QUALITY ASSURANCE PROJECT PLAN

for the

BUZZARDS BAY PROJECT

final

November 10, 1994

Eileen Gunn, The Coalition for Buzzards Bay
David S. Janik, Buzzards Bay Project
Joseph E. Costa, Buzzards Bay Project

Project Officer:	Joseph E. Costa, Ph.D., Buzzards Bay Project
Project QA Officer	Eileen Gunn, Coalition for Buzzards Bay
Principal Investigator:	Joseph E. Costa, Ph.D, Buzzards Bay Project
EPA Project Officer:	Bruce Rosinoff
EPA Quality Assurance Officer:	Arthur E. Clark (617) 860-9374

Background

In 1988, Buzzards Bay, located between southeastern Massachusetts and Cape Cod, was designated as a national estuary by the U.S. Environmental Protection Agency. The Buzzards Bay Project was then created to develop a Comprehensive Conservation and Management Plan (CCMP) to manage and protect the resources of the bay. The CCMP consists of a synopsis of the problems facing the estuary, management recommendations, and a monitoring plan. The CCMP identified three priority pollution problems; pathogen contamination, nitrogen inputs and toxic contamination. The Buzzards Bay Project has implemented components of a Water Quality Monitoring Program to help achieve the goals of the Buzzards Bay Comprehensive Conservation and Management Plan.

In order to develop a comprehensive baseline and to determine water quality trends related to nitrogen loading, a volunteer citizen water quality monitoring program was implemented. Toxic contamination characterization is considered beyond the scope of a citizen monitoring plan. Besides the citizen monitoring initiative, the Buzzards Bay Project will test stormwater discharges and document the need for management action and to determine the effectiveness of remediation projects.

The Coalition for Buzzards Bay, a bay-wide citizen advocacy group is under contract with the Buzzards Bay Project to organize and implement a citizens' water quality monitoring program. The Buzzards Bay Project also contracted with the Woods Hole Oceanographic Institution to analyze water quality samples and also to provide training to the citizens on proper sample collection techniques in the nitrogen loading impact monitoring component of the Buzzards Bay Project's monitoring efforts. The program is modelled after the Citizens Program for the Chesapeake Bay, Inc. and Falmouth Pond Watchers, both of which have been in operation for several years.

The Buzzards Bay Project distributes grants and assists towns in conducting remedial projects (ie. storm drain filtration basins) to meet the goals of the CCMP. This Quality Assurance Project Plan will serve to contain quality control plans for all of the projects granted through the Buzzards Bay Project. The majority of the plan is focused on the citizen water quality monitoring aspect. The water quality testing related to stormwater quality and treatment, as well as efforts related to monitoring fecal coliform in fresh water and seawater sources is being conducted by American environmental Laboratories (AEL) which is also under contract with the Buzzards Bay project. In some cases AEL is measuring the identical parameters as the Woods Hole laboratory, but using a different Methodology. These differences reflect the different needs in regards to limits of detection, accuracy, and contaminant levels in the different water matrixes.

Project Description

A. Objective and Scope Statement

The primary goal of the Citizen's Water Quality Monitoring Program to evaluate nitrogen loading inputs is to provide accurate and reliable water quality data for most of the major embayments around Buzzards Bay to assist environmental managers to:

*Establish baseline water quality,
*Characterize and identifying sources of pollution,
*Document long-term environmental trends in water quality,
*Evaluate the relative success of clean-up efforts,
*Facilitating implementation of management recommendations contained in the CCMP, and

* Evaluate the appropriateness of the Buzzards Bay Project's recommended nitrogen limits

The primary goal of the Citizen's Water Quality Monitoring Program to evaluate the stormwater and fecal coliform monitoring elements is to provide accurate and reliable water quality data for most of the major embayments around Buzzards Bay to assist environmental managers to:
*Establish baseline water quality,
*Characterize and identifying sources of pollution,
*Document long-term environmental trends in water quality,
*Evaluate the relative success of clean-up efforts,
*Facilitating implementation of management recommendations contained in the CCMP, and
* Evaluate the appropriateness of the Buzzards Bay Project's recommended nitrogen limits

The primary goal of the stormwater and fecal coliform monitoring elements of the monitoring program is to:
* Identify stormwater discharges for management action,
*Identify upstream sources of fecal coliforms not monitored through other state and local programs to better focus remediation efforts,
*Evaluate the relative success of clean-up efforts, including pollutant removal effectiveness of certain nonpoint source pollution best management practices and treatment devices, and
*Facilitate implementation of management recommendations contained in the CCMP

B. Data Usage
The data will be interpreted and used primarily by the Buzzards Bay Project to help rank each embayment with respect to its relative health for the purpose of prioritizing remedial management activities. Mean summertime values of dissolved oxygen percent saturation, secchi disk depth, chlorophyll a, total organic nitrogen (TON), and dissolved organic (DIN) were combined in a Eutrophication Index modeled after a similar index developed by Hillsborough County, Florida, U. S. A. (Hillsborough County, 1991). The Hillsborough County Index included 7 water quality parameters(% dissolved O_2 saturation, Chl a, total coliform, light penetration, total phosphorus, TKN, and BOD). Because the focus of the Buzzards Bay Eutrophication Index was on the effects of nitrogen loading, BOD and coliforms were omitted from our index, and DIN and DON were included instead of TKN because of problems associated with measuring low levels of nitrogen in seawater using the TKN methodology (D'Elia et al., 1985). As noted by Harkins (1974), it is acceptable for parameters used in a water quality index to show interaction or interdependence, but the must not be any redundancy in the parameters. Thus, it acceptable to have DIN and DON included in a water quality index as we have done, but inappropriate to include both TKN and DIN because the parameters have redundancy in that the both include NH_4 concentrations.

