality samples will also be collected from this gauging location.

4.2 Kingston Bay:

Samples collected from this system will be labeled with the identifier "PDH". This tidal portion of the overall embayment system is situated in the Town of Kingston. The bay has a tide range of 8 to 10 feet.

Maximum depth is expected to be no greater than 25 feet in the main channel and 2 to 10 feet in the body of the bay. Kingston Bay is extremely tidal with large portions of the bay being characterized as inter-tidal flats. Five sample stations are proposed and are shown in Figure 2 including:

- In the main channel at its entrance: PDH-6
- Off Rocky Nook: PDH-7
- In north tributary channel off Goose Point: PDH-8
- The mouth of the Jones River: PDH-9
- The mouth of Kingston and Duxbury Bays off Duxbury Pier Lighthouse: PDH-10

The Jones River is being gauged at the pump station just prior to the Jones River crossing under Route 3A in Kingston. The gauging location is non tidal and also being used as a weekly water quality sampling station. The gauging station identification name is PDH-16.

4.3 Duxbury Harbor/Bay:

Samples collected from this system will be labeled with the identifier "PDH". This portion of the overall embayment system is located in the Town of Duxbury. The tide range in the bay is approximately 8 to 10 feet.

The bay is shallow, generally less than 10 feet except in the main navigational channels where depth ranges from 15 to 25 feet. Duxbury Bay is extremely tidal with large portions of the bay being characterized as inter-tidal flats. The proposed sample stations are shown in Figure 2, including:

- In the entrance to the main channel (Cowyard): PDH-11

- Northeast of Clarks Island: PDH-12
- In the central portion of Duxbury Bay: PDH-13
- South of Long Point in open water: PDH-14
- At the mouth of Back River: PDH-15

The Town Brook is being gaged south of Arms House Pond just prior to the Town Brook crossing under Route 3A (Sandwich Road) in Plymouth. The gaging location is non tidal and also being used as a weekly water quality sampling station. The gaging station identification name is PDH-17.

4.4 Ellisville Harbor:

Ellisville Harbor is a separate embayment located south of the Plymouth/Kingston/Duxbury embayment system. Ellisville Harbor is located in the Town of Plymouth east of Route 3A and discharges to Cape Cod Bay. The tide range is between 8 to 10 feet. The Ellisville Harbor system is shallow, being less than 6 feet throughout. Samples collected from this system will be labeled with the identifier "EVH" and are shown in Figure 3. Sample stations are located as follows:

- Main channel: EVH-3, 4, 5, 6.
- Offshore Reference Station: EVH-7
- Tributary channel down gradient of cranberry bog: EVH-2.
- Freshwater input to Ellisville Harbor: EVH-1

Figure 2. Plymouth Harbor, Duxbury Harbor, Kingston Bay sampling station locations

