SPECIAL REPORT NO. 92-002

Quality Assurance Project Plan
for
BAYWATCH
A Volunteer Program to Monitor Alabama's Coastal Waters

July 1992

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1. PROJECT DESCRIPTION

Baywatch has been designed to gather water quality data throughout the coastal region of Alabama, including Mobile Bay and its tributaries, Perdido Bay and its tributaries, the Gulf Intracoastal Waterway, Mississippi Sound, Grand Bay and Wolf Bay. Volunteers collect data at nearshore and open water stations which may then be used to assess water quality in these areas. The data will be used in determining long term trends and in evaluating existing water quality in areas not currently monitored by state agencies. In addition, EPA has encouraged states to use citizen monitoring data in preparing the "305B Water Quality Report to Congress" in which state waters are evaluated according to their ability to meet designated water use classifications. Benefits of the program are not limited to the data generated by the participants but also include the advantage of increased public awareness and understanding of the coastal system.

Parameters to be measured weekly include air and water temperature, salinity, dissolved oxygen, and secchi depth. The end point of many physical and biological processes in estuaries depends on the prevailing temperature and salinity. Dissolved oxygen concentration, a primary indicator of water quality, is often used to designate water use classifications. Secchi depth, a measure of the depth to which one may see into the water, can be used to compare visibility of water over time.

It is not always practical to preselect precise sites in a voluntary program. However, sites are located using the following criteria:

- equally divided among the estuarine, transition and tidal fresh portions of the bays;
- above and below the mouth of any tributary running into the bay;
- near a farm or animal holding facility that is instituting best management practices;
- on shore opposite a state monitoring site to allow for comparison of data sets.

Initial funding for citizen monitoring in coastal Alabama was provided by EPA as part of the Perdido Bay Cooperative Management Project to establish the Perdido Bay Citizen Monitoring Program. Additional funding through EPA's Near Coastal Waters Program as well as a grant from the Alabama department of Economic and Community Affairs and contributions from local industries and individuals allowed the expansion of citizen monitoring to encompass Alabama's entire coastal region.. The long-range intention is to erect a statewide program under the aegis of ADEM with support from the state general fund supplemented by project support from EPA.

2. PROJECT ORGANIZATION AND RESPONSIBILITY

The current project is funded by a grant to the Alabama Department of Environmental Management (ADEM) from the Environmental Protection Agency, Region IV, Near Coastal Waters Program. The Marine Environmental Sciences Consortium (MESC) has been contracted by ADEM to provide technical support for the program. The Program Manager and his assistant coordinate recruitment and training of volunteers in the use of sampling equipment, sampling techniques and reporting of data; enter data into a computerized spreadsheet format; compile and analyze data; and prepare and distribute semi-annual reports and/or newsletters. A quality assurance project plan has been developed and is implemented by the program QA Officer. The program Training Officer conducts training sessions, orders equipment, and provides replacements and refills to the volunteers. QA/QC protocols, data analysis, reports and newsletters are subject to review and approval by the Project Director. Various educational institutions and state agencies have agreed to act as "Baywatch Centers". These offices are located throughout the coverage area and provide a local source of technical assistance. Technical personnel at area Baywatch Centers have also acted as an advisory committee in the development of the monitoring program, in the preparation of QA/QC protocols, and in review of water quality data.

The advisory committee and their geographic areas are as follows:

Kelly Williams, Alabama Department of Environmental Management - **Perdido Bay, Old River**

Skip Lazauski, Alabama Department of Conservation and Natural Resources - **Bon Secour Bay, Little Lagoon, Gulf Intracoastal Waterway**

Phillip Hinesley, Weeks Bay Estuarine Research Reserve - **Weeks Bay, Fish River, Magnolia River**

John Borom, Faulkner State Junior College - **Eastern Mobile Bay, Delta**

Mary Frances Dove, Mobile College - **North Mobile County, Delta**

Lloyd Scott, Mobile County Environmental Studies Center - **Dog River, Deer River**

Rick Wallace, Auburn Marine Center Sea Grant Extension Service - **Western Mobile Bay**

Leslie Hartman, Dauphin Island Sea Lab - **South Mobile County, Dauphin Island**

The Field Monitors collect samples, perform designated analyses and send data forms directly to the Program Manager. Figure 1 summarizes the project organization in outline form. In addition to overall project oversight, ADEM will continue to provide equipment and quality assurance to the Perdido Bay Center.