Like the Hillsborough County Index, the Buzzards Bay Eutrophication Index evaluated water quality parameters against a scoring curve like the one we used for mean secchi depth shown in Figure 4. As shown, if the summertime mean secchi depth was less than 0.5 m, then a score of 0 was received for that parameter. Conversely, a secchi depth greater than 3.0 m received a score of 100. If Secchi depth was between 0.5 and 3.0 m, the score was calculated using the following equation:

$$\text{Score}=(\ln(\text{value})-\ln(0\text{ pt. value}))/(\ln(100\text{ pt. value})-\ln(0\text{ pt. value}))$$

The 100 and 0 point values for each parameter is shown in Table 1. The Eutrophication Index equaled the

mean of the scores for the five parameters (i.e., all parameters were equally weighted). These end points chosen for Buzzards Bay were based on knowledge of conditions typically found in a range of southern New England embayments.

When several sites were monitored in an embayment, we averaged only those data from sites in the upper half of the estuary because of the steep gradient in water quality near the mouth to Buzzards Bay conditions.

Table 1. Parameter Scale endpoints for the Buzzards Bay Eutrophication Index.

Parameter	0 point value	100 point value
Oxygen saturation	30 %	100 %
Transparency	0.5m	3.0 m
Chlorophyll	10.0µg/l	1.5µg/l
DIN	10.0µM	1.0µM
Organic N	40.0µM	20.0µM

The overall embayment ranking will be in the report "A Buzzards Bay Embayment Subwatershed Evaluation: Establishing Priorities for Nitrogen Management Action" developed by the Buzzards Bay Project (draft, February 28, 1994). This is a simplified land use evaluation process which determines existing and future nitrogen loading levels for 30 embayments and compares them to the recommended maximum nitrogen load (CCMP,1991). The citizens' water quality data is used to support the existing values for nutrient loads as well as show the results of the nutrient load through the Eutrophic Indexes relative to dissolved oxygen ranking.

Subwatershed based fecal coliform data collected through this program will be part of a similar report that will rank embayments and their watersheds from a bacterial perspective for non-point source prevention and remediation activities, such as installing future stormwater remediation projects.

Data collected at specific locations where stormwater remediation projects have already been installed will be used to document the effectiveness of the selected remediation projects in removing pollutants from stormwater prior to discharge to surface waters. Four remediation project locations currently need performance assessments: Sprague's Cove, Broad Marsh River, Hen Cove, and Red Brook. Additional remediation sites are expected to be added in the future.

C. Technical Design and Rationale/Monitoring Parameters and Collection Frequency

Because nitrogen loading has been identified as one of the primary problems to coastal waters in Buzzards Bay, the citizen volunteer elements of the monitoring plan will be focused on parameters that can be monitored frequently and inexpensively in the field to determine the impact of nutrients. Pathogen indicator monitoring will also be conducted in certain embayments to help locate sources of pathogenic pollution. Stormwater remediation sites will also be monitored for pathogen indicators organisms as well as selected metals, volatile organic compounds, and petroleum hydrocarbons.

The Coalition for Buzzards Bay will enlist approximately 80 volunteers to monitor water quality in

28-30 major embayments. Volunteers will monitor water quality for **basic parameters**: dissolved oxygen, temperature, salinity and water clarity, and collect water samples for a series of **nutrient analysis** (Refer to Appendix I and II for sampling protocols). Water samples will be collected for the basic parameters from late May to September on a weekly to bi-weekly schedule between the hours of 6-9 AM. Volunteers will be asked to take samples on a designated day, but will also be given the opportunity to sample a day before or after the designated day if necessary because of schedule conflicts. This simultaneous sampling schedule is critical to allow site to site comparisons of data. Monitoring may be more frequent during the warmer, more biologically active months of July and August when lowest dissolved oxygen levels can be identified. Volunteers will be encouraged to take additional samples during periods of overcast weather when reduced sunlight and photosynthesis will lower dissolved oxygen levels. In order to characterize surface and deep water conditions, samples will be collected at a depth of 15 centimeters below the surface and deep samples will be collected at a depth of 30 centimeters off the bottom if there is greater than 1.2 meters of water at the station. These depths have been determined by Woods Hole Oceanographic Institution as representative. Collection of a sample 15 cm below surface prevents collection of atmospheric oxygen into the sample, and 30 cm off bottom prevents stirring of the bottom sediments and collection of organic matter that may alter the results.

Certain limited embayments will be selected for monitoring of bacterial indicator organisms for pathogens, fecal coliforms and clostridia perfringens. Both dry weather and wet weather samples will be collected at these embayments. Dry weather samples will usually be collected at preselected locations during a window from low tide to two hours following low tide. Wet weather samples will be collected at these same locations during or immediately following the rain event. In some cases actual runoff from paved impervious surfaces will be collected and analyzed for bacterial indicator organisms.

At sites of stormwater remediation projects stormwater will be collected and analyzed prior to treatment by the remediation facility and following treatment by the facility. Where infiltration is the primary means of stormwater treatment samples will be collected from groundwater directly down-gradient of the infiltration device. Background groundwater quality will also be determined by sampling up-gradient monitoring wells. The primary parameter used to determine pollutant removal efficiency will be fecal coliform, but additional parameters such as metals, volatile organic compounds, total petroleum hydrocarbons, total suspended solids, and nutrient may be used.

Methodology, detection limits, and QAQC objectives of the various monitoring parameters are included in Tables 2-6.

Sample stations and a sample identification code will be assigned to each volunteer by the coordinator and will be dependent on access, embayment distribution of stations, convenience for volunteer. Stations will be selected to give good coverage of the inner and sometimes outer, more well-flushed embayment. Samples stations will include boatyard docks, town landings and piers. An attempt will be made to minimize stations at private docks and off of boats if it is thought that those stations can not be replicated over the life of the program. All sampling stations will be recorded on a U.S.G.S. Quadrangle sheet and also on a GIS map via UTM coordinates (refer to Appendix III). Offshore stations will be marked by a navigational marker, mooring, or by triangulating from land. A 50 foot radius is allowed for off shore sample stations.