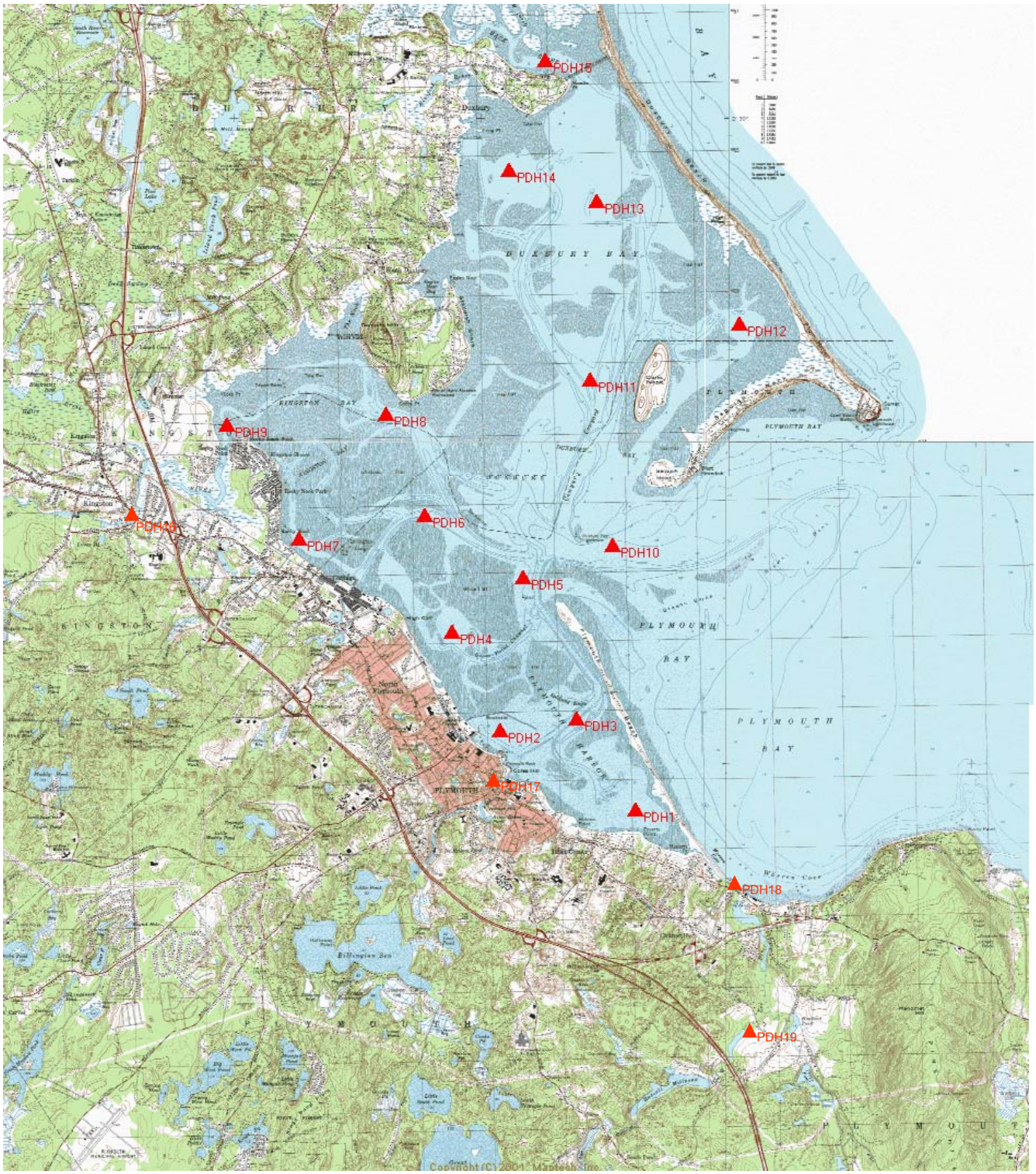
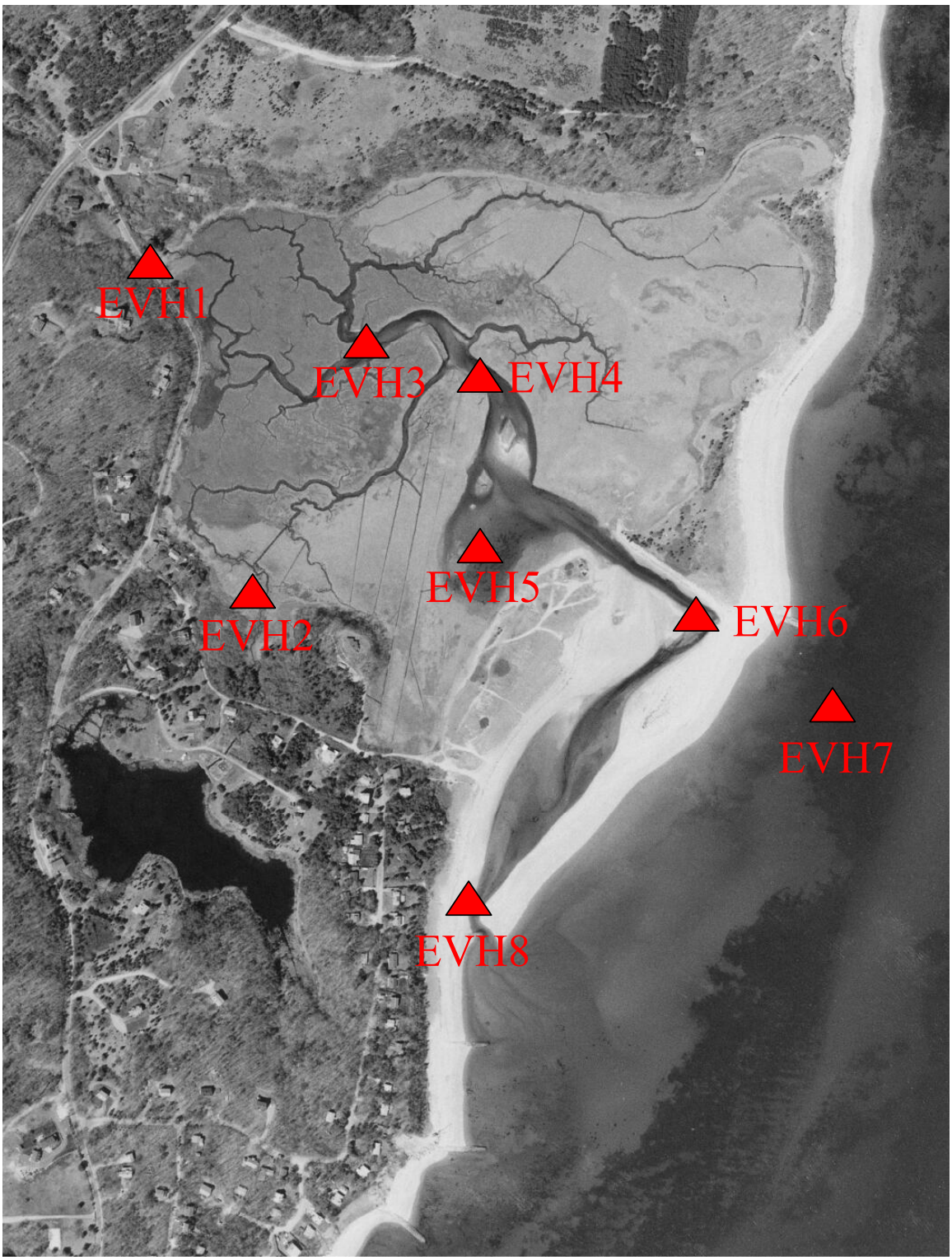