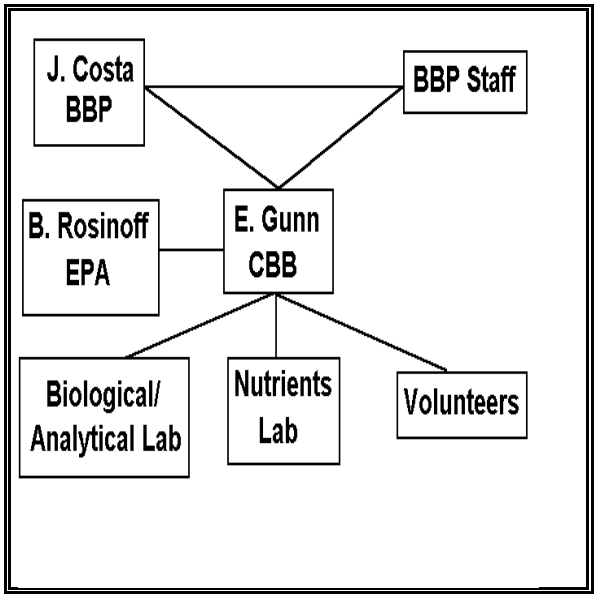
The Volunteers will collect nutrient samples two to four times per summer as their availability allows. In

addition to taking samples at existing basic parameter stations, a sample will be collected along a transect from the inner to outer bay in order to characterize a nutrient cycle throughout the bay. Samples will be collected simultaneously during the last three hours of low tide in order to best characterize nutrient conditions in the embayment, not from outer Buzzards Bay waters.

Volunteer Training-Volunteers will initially receive a packet of information explaining the program's objectives, the time involved, and the role and responsibilities of volunteers. They will also receive a training manual that gives an overview of the program and explains the significance of each parameter in the coastal ecosystem. Volunteers will receive a lecture on the program from the Coordinator and the Executive Director of the Buzzards Bay Project and formal hands-on training from scientist from the Woods Hole Oceanographic Institution. Specifically, volunteers will be instructed on the goals of the program and the importance of taking accurate and timely measurements. They will be given a demonstration of the protocol and then break into small groups to practice performing the tests and collecting the samples; this will entail groups of no more than 25 volunteers per session. Retraining sessions will be held on an annual basis. When necessary, the coordinator will follow up with field checks.

Project Organization and Responsibilities

The program will be jointly sponsored by the Coalition for Buzzards Bay and the Buzzards Bay Project, with the Coalition organizing the program and managing the volunteers and database, and the Project providing technical support in the design of the monitoring program and interpretation of the data. Additional administrative support will come from the Buzzards Bay Project. Volunteers will be used for many of the required tasks.



Principal Investigator:Joseph E. Costa, Ph.D., Buzzards Bay Project (508) 748-3600
Project Officer:Joseph E. Costa, Ph.D., Buzzards Bay Project (508) 748-3600
Eileen Gunn coordinates citizens
Project QA OfficerEileen Gunn, Coalition for Buzzards Bay (508) 759-1440
EPA Project Officer:Bruce Rosinoff (508) 748-3600
EPA QA Officer:Arthur Clarke
Nutrient Laboratory:Woods Hole Oceanographic Institution, Brian Howes (508) 548-1400 x 2319
Biological/Analytical Lab:American Environmental Laboratory, Mike Diamantopolus (800)-522-0094

Project Schedule and Tasks

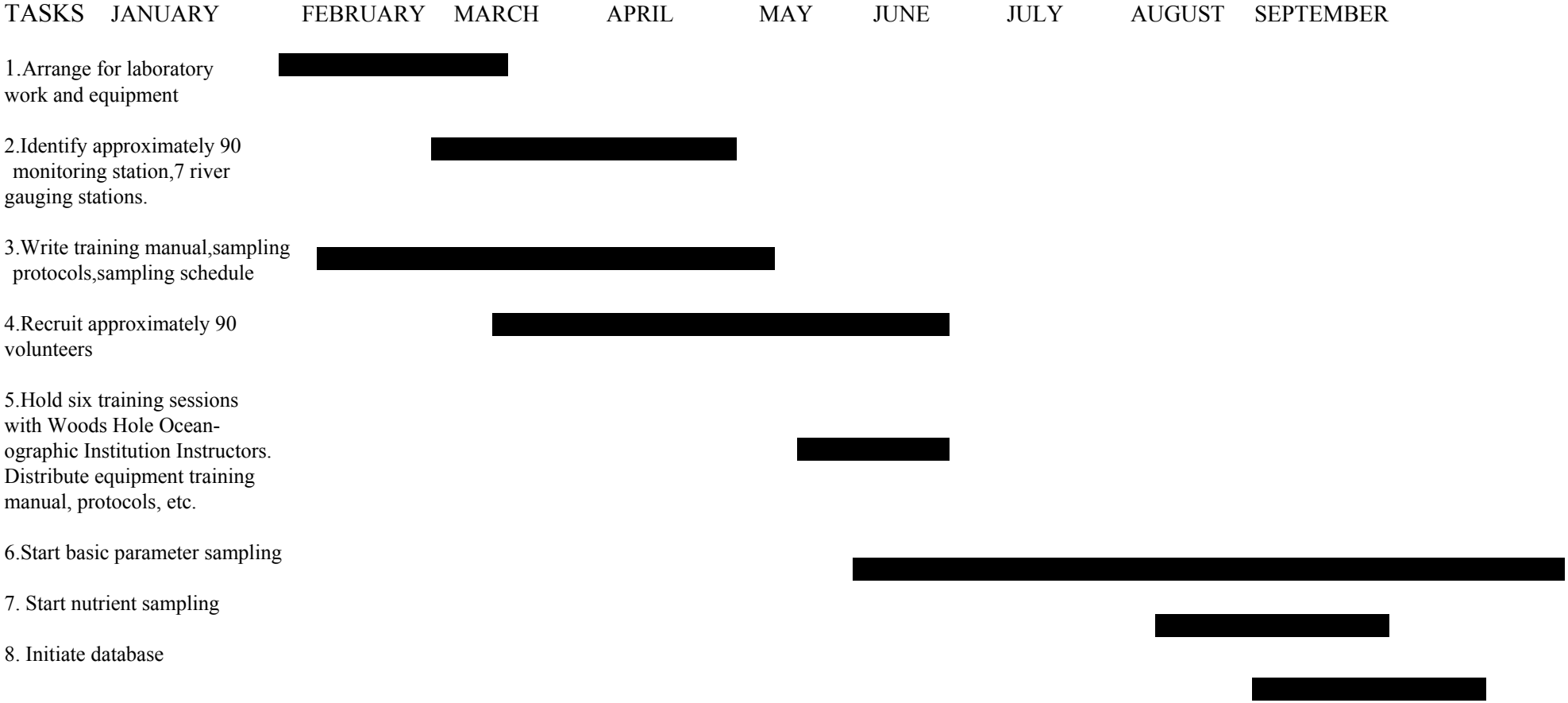


Table 2. Citizen's Monitoring Program, field parameters measured for nutrient loading evaluation monitoring

Parameter	Est. # of field observations	Method/Range	Units	Sensitivity	Precision	Accuracy	Calibration
Temperature	950	Thermometer -15 °C to 104°C	Celsius	0.5°C	0.5°C	0.5°C	With mercury thermometer over temperature range[a]
Salinity[b] specific gravity /Thermometer	950	Hydrometer 1.000 to 1.050 (ppt)	Parts per thousand	0.5 ppt	1 ppt	1-2 ppt	Refractometer
Dissolved Oxygen	950	Modified Winkler Titration	Parts per million	0.5 ppm	.05 ppm	1 ppm	Simultaneous sample
Water Clarity	950	Secchi disk disappearance depth	meters	NA	NA	NA	NA

[a] See calibration procedures
[b] Salinity value obtained from specific gravity/temperature table formulated by the BBP

Note: Citizen Volunteers collect water samples that are analyzed for the parameters listed in Table 2. Citizen volunteers also record observations about weather conditions during sampling.

Table 3. Citizen's Monitoring Program, parameters measured through Woods Hole Oceanographic Institution subcontract on water samples collected by volunteers related to N-loading assessment.

Parameter	Matrix[a]	Total # Samples	Sample Volume/ Container	Max. Holding Time	Field Processing/ Preservation	Units
Nitrate + Nitrite	1	300-400	60 ml polyethylene acid-washed	72 hours	Field filter, store on ice in dark	µg/l
Ammonium	1	300-400	60 ml polyethylene acid-washed	24 hours	Field filter, store on ice in dark	µg/l
Total Phosphorus	1	300-400	60 ml polyethylene acid-washed	28 days	Field filter, store on ice in dark	µg/l
Orthophosphate	1	300-400	60 ml polyethylene acid- washed	24 hours	Field filter, store on ice in dark	µg/l
Chlorophyll a	1	300-400	1000 ml polyethylene acid-washed	24 hours	Field filter, store on ice in dark	µg/l
Total dissolved N	1	300-400	1000 ml polyethylene acid-washed	24 hours	Field filter, store on ice in dark	µg/l
Periphyton	1	300-400	50 ml centrifuge tube	1 week	Store on ice in dark in field, -20 C in laboratory	$\mu g/cm^2$
Particulate N	1	300-400	1000 ml polyethylene acid-washed	72 hours	Store on ice in dark	µg/l

[a] Matrix: 1 = salt water, 2 = fresh water

Sample Custody Procedures

Although samples will not be used for legal purposes, sample custody forms are provided for the collection of nutrient-related sample collection. The forms identify the sample collector, sample identification and time of sample collection. Upon any transfer of the sample until final delivery to the laboratory a signature, date, and time will be required prior to handing over the samples.

Table 4. Citizen's Monitoring Program, parameters measured through AEL subcontract on water samples collected by volunteers related to upstream sources of fecal coliform.

Parameter	Matrix[a]	Total # Samples	Sample Volume/ Container	Max. Holding Time	Field Processing/ Preservation	Units
Fecal Coliform	**1 & 2**	**500**	**100 ml-sterilized single use polypropylene**	**6 hours**	**Collect, label, store on ice in dark**	**1 org./100 ml**

[a] Matrix: 1 = salt water, 2 = fresh water

Sample Custody Procedures

Although samples will not be used for legal purposes, sample custody forms are provided for the collection of fecal coliform sample collection. The forms identify the sample collector, sample identification and time of sample collection. Upon any transfer of the sample until final delivery to the laboratory a signature, date, and time will be required prior to handing over the samples.

Table 5. Buzzards Bay Project stormwater remediation evaluation monitoring through subcontract with AEL

Parameter	Matrix	Total # Samples	Sample Volume/ Container	Max. Holding Time	Field Processing/ Preservation	Units
Fecal Coliform	**1 & 2**	**500**	**100 ml-sterilized single use polypropylene**	**6 hours**	**Collect, label, store on ice in dark**	**1 org./100 ml**
Clostridium Perfringens	1 & 2	40	100 ml-sterilized single use polypropylene	6 hours	Collect, label, store on ice in dark	1 org./100 ml
Fecal Streptococcus	1 & 2	15	100 ml-sterilized single use polypropylene	6 hours	Collect, label, store on ice in dark	1 org./100 ml
Total Petroleum Hydrocarbons	1	10	1 liter glass container w/ teflon cap (hcl)	14 days	Collect, label, store on ice in dark	µg/l
Total Nitrogen	1	5	60 ml-single use polyethy-lene acid-washed	28 days	Field filter, store on ice in dark	µg/l
Total Phosphorus	1	5	100 ml-single use polypropylene acid washed	28 days	Collect, label, store on ice in dark	mg/l
Total Suspended Solids	1	10	100 ml-single use polypropylene	7 days	Collect, label, store on ice in dark	mg/l
Zinc	1	10	100 ml-single use polypropylene	6 months	Collect, label, store on ice in dark	µg/l
Copper	1	10	100 ml-single use polypropylene	6 months	Collect, label, store on ice in dark	µg/l
Cadmium	1	10	100 ml-single use polypropylene	6 months	Collect, label, store on ice in dark	µg/l
Chrome	1	10	100 ml-single use polypropylene	6 months	Collect, label, store on ice in dark	µg/l
Lead	1	10	100 ml-single use polypropylene	6 months	Collect, label, store on ice in dark	µg/l
Volatile Organic Compounds	1	10	approx. 60 ml glass (no head space)	14 days	Collect, label, store on ice in dark	µg/l

Matrix: 1 = salt water, 2 = fresh water

Sample Custody Procedures

Although samples will not be used for legal purposes, sample custody forms are provided for the collection of nutrient and bacteria sample collection. The forms identify the sample collector, sample identification and time of sample collection. Upon any transfer of the sample until final delivery to the laboratory a signature, date, and time will be required prior to handing over the samples.