Figure 3 Ellisville Harbor sampling station locations



Summary Table of Parameters to be Analyzed within Marine and Freshwater Systems

Location	Station I.D.	Dissolved Nutrients	Particulate Nutrients	Chlorophyll /Pheophytin	Total P	Field Parameters
MARINE						
Plymouth Harbor	PDH 1 – 5	X	X	X		X
Kingston Bay	PDH 6 – 10	X	X	X		X
Duxbury Harbor/Bay	PDH 11 – 15	X	X	X		X
Ellisville Harbor	EVH 3 – 8	X	X	X		X
FRESH						
Jones River	PDH16	X	X		X	
Town Brook	PDH17	X	X		X	
Eel River	PDH18-19	X	X		X	
Ellisville Crk	EVH 1	X	X		X	
Ellisville Bog	EVH2	X	X		X	

Dissolved parameters: (measured in the lab) nitrate+nitrite, ammonium, dissolved organic nitrogen, specific conductance, salinity, and orthophosphate.

Particulate parameters: particulate carbon and particulate nitrogen

Total P (Total phosphorus): this analysis will be performed on samples from selected stations as identified

Field parameters: Dissolved oxygen (saturation and milligrams per liter), temperature, secchi depth

5.0 MEP FIELD SAMPLING PROTOCOLS: NUTRIENTS

5.1 Nutrient Sample Collection Overview (MEP QAPP Appendix B-1, H)

The goal of the Water Quality Monitoring Program is to provide needed data with which to evaluate overall water quality conditions in nearshore waters and harbors. These waters are most likely to be impacted by excessive nutrient loading originating from local land use. Because of the value of this data, it is very important that measurements are made using the protocol provided and that collections occur during the last three hours of an outgoing tide. Through training sessions, hands-on instruction and sampling tips, we will provide you with the information necessary to ensure efficiency and accuracy in the measurements. Please call (Paul Henderson) 508-910-6352) if you have any questions and note any problems on the data sheet.

In addition to nutrient sample collection and filtering, the following measurements need to be taken at each station: dissolved oxygen (milligrams per liter), water temperature, salinity, water clarity (Secchi disk) and total depth. Samples collected for nutrients will be analyzed at the SMAST laboratory for:

Ammonium	Nitrate+Nitrite	Particulate Organic Nitrogen
Ortho-Phosphate	Chlorophyll a & pheophytin a	Particulate Organic Carbon
Dissolved Organic N	Total Phosphorus (streams)	Specific Conductance

5.2 Arriving On Station

The on-shore landmarks will be used to approximate sample station location, with final sample station determined by GPS. However, it is anticipated that, for the stream stations and nearshore marine stations, that landmarks or navigational bouys will provide sufficient location information once sampling is underway. All stations will be located by GPS so that future sampling programs can easily return to them. The boat will be anchored so that it remains in a fixed position while samples are collected and profile readings taken. The boat should approach the sample location moving into the current to minimize sediment disturbance for all sample stations but particularly for shallow stations (anticipated water depth less than 1 meter).