Table 6. Analytical Procedures/Quality Control Samples

Parameter	Method	Detection Limits	Frequency	QC Samples
Temperature	Thermometer -15 °C to 104°C	0.1 C	Weekly - Biweekly May - October*	Field Dups 10%+
Salinity	Hydrometer 1.000 to 1.050	1 ppt	Weekly - Biweekly May - October	Field Dups 10%+
Dissolved Oxygen	Modified Winkler Titration/Hach OX2P	0.2 ppm	Weekly - Biweekly May - October	Field Dups 10%+
Water Clarity	Secchi disk	5 cm	Weekly - Biweekly May - October	Field Dups 10%+
Fecal coliform	Standard Method 9222 w/ M-tech media, EPA	1 fc/100 ml	Site specific/Varied	Lab Dups 10%±
Clostridium perfringens	As in Bisson & Cabelli, 1979, Applied and Envt'l Microbiology Volume 37, No. 1, pp 55-56	1 /100 ml	Site specific/Varied	Lab Dups 10%±
Fecal Streptococcus	KF Strep Media	1 /100 ml	Site specific/Varied	Lab Dups 10%± Trip Blanks
Total Petroleum Hydrocarbons	418.1 Infra-red refraction		Site specific/Varied	Lab Dups 10%±
Volatile Organic Compounds	EPA 624		Site specific/Varied	Lab Dups 10%± Trip Blanks
Total Nitrogen-stormwater evaluation	EPA 351.2 (TKN) (NO_2 & NO_3) & EPA 350 (Ammonia)[d]		Site specific/Varied	Lab Dups 10%± Trip Blanks
Total Phosphorus	EPA 365.2		Site specific/Varied	Lab Dups
Total Suspended Solids	EPA Standard Methods 2540 dried at 103-105°C		Site specific/Varied	Lab Dups
Zinc	EPA 3111 Flame AA or better ICAP 200.7 may be acceptable		Site specific/Varied	Lab Dups
Copper	EPA 3113 or better ICAP 200.7 may be acceptable		Site specific/Varied	Lab Dups
Cadmium	EPA 3113 or better ICAP 200.7 may be acceptable		Site specific/Varied	Lab Dups
Chrome	EPA 3113 or better ICAP 200.7 may be acceptable		Site specific/Varied	Lab Dups

Lead	EPA 3113 or better ICAP 200.7 may be acceptable		Site specific/Varied	Lab Dups
Nitrate + Nitrite-coastal WQ	Autoanalyzer[a]	0.1 µM	Biweekly July-August	Lab Dups
Ammonium- coastal WQ	Indophenol[b]	0.1 µM	Biweekly July-August	Lab Dups
Orthophosphate-coastal WQ	Molyb. Blue[c]	0.05 µM	Biweekly July-August	Lab Dups
Chlorophyll a	Acetone extraction[e]	0.1 µg/l	Biweekly July-August	Lab Dups
Total Dissolved N	Persulfate digestion[d]	0.5 µM		
Particulate N-coastal WQ	Elemental analysis[f], 440.0	0.5 µM	Biweekly July-August	Lab Dups
Periphyton	Standard Method 10300	0.2 µg/cm^2	Annually (once per summer)	

*Yearly temperatures are available

aLachat Autoanalysis procedures based upon the following techniques:

--Wood, E., F. Armstrong and F. Richards. 1967. Determination of nitrate in sea water by cadmium copper reduction to nitrite. J. Mar. Biol. Ass. U.K. 47:23-31.

--Bendschneider, K. and R. Robinson. 1952. A new spectrophotometric method for the determination of nitrite in sea water. J. Mar. Res. 11:87-96.

bSchneider, D. 1976. Determination of ammonia and Kjeldahl nitrogen by indophenol method. Water Resources 10:31-36.

cMurphy, J. and J. Riley. 1962. A modified single solution method for the determination of phosphate in natural waters. Analytica Chimica Acta 27:31-36.

dD'Elia, C.F., P.A. Steudler and N. Corwin. 1977. Determination of total nitrogen in aqueous samples using persulfate digestion. Limnol. Oceanogr. 22:760-764.

eParsons, T.R., Y. Maita and C. Lalli. 1989. Manual of Chemical and Biological Methods for seawater analysis. Pergamon Press, 173 pp.

fPerkin-Elmer Model 2400 CHN Analyzer Technical Manual.

Table 7. Acceptance criteria for QC samples

Parameter	Acceptable % difference[a]	Acceptable absolute difference
Temperature	-	0.5 C
Salinity	-	2 ppt
Dissolved Oxygen	-	1 ppm
Water Clarity	20%	0.2 m
Fecal coliform	30%	-
Clostridium perfringens	30%	
Fecal Streptococcus	30%	
Total Petroleum Hydrocarbons	20%	
Volatile Organic Compounds	20%	
Total Nitrogen-stormwater evaluation	30%	
Total Phosphorus	20%	
Total Suspended Solids	30%	
Zinc	30%	
Copper	30%	
Cadmium	30%	
Chrome	30%	
Lead	30%	
Nitrate + Nitrite- coastal WQ	20%	0.5 µM
Ammonium- coastal WQ	20%	0.5 µM
Orthophosphate- coastal WQ	20%	0.5 µM/l
Chlorophyll a	30%	0.5 µg/l
Total Dissolved N	30%	5 µM/l
Particulate N- coastal WQ	30%	10 µM/l
Periphyton	30%	20 µg/cm^2

[a] acceptable percent difference not applicable when values close to the limit of detection, in which case absolute acceptable error takes precedence.