5.3 Order of Data Collection on Station

In order to avoid bottom disturbance, the following data collection order will be followed:

- Use Secchi disk to determine light penetration and to determine exact depth from stern of boat and wait until after touching bottom (5 minutes) before proceeding
- Collect meter data in vertical profile using depth information to collect data to within 0.5 meters of the bottom (from side or bow of boat)
- Collect water samples (from the side or bow of boat)

5.4 General Information and Weather Conditions (Appendix A also MEP QAPP Append B-1 H)

The following parameters will be recorded on the data sheet:

*Time of nearest low tide from tide table and whether the tide is ebbing (approaching low) or flooding (approaching high)
*Wave conditions - see Beaufort scale
*Wind direction - the direction the wind is coming from
*Weather conditions
*Rainfall in last 24 hours (collected by SMAST from KPYM weather station located at Plymouth Municipal Airport, Lat. 41 54 31N Lon. 070 43 41 W 43min.).
* Any unusual natural or man-made conditions.
*Fill out each field data sheet with the pond, station number, time, cloud cover and wind direction and speed and wave height if it has changed from the previous station.

5.5 Secchi Depth / Total Depth (Appendix A also MEP QAPP Append B-1 H)

These readings should be taken over the shaded side of the boat and without the aid of polarizing sunglasses.

Step 1. Lower Secchi disk into water slowly from shady side of a boat, dock or pier until it just disappears from view. Raise and lower slightly to insure the proper average depth of disappearance.
Step 2. Read depth on tape where it intersects the water surface, record on data sheet. *Note: Sometimes the Secchi disk will hit the bottom before it disappears — in this case write "visible on bottom" or "vis/btm" on disk depth on data sheet.*
Step 3. Lower Secchi disk slowly until it touches bottom, record station total depth.

5.6 Dissolved Oxygen, Field Data Collection with YSI-85 Multi-Parameter Meter

The meter is calibrated each day on shore before starting the sampling. Calibration is described in Appendix B. Once calibrated, the meter should be left on throughout the course of the sampling day. If turned off, it must be re-calibrated for Dissolved Oxygen prior to proceeding with data collection. The meter provides readings of four parameters with six pieces of information: dissolved oxygen percent saturation, dissolved oxygen milligrams per liter, conductivity, specific conductivity, salinity and temperature. When arriving on station, once the boat is secured with the anchor, remove the probe from its protective housing and place it into the surface water to allow it to equilibrate with the surface water temperature. Water depth will initially be determined with a Solinst depth-sounding device to avoid disturbance of the sediment. After meter readings and water sample collection, the Secchi readings will be taken and the marked cable used to determine the exact depth.

The meter data should be collected in the same order as listed above at each depth interval. Record the data on the field data sheets. The meter cable is marked in one-meter intervals. At each depth, the probe should be moved in an up and down manner over a distance of several inches to circulate pond water over the probe. Wait to record data until the reading for each parameter has stabilized. Data should be collected at the surface (at a depth of 6 inches) and then at one-meter intervals to the bottom reading at less than one-half meter above the sediment. If the water depth is one meter or less, readings should be taken at the surface and at one-half meter and near the bottom.

If the D.O. reading from the YSI 85 is less than 5 mg/L, collect a water sample for dissolved oxygen by Winkler analysis.

When the data collection is completed, retrieve the probe and insert it in the protective housing. Do not shut the meter off until the last station readings are completed.

5.7 Dissolved Oxygen, Water Sampling and Processing

Note to YSI meter Teams: If the D.O. reading from the YSI 85 is less than 5 mg/L, collect a water sample for dissolved oxygen by Winkler analysis, that sample will be collected first. All other Teams collect Winkler D.O. samples at each location.

First: Following the protocol below, fill glass O_2 reagent bottle from blue oxygen kit:

Step 1. Label one 300 mL glass Winkler bottle with station I.D., date, and depth.
Step 2. Using Niskin Bottle collect sample from depth and bring to surface.
Step 3. Remove glass stopper from 300 mL Winkler bottle
Step 4. Lower rubber tube from Niskin Bottle to the <u>bottom</u> of the glass reagent bottle from the blue oxygen kit.
Step 5. Drain ¾ of the Niskin Bottle through the glass Winkler bottle, overflowing the glass bottle.
Step 6. Gently tap glass bottle to insure that no bubbles stick to sides.
Step 7. As volume reaches ¾ of the Niskin, slowly remove the rubber tube from the glass bottle and then carefully insert glass stopper so as not to trap any bubbles. Dropping glass stopper in from above works best.

Now: Continue the dissolved oxygen analysis instruction below:

Step 8. Open Reagent packet #1 (use the scissors in your kit);
Step 9. Open Reagent packet #2
Step 10. Remove glass stopper from glass oxygen reagent bottle;
Step 11. Pour Reagent #1 into bottle and then add reagent packet #2 to bottle.
Step 12. Replace glass stopper, <u>careful not to trap bubbles</u>.
Step 13. Shake bottle vigorously holding bottle and stopper (some reagent may stick to bottom of bottle…this is O.K.).
Step 14. Let stand 2 minutes, shake again.

After a total of 5 minutes (when the chemical floc has settled the second time and there is a clear division), open Reagent packet #3, remove glass stopper, add powder to bottle, replace stopper (no bubbles), shake vigorously until water in bottle becomes clear (no #3 particles). *THE SAMPLE IS FIXED NOW CAN BE FIELD TITRATED.*

Step 15. Using small clear plastic tube and square glass bottle from oxygen kit, rinse tube with sample and discard. Then place two tube-fulls of sample in glass jar. When filling tube with sample make sure there is no bulge on top of vial.

Step 16. Using the eyedropper in the brown plastic bottle in kit (do not get on hands). **Hold the dropper vertically**, add 1 drop to the square glass jar and swirl. Continue to add drop by drop and swirl each time(about 10 seconds between drops) until the yellow color goes away. **DO NOT ADD DROPS TOO FAST!** At the point you think color is gone add one more drop to check; often the eye is fooled by the color (hold up to white background to check).

Step 17. Record the number of drops to turn clear; don't count the extra drop added as a check unless it was needed (1 drop = 0.5 mg O_2/Liter). Surface samples usually take 14-15 drops to turn clear. Collect and save oxygen waste in a waste bottle, which will be collected at the end of the final sampling. Rinse glass bottle, plastic tube, and dropper with distilled or tap water when done.

5.8 Nutrient & Chlorophyll Sample Collection Protocol (MEP QAPP Appendix B-1, H)

Sample collection should proceed in the up-current or up-wind direction from the meter readings and only after any suspended bottom sediments have settled. You will perform each of these steps at each station in your embayment beginning in the inner portion and moving outward (toward the inlet). Samples are collected by Niskin Bottle. A surface sample will be collected at every station at 15 cm below the surface at pre-selected depths where required with the bottom sample 50 cm above sediment surface (be sure not to hit the bottom).

MAKE SURE ICE IS IN COOLER

a) Label one 1 liter nutrient (white) bottle and one 1 liter chlorophyll (brown) bottle with station I.D., date, depth, and time of collection).

b) Lower Niskin Bottle to 15 cm below the surface and pull stopper, bring to surface, shake and dump to rinse bottle; reset and repeat. If a sample is collected for dissolved oxygen Winkler analysis, that sample will be collected first and processed as in Section 5.7, above.

c) Add about 50 mL to 1L nutrient (white) bottle, cap, shake and dump out, repeat. Then fill bottle to shoulder then put in cooler, and shut cooler lid.

d) Repeat rinse and filling procedure with 1 liter brown Chlorophyll bottle, cap and put in cooler. Shut cooler.

PUT NUTRIENT AND CHLOROPHYLL SAMPLES IN COOLER IMMEDIATELY

e) Move to next station, repeat.

Note: Surface samples can be taken by hand if desired. If taking samples by hand you must hold the open bottle in an inverted vertical position while submerging to the desired depth and then tip upright to fill.

6.0 FIELD SAMPLE PROCESSING (on station filtering)

Samples will be prepared for dissolved nutrient analyses by filtration. This process will be done by sampling teams in the field as described in item 6.1.

Dissolved Nutrient Analyses (MEP QAPP Appendix B-1, H)

Samples for dissolved nutrient analyses will be filtered through a 0.25-micron cellulose acetate filter 47 millimeters in diameter into a 60 cc acid-leached plastic bottle.