Project Fiscal Information
Approximately $60,000 in funding from the National Estuary Program is being used to pay the analytical laboratory costs of this program. An additional $40,000 is being used to coordinate the citizen effort through the Coalition for Buzzards Bay. More detailed project information can be obtained from the Buzzards Bay Project.

Calibration Procedures and Preventive Maintenance for Field Equipment
The equipment in the basic parameter kits will be calibrated on a yearly basis to assure data accuracy. Several calibrations sessions will be held at which the thermometers will be tested in air, room temperature bath and ice bath against a mercury thermometer; the hydrometers will be tested in three different salt solutions; and volunteers will process an oxygen sample from a room stabilized bath. Results will be compared, an accuracy range determined and limits for acceptable ranges determined. Instruments outside the acceptable limits will be replaced and the data set corrected.

CALIBRATING PROCEDURE:
THERMOMETERS:
1) Set up an ice bath in a large bucket. Fill the bucket close to the top with small ice cubes and water. Be sure the ice is distributed evenly throughout the entire bucket. You will want to be sure the sensors are not in a pocket of water.

2) Set up a room temperature water bath. Fill another large bucket close to the top with tap water.

3) Set aside an undisturbed area in which to take air temperature.

4) Place all the thermometers as close as possible and record all air temperatures after allowing them to stabilize.

5) Place all the thermometers in holes made in a cardboard sheet placed over the water temperature bath. Allow them to stabilize for a few minutes then record temperatures.

6) Place the cardboard sheet and thermometers over the ice bath. Allow them to stabilize and record the temperatures.

7) Calculate differences. Any thermometer with a difference greater than 1.0 degree ???should be discarded.

HYDROMETERS: Take refractometer readings of each solution before and after testing hydrometers.
1) Rinse all hydrometers to be calibrated with deionized water and dry.

2) Fill one 500 ml graduated cylinder with fresh water.

3) Fill a second 500 ml graduated cylinder with water known to be of 10 ppt salinity.

4) Fill a third 500 ml graduated cylinder with water known to be of 20-25 ppt salinity.

5) Place calibrating thermometer in fresh water cylinder. Read each hydrometer and record the temperature at the time of each reading.
RINSE EACH HYDROMETER WITH DEIONIZED WATER AND DRY

6) Place calibrating thermometer in the 10 ppt salinity cylinder. Read each hydrometer and record the temperature at the time of each reading.
RINSE EACH HYDROMETER WITH DEIONIZED WATER AND DRY
7) Place calibrating thermometer in the 25 ppt salinity cylinder. Read each hydrometer and record the

temperature at the time of each reading.

8) Calculate the salinity for each reading and compare. Discard any hydrometer with a salinity more than 1.5 ppt off standard.

Documentation, Data Reduction and Reporting

A. Documentation

All data will be recorded on-site at the time the measurements are taken on standardized data sheets. The volunteers will be asked to check that all data is accurate and legible before making a copy and mailing it in on a bi-weekly basis. Data will be reviewed by the program coordinator before being entered by the coordinator or intern into a spreadsheet. Upon being entered the data sheets will be checked against the spreadsheet on a regular basis. Automatic calculations of %oxygen saturation for each entry will allow an additional mechanism for identifying unusual dissolve oxygen or temperature readings or potential data entry errors. If an unusual or unbelievable recording is noted, the volunteer will be called to discuss the data. Volunteers are also instructed to take replicate samples if an unusual reading is recorded.

APPENDIX I
Buzzards Bay Citizen's Water Quality Monitoring Program
BASIC PARAMETER SAMPLING AND ANALYTICAL PROTOCOLS

Monitoring Overview

1) Measure secchi depth and total depth
2) Collect surface sample
-analyze temperature, dissolved oxygen, specific gravity/temperature,
3) Collect bottom sample*
-analyze temperature, dissolved oxygen, specific gravity/temperature
* *Only collect bottom samples when their is at least 4 ft of water at your station.*

SECCHI DEPTH/TOTAL DEPTH

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 depth of disappearance. Read depth on tape where it intersects the water surface, record. *Note: Sometimes the secchi disk will hit the bottom before it disappears -- in this case leave secchi disk depth blank from the tape. In areas where the tape cannot be seen ie.bridges, read the tape at a fixed point on the bridge when the secchi disappears, and then raise the secchi disk to the water surface, the difference in these numbers will give you the secchi depth.*
2. Lower secchi disk slowly until it touches bottom, record station depth.

Sample Collection

Note: For simplicity we use the sampling pole for both surface and deep water sample collection. If you like, you can fill the surface 1 liter nutrient bottle by hand; try not to suck in water directly from the surface. All volunteers are equipped with a 1 liter nutrient bottle for collecting water for temperature and salinity readings.

Step 1 Put stopper in 1 liter salinity bottle and in the 0.5 liter oxygen bottle. Make sure the tube on the 0.5 liter bottle is secured at the top of the bottle.

Step 2 Move a couple of feet upstream from where you measured total depth (to avoid disturbed sediments). Lower the sampling pole gently to the appropriate depth (6 inches (15.25 cm) below the water surface for the surface sample and 1 foot (30.5 cm) above the bottom for bottom sample). While holding sampling pole in place, pull oxygen bottle stopper (0.5 liter), let sample bottle fill. When all bubbles have ceased coming to the surface then pull nutrient bottle stopper (1 liter), allow to fill. *NOTE: It is imperative that the oxygen bottle is filled first to avoid oxygenating the sample.*

Step 3 Keeping the pole vertical, bring the samples on deck. Remember to support the bottles as they will be heavier out of water. Remove the bottom section of the sampling pole for ease in handling the sample bottles.