- TO BE DONE AS SOON AS POSSIBLE AFTER COLLECTION (<1 hr)
- Filtered samples are to be shipped in the small white 60 cc plastic bottle (these bottles are acid leached and provided by SMAST)

Procedure (MEP QAPP Appendix B-1, H):

1. Remove white 1 liter sample bottle from cooler, one station bottle at a time.
2. Label a 60cc bottle with identical station information:
   a. Embayment abbreviation name
   b. Station ID
   c. Sample Depth (in meters)
   d. Date (mo/dy/yr)

3. Place filter (using provided forceps) in clear plastic filter holder. (white filter, not the blue paper).
4. Vigorously Shake 1-liter nutrient (white) sample bottle (in case of particulate settling) and fill 60cc syringe with water from bottle by removing plunger and pouring in, replace plunger.
5. Attach filter (cup side up) to syringe (most filter holders have an arrow drawn on side indicating the direction of flow) and push through and discard the first approx. 30 cc of water through the filter.
6. Push next 20 cc – 30 cc of water through the filter into the small 60 cc sample bottle, replace cap, shake and discard water.
7. Now refill syringe, **attach to filter** (cup side up) and collect all water through the filter into the now rinsed bottle until bottle is full to shoulder, **taking care that no unfiltered water drips into sample**, Fill bottle to top leaving only a small (2-3 ml) bubble, cap and put on ice.
8. Cap 1-liter nutrient (white) sample bottle with the remaining water, check label and put on ice. The bottle must be at least ¾ full to be used for analysis.
9. Remove used white filter paper and discard.

10. Repeat steps a) through h) for each 1 liter nutrient (white) sample bottle.

The samples must remain in the dark and cold. Keep cooler lid closed.

7.0 SHIPPING AND HANDLING

All samples will be transported by SMAST involved in the field program. The SMAST person transporting the samples will check the Chain of Custody and verify that the samples are as stated before accepting them for transport. Samples will be transported the same day as collection to arrive within 8 hours of collection in the case of morning sampling and the following morning within 12 hours of collection in the case of afternoon sampling. After collection, samples will be kept continuously on ice or in refrigeration. Samples will be shipped in heavy-duty styrofoam coolers with ice or cold packs adequate to maintain cold internal temperatures. All shipments will be accompanied by a Chain of Custody (sample in Appendix A).

8.0 DATA REVIEW

The lab data will be reviewed by Dr. Brian Howes to assure that the data meets SMAST Quality Assurance requirements. At this stage, the source identity of blind duplicate samples will reside solely with Dr. David White, Project QA Officer. The resulting data will then be evaluated by Dr.s White and Howes to compare blind duplicate results with their source samples to assess the accuracy of the lab analyses.

Lab results will be scrutinized both for each station over the course of the sampling program and for all stations within the embayment system during each sampling round. The data will be compared to identify suspicious outliers that will be assessed first by examining the lab accuracy for that date and then by considering the setting at the sample site to determine any unique conditions that might cause the observed results. Possible causative factors for data outliers are anticipated to include: proximity to a fresh water discharge; location within a poorly circulated recess of the estuary; recent rainfall; handling or collection errors; and lab error as indicated by blind duplicate results for that date.

Record keeping of Quality Assured (QAed) data will follow the Coastal Systems Program Analytical Facility Laboratory Quality Assurance Plan which has been submitted and accepted by the MA DEP and is available for DEP internal use only. Hard copy data such as raw data books, field data sheets, and chain of custody forms are all held by the Laboratory Manager in data notebooks. Analytical data sheets, field data sheets, COC's, electronic spreadsheets, calculation sheets are annotated with personnel's name and date when they were created and modified (when and by whom). Electronic databases are held both on the access protected hard drives of the Laboratory Manager and/or the QA Manager. In addition, immediate backup is held on the SMAST central computer which is maintained by professional full-time CIT staff. CD copies are also generally created for larger projects. Synthesized data will be reported to each of the three towns in a report discussing the details of the sampling program, water quality data presented in tabular format, discussion of water quality trends, flow and nutrient loads from freshwater inputs, and a discussion of seasonal differences. A summary will be provided

describing the general state of the embayment system relative to the water quality data collected under this monitoring program.

APPENDIX A - Field Data Sheet / Chain of Custody

Kingston/Duxbury/Plymouth Harbor
Citizen Water Quality Monitoring Program – Water Sampling Data Sheet 2003
General Conditions

_____ Station ID. Embayment _____

_____ Sample Date Volunteers Names _____

_____ Beaufort Scale (Force# 0 - 12)

_____ E / F Ebb (outgoing) or Flood (incoming) tide Time of nearest LOW tide _____am / pm (refer to your tide table)

#_____ Weather Conditions: (choose one) 1. Cloudless 2. Pt. Cloudy 3 Overcast 4. Rain 5. Fog/Haze 6. Drizzle 7. Intermit. Rain

#_____ 24 hour Precipitation (choose one) 1 None 2 Light 3 Heavy

_____ Wind direction (ie. SE, NW) Secchi Depth _____(m)Disappearance/descending _____(m)Reappearance/ascending

_____(meter) Total water depth at station _____(m) Average

Observations: Birds _____ # , _____type; Moorings _____ #
Swimming _____yes/ no ; Shellfishing _____ yes / no

Please continue comments on back

Depth Specific Parameters

	SURFACE 15 cm below		MID 1/2 of total depth		BOTTOM 50 cm from bottom	
Collection Time						
Collection Depth				Meters		
Dissolved Oxygen		# of Drops				# of Drops
Temperature Reading				°C		

Did you collect a 1 L Brown, 1 L Clear and 60cc bottle at each nutrient depth?

Return data sheet with samples to Coastal Systems Program, SMAST c/o Dr. Brian Howes, 706 S. Rodney French Blvd., New Bedford, MA 02744.

Ellisville Harbor
Citizen Water Quality Monitoring Program – Water Sampling Data Sheet 2003
General Conditions

_____ Station ID. Embayment _____

_____ Sample Date Volunteers Names _____

_____ Beaufort Scale (Force# 0 - 12)

_____ E / F Ebb (outgoing) or Flood (incoming) tide

Time of nearest LOW tide _____am / pm (refer to your tide table)

#_____ Weather Conditions: (choose one) 1. Cloudless 2. Pt. Cloudy 3 Overcast 4. Rain 5. Fog/Haze 6. Drizzle 7. Intermit. Rain

#_____ 24 hour Precipitation (choose one) 1 None 2 Light 3 Heavy

_____ Wind direction (ie. SE, NW)

Secchi Depth _____(m)Disappearance/descending
_____(m)Reappearance/ascending
_____(m) Average

_____(meter) Total water depth at station

Observations: Birds _____ # , _____type; Moorings _____ #
Swimming _____yes/ no ; Shellfishing _____ yes / no

Please continue comments on back

Depth Specific Parameters

	SURFACE **15 cm below**		MID 1/2 of total depth		BOTTOM **30 cm from bottom**	
Collection Time						
Collection Depth				Meters		
Dissolved Oxygen		# of Drops				# of Drops
Temperature Reading				°C		

Did you collect a 1 L Brown, 1 L Clear and 60cc bottle at each nutrient depth?
Return data sheet with samples to Coastal Systems Program, SMAST c/o Dr. Brian Howes, 706 S. Rodney French Blvd., New Bedford, MA 02744.

COASTAL SYSTEMS GROUP
Chain of Custody Record

Personnel Contacts

RECEIVED		RECEIVED	
name		name	
date	time	date	time
COLLECTED		CONTACT	
name		name	
date	local	phone/address	

Sample Notes

Special notes/ Sample Handling	Total number of samples

Sample Status

Sample ID	NH4	PO4	NO3/NO2	TDN	POC/N	TSS	CHLA	TP	Salinity	pH	Alkalinity				

APPENDIX B - Equipment to be Used and Calibration

GPS Station Location:
Garmin Global Positioning Units will be used to locate all sample stations by each team. Location measurements will proceed only with at least 5 satellites available to assure accuracy. The goal will be a minimum of six satellites using the High Precision setting. Station locations will be corrected with the download data available at the National Geodetic Survey CORS site (continuously operating reference system). Corrected station locations are expected to be accurate within 3 meters and probably within 1 meter.

YSI 85 Field Meter
The YSI-85 model field monitoring equipment will be maintained and checked as per manufacturers' instruction. The probe is a non-detachable, combination sensor that reads conductivity, dissolved oxygen and temperature. As suggested, the probe and its storage cell will be rinsed with clean tap water after each use.