Water Sample Processing

Step 1 Fill O_2 reagent bottle:

Lower tube from oxygen bottle on pole to the bottom of the glass bottle (with glass stopper) from the blue oxygen kit. Drain about 3/4 of the 0.5 liter bottle through the glass bottle, overflowing the glass bottle. Tap glass bottle if bubbles stick to sides. As volume reaches 3/4 of the 0.5 liter bottle, slowly remove the side tubing from the glass bottle and carefully insert the glass stopper so as not to trap any bubbles.

Step 2 Put thermometer in salinity bottle, let stabilize, record temperature. Cap and set salinity bottle aside.

Step 3Continue oxygen analysis, at least until sample is "fixed".
Step 4Measure specific gravity of water with hydrometer and record temperature at which specific gravity was measured.

Analytical Methods

DISSOLVED OXYGEN
1.open Reagent packet 1 (use the clippers in your kit);
2.remove glass stopper from glass oxygen bottle;
3.pour Reagent 1 into bottle;
4.open Reagent packet 2 and add to bottle.
5.replace glass stopper, careful not to trap bubbles.
6.shake bottle vigorously holding bottle and stopper (some reagent may stick to bottom of bottle...this is O.K.).
7.let stand 2 minutes, shake again.
- YOU CAN MEASURE SPECIFIC GRAVITY WHILE YOU WAIT
8.After a total of 5 minutes, open Reagent packet 3, remove glass stopper, add powder to bottle, replace stopper, shake vigorously until water in bottle becomes clear (no particles). *THE SAMPLE IS FIXED NOW AND CAN BE TRANSPORTED* if needed.
9.Remove glass stopper and fill small plastic tube to top TWICE (two volumes) pouring each time into the square glass bottle in the kit. It helps to tip the bottle to overcome the surface tension.
10. You are now ready to determine the oxygen content:
Take the eyedropper and fill with sodium thiosulfate solution in the brown plastic bottle in kit (do not get on hands). Now the critical part: add 1 drop to the square bottle and swirl. Continue to add drop by drop (about 10 seconds between drops) and swirl until the yellow color goes away. Record the number of drops (1 drop = 0.5 mg O_2/liter-ppm).
NOTE: Be careful not to contaminate solution by touching dropper in 02 sample.
11. Pour waste reagent in to waste bottle and save for disposal.
12. Rinse bottles with tap water.

SPECIFIC GRAVITY/TEMPERATURE = Salinity
Rinse 500 ml graduated cylinder with 100-200 ml sample from 1 l bottle. Rinse hydrometer directly from bottle with a little water (no more than 100 ml). Fill graduated cylinder with 500 ml of sample (if very salty) or 600 ml of water if fresher (i.e. inshore stream samples). Gently place hydrometer in cylinder (do not drop). Read number on stem of hydrometer where it intersects the water line in the cylinder, record. Take hydrometer out and put thermometer into cylinder and measure temperature (AGAIN); record. Obtain salinity from your table, record. Rinse equipment.

OTHER PARAMETERS: Record other parameters listed on data sheet:
*Time of nearest low tide from your tide table (add 1 hour-daylight savings) 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

APPENDIX II

NUTRIENT SAMPLING AND ANALYTICAL PROTOCOLS

Nutrient Sample Collection Overview

The goal of the Buzzards Bay Citizen's Monitoring Program is to provide needed data with which to evaluate overall water quality conditions in the nearshore waters and harbors of the Bay. These waters are most likely to be impacted by excessive nutrient loading originating from local land use. Water quality degradation is most pronounced in coastal embayments because they are poorly flushed and have high pollution loadings relative to their volume. The participation of citizen volunteers enables monitoring of physical parameters and collection of samples from a large number of stations almost simultaneously, critical to making site to site comparisons under the comparable environmental conditions of weather and tide.

Because of the value of this data, it is very important that measurements are made and samples collected according to the protocol provided. Through training sessions, hands-on instruction and sampling tips, we will be providing you with the information necessary to insure efficiency and accuracy in the measurements.

In addition to nutrient sample collection, physical measurements include temperature, salinity, water transparency (by Secchi disk) and total depth. Samples collected for nutrients will be analyzed at the Woods Hole laboratory for:

Ammonium, Nitrate, Nitrite, Particulate Organic Nitrogen, Chlorinity, Chlorophyll a, Particulate Organic Carbon, Total Nitrogen. In addition, periphyton settlement strips (floats) will be set out to collect and analyze colonization of epiphytes in certain areas.

PICKING YOUR STATIONS-
The number and locations of sampling stations will depend on the size and shape of your embayment or river, access, and navigational passages. Basically, we want a uniform distribution from the inner to the outer embayment with coverage in sub-embayments (or lobes); all out of navigational pathways. Stations near private docks, moorings, or rocks are good for duplicating locations during the second and future sampling events. All stations must be located on a U.S.G.S Quadrangle map or chart as accurately as possible.

NUTRIENT SAMPLE COLLECTION/FILTERING
Each of these steps will be performed at each station in your embayment beginning in the inner portion and moving outward, if possible. A surface sample will be collected at every station at 15 cm below the surface and a bottom sample will be collected only at selected stations. The bottom sample will be collected 30 cm from the bottom up to 3 meters.

MAKE SURE ICE IS IN COOLER
1.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 sampling pole with the 1 liter nutrient (white) sample bottle and oxygen bottle to 15 cm

below the surface, pull stoppers (order doesn't matter in this case), bring to surface.

c) Immediately cap nutrient bottle, put in cooler, an shut cooler lid.

d) Record temperature in oxygen bottle and use water in oxygen bottle to determine salinity (or refractometer). Use surface water to rinse graduated cylinder between samples.

e) Lower sampling pole again 1 liter brown Chlorophyll bottle to 15 cm below surface only, pull stopper, bring to surface, cap and put in cooler. Shut cooler.

****PUT NUTRIENT AND CHLOROPHYLL SAMPLES IN COOLER IMMEDIATELY***

2. Take secchi depth and total station depth if possible.

3. **If a bottom sample is required, repeat a through e at a depth of 30 cm above the bottom or at meters if the water is too deep for the sampling pole.**

4. Deploy periphyton float leaving enough slack in line for high tide.

5. Move to next station, repeat.

Note: Surface samples can be taken by hand or with the sampling pole. 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 to fill.

You have just collected two 1 liter samples. The sample in the 1 liter nutrient (white) bottle will be divided and used for two analysis, dissolved nutrients and particulate nutrients. The sample in the brown 1 liter bottle will be analyzed for chlorophyll content.

Back on shore

6. a) Remove 1 liter nutrient (white) sample bottle from cooler, one station at a time.

b) Label one 60 cc with identical station information, station name, time, depth

c) Place filter in clear plastic filter holder.

d) Shake 1 liter nutrient (white) sample bottle (in case of particulate settling) and fill 60 cc syringe with water from bottle by removing plunger and pouring in, replace plunger.

e) Attach filter to syringe and discard first approx. 30 cc of water.

f) Push next 30 cc of water into the small sample bottle (60 cc) provided, replace cap, shake and discard water.

g) Now refill syringe, **attach to filter** (cup side up) and collect all water in the now rinsed bottle until bottle is full to shoulder, **taking care that no unfiltered water drips into sample**, cap and put on ice.

h) Cap 1 liter nutrient (white) sample bottle with the remaining water, check label and put on ice. The bottle must be at least 3/4 fill to be used for analysis. If it is not 3/4 full, take another sample at the same depth, cap and put in cooler.

i) Remove filter paper and rinse filter holder and syringe with tap water.

j) 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 down

Record the sample label information (per each cooler) on the sample record sheet, make a copy, and place in cooler in a plastic bag.

<u>POTENTIAL ERRORS</u>

Always remove syringe from filter before pulling back syringe. Otherwise the filter can puncture.

Make sure the O-ring is seated properly under the filter to prevent leakage. You will see leakage if it is not on correctly.

The filter must be attached to syringe with cup side up.
If the water is especially difficult to get through the filter, there may be a blue paper remaining on the filter. Some more particulate rich water will just be slow to filter.

PERIPHYTON FLOAT DEPLOYMENT AND HARVESTING

It is very important that the floats remain vertical and in place. This means that they must be properly weighted and have enough slack in the anchor line to float at high tide. The floats should be deployed at each station if possible. At stations where you know there will be less than two feet of water at low tide, do not deploy a float.

The floats must be checked periodically within the week for stability and possible tampering. If the float is not functioning properly or is vandalized it needs to be corrected or replaced.

When the floats are harvested cut 3 inches from the "best" two out of three strips of screening and immediately place each in an individual container with station identification information (embayment, station #, date). The "best" strips will have the most evidence of periphyton growth. Put the containers in the cooler. It would be helpful to prelabel two containers for each station.

When sample processing is completed bring coolers to your designated drop off location as soon as possible. Relinquish the coolers by signing the sample record report to the person at your drop off location. KEEP the periphyton containers and filter equipment for the second round of samples.

Appendix III SAMPLING STATION LOCATIONS

Station	UTM Easting (km)	UTM Northing (km)
QH1	362	4599.9
QH2	362.1	4600.3
QH3	361.8	4600.4
WF1	363.3	4606.8
WF2	363.3	4607.4
WF3	363	4607.3
WF4	363.1	4606.3
WH1	363.0	4611
WH2	363.1	4610.4
MG1	364.87	4612.7
MG2	364.12	4613.0
FC1	363.62	4611.7
RH1	364.3	4611.6
SQ1	365.1	4613.5
RB1	365.9	4614.7
RB2	365.3	4614.5
RB3	365.2	4615.0
HP1	364.4	4612.5
HC1	365.5	4615.9
PC1	364.5	4616.52
PC3	363.22	4615.72
PR1	365.17	4617.05
PH1	365.28	4620.31
PH2	365.6	4620.24
PH3	365.4	4618.5
BR1	365.75	4620.64
EP1	366.1	4620.3
LB2	366.4	4624.6
BC1	364.3	4622.7
OB1	362.05	4622.10
OB2	363.00	4621.8
OB3	361.2	4622.0
BD1	362.37	4622.87
ER1	362.50	4622.25
SP1	360.86	4622.26
BNC1	359.75	4620.5
LH1	360.4	4621
WR1	357.6	4623.9
WR2	357.9	4623
BMR1	357.1	4623.2
WK1	357	4623.9
AG1	359.5	4624.6
WCM1	356.1	4618.45
WCM2	356.85	4617.20
HM1	353.92	4620.07
SH1	353.12	4619.25

Station	UTM Easting (km)	UTM Northing (km)

5

SH2	353.66	4618.15
BLK1	355.00	4618.0
PL1	355.57	4617.50
AC1	352.77	4615.15
AC2	353.1	4615.30
GL1	353.32	4614.10
PI1	352.2	4612.3
MH1	349.0	4612.92
MH2	347.72	4612.45
EL1	348.42	4613.10
BI1	348.2	4610.4
LT1	344.47	4610.55
AR1	340.27	4615.57
NB1	341.37	4610.25
NB4	341.40	4609.72
PT1	343.1	4610.25
AB2	337.25	4605.35
SR1	334.5	4600.4
SR2	335.37	4600.5
SR3	335.7	4599.87
SR4	334.92	4600.17
AP1	333.55	4597.62
PN1	339.5	4590.2
CI	338.8	4587.5
AG2	358.5	4624.6
LT2	344.8	4609.5
WI1	34631	4606.5
CC1	339.2	4608.0
NR1	344.4	4611.4
SG2	353.8	4617.3
AB1	366.75	4606.6
AB2	377.8	4605.3
NB3	341.5	4607.3
WW1	354.6	4622
113W	324.2	4601.3
112W	325.0	4598.9
111W	325.1	4597.2
110W	326.5	4598.6
109E	327.2	4597.6
108E	327.3	4598.1
107E	327.6	4598.5
106E	328.7	4601.7
105E	327.5	4602.4
104E	327.9	4602.7
100HB	327.25	4603.9
101E	328.4	4609.5