It will be the responsibility of SMAST Laboratory Manager to check the calibration status of any meter prior to using the instrument and to check its calibration periodically during use. A log documenting problems experienced with the instruments and corrective measures taken will be maintained by the Sampling Coordinator.

All equipment to be utilized during the field analysis and laboratory analysis will be checked, prior to its use, to see that it is in operating condition. This includes checking the manufacturer's operating manuals and the instructions with each instrument to ensure that all maintenance items are being observed.

The meter will be auto-calibrated for dissolved oxygen before each sampling event following manufacturers recommended procedures. The accuracy of dissolved oxygen readings will be checked by collection of samples for Winkler method DO determination at two-week intervals.

The accuracy of the instrument will be checked with a standard conductivity solution each week and the instrument will be calibrated by two-point calibration using lab standard solutions should the instrument error reading of the standard solution exceed 5 percent. Any deviation from these recommendations due to specific peculiarities with certain instruments will be documented in the field logbooks and the monitoring program of the grant work plan. Instruments will be left on for the duration of the sampling round, at station and en route. All standards will be traceable to a nationally recognized standard and documented in field logbooks. A monthly two-point calibration will be performed for the dissolved oxygen probe. Temperature will be calibrated quarterly, by validating the temperature in a known temperature water bath.

CALIBRATION OF DISSOLVED OXYGEN PROBE

The probe is equipped with a polargraphic Clark-type sensor. A new dissolved oxygen membrane will be installed at the beginning of the field season and at 8-week intervals as per the manufacturer’s recommendations outlined below:

1. Before departing from the shore, turn the meter on by pressing the ON/OFF button, and then press MODE button until dissolved oxygen is displayed in mg/l or %. Allow the readings of dissolved oxygen and temperature to stabilize for 15 minutes.

2. The meter has two buttons with arrows; one pointing up and the other pointing down. Push both buttons simultaneously. The screen will read "0", press "enter" if at sea level to set altitude. If above sea level, use the arrow keys to set the altitude in units of 100 feet (i.e. 12 is 1200 feet). For work on all coastal ponds the altitude will be set at zero. When correct altitude is shown, press ENTER.

3. The YSI 85 will now display CAL in the lower left of the display screen. The calibration value should be displayed in the lower right of the screen and the current % reading shows in the main display of the screen. This reading should be within the range of 99 to 101 percent. When the current reading display is stable, press ENTER button. The display will then read SAVE and return automatically to the Normal Operation Mode.

CALIBRATION OF CONDUCTIVITY METER

1. Turn the instrument on and allow it to go through its self-test procedure.
2. Select a calibration standard appropriate to the expected conductivity in the pond to be sampled:
    a. For seawater a 50 mS/cm will be used.
    b. For fresh water, a 1mS/cm standard will be used.
    c. For brackish water, a 10mS/cm standard will be used.
3. Place at least three inches of calibration fluid in a clean glass beaker.
4. Use the MODE button to advance the display to conductivity.
5. Insert the probe deep enough into the standard solution so the oval hole on the side of the probe is completely covered. Suspend the probe ¼ inch from the bottom of the beaker. Do not rest it on the bottom of the beaker.
6. Allow at least 60 seconds for the temperature reading to stabilize.
7. Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.
8. Press the UP and DOWN arrows simultaneously. The CAL symbol will appear.
9. Use the UP or DOWN arrow buttons to adjust the reading on the display to match the value of the calibration standard.
10. Once the display reads the exact value of the calibration solution, press the ENTER button once. The display screen will then read SAVE indicating the calibration has been accepted.

The YSI 85 is designed to retain its last conductivity calibration permanently. Before each use, the instrument will be checked against the appropriate standard and corrected as needed to maintain accuracy within +/- 5 percent.

DISSOLVED OXYGEN MEMBRANE CAP REPLACEMENT

The membrane cap will be replaced annually at the beginning of field season and again at 8-week intervals or as needed based on inspection of the membrane for defects.

1. Unscrew and remove the probe sensor guard.
2. Unscrew and remove the old membrane cap.
3. Thoroughly rinse the sensor tip with distilled water.
4. Prepare the KCl electrolyte according to the directions provided by the manufacturer with the solution .
5. Hold the membrane cap and fill at least ½ full with electrolyte solution.
6. Screw the membrane cap onto the probe moderately tight. A small amount of electrolyte should overflow.
7. Screw the probe sensor guard on moderately tight.