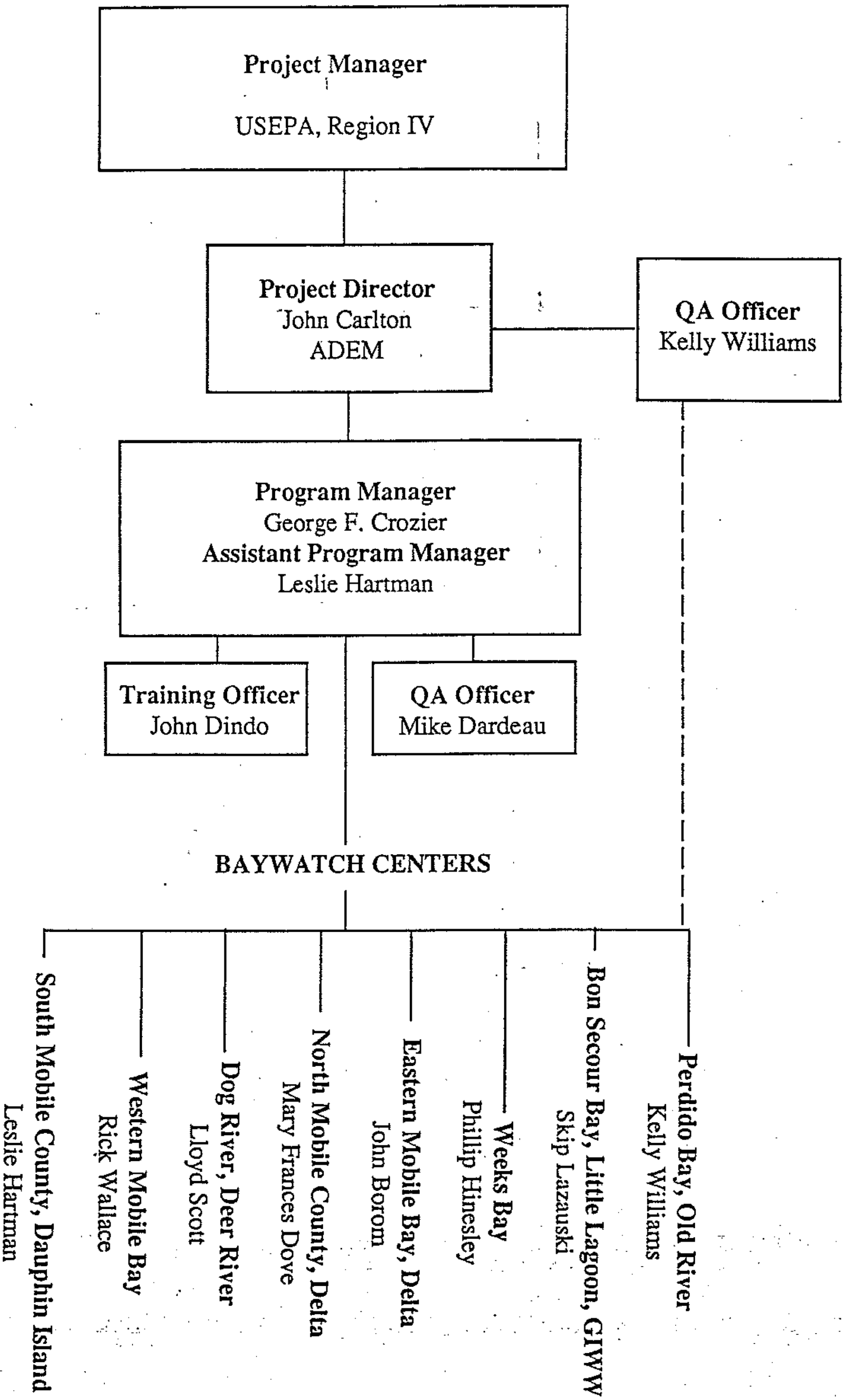


Figure 1. Project Organization and Responsibility Charges.

3. QUALITY ASSURANCE OBJECTIVES

Volunteer monitors are requested to collect data once a week; a potential of 52 observations per site per year. It is understood that some weeks may be missed for vacations, illness, and severe weather; therefore, 48 observations per year will be considered a complete data set for a given site.

Most volunteers will be sampling from their own property which means that if they drop out of the project that site will no longer be accessible. If data from that location is considered important to the overall program, an effort will be made to recruit a replacement nearby at a site with similar ecological characteristics. However, when working with volunteers this may not always be practical.

One quality control session will be held each year. Plans for this session are described in Section 9. If a monitor cannot attend the session, a site visit will be made by the QA Officer to ensure that methods of sampling and competence of the monitor meet the project standards. Volunteers will be contacted by letter or telephone when data which has been reported appear to be incorrect to the Program Manager. If the question cannot be resolved by contacting the volunteer, the Program Manager or his/her assistant will make a site visit. If a monitor is unable to meet the data quality objectives for this project, consideration will be given to allowing the person to continue if he/she wishe; however, data set will not be entered into computer.

Table 1 summarizes the QA objectives for data collected by Baywatch volunteers.

Table 1. Precision and Accuracy Objectives

Parameter	Method	Units	Sensitivity*	Precision	Accuracy	Calibration
Temperature	Thermometer	°C	0.5	∓ 0.5	∓ 1.0	NIST Certified Thermometers
Specific Gravity	Hydrometer	Specific gravity is a unitless ratio	.0005	∓ .0005	∓ .0005	NIST Certified Hydrometer
Dissolved Oxygen	Micro Winkler Titration	mg/l	1.0	∓ 5%	∓ 20%	Orion Field D.O. Meter; Hydrolab
Limit of Visibility	Secchi Disk Depth	meters	0.10 m	NA	NA	NA

*Determined by the increments measurable with the stated method reflecting estimation where allowed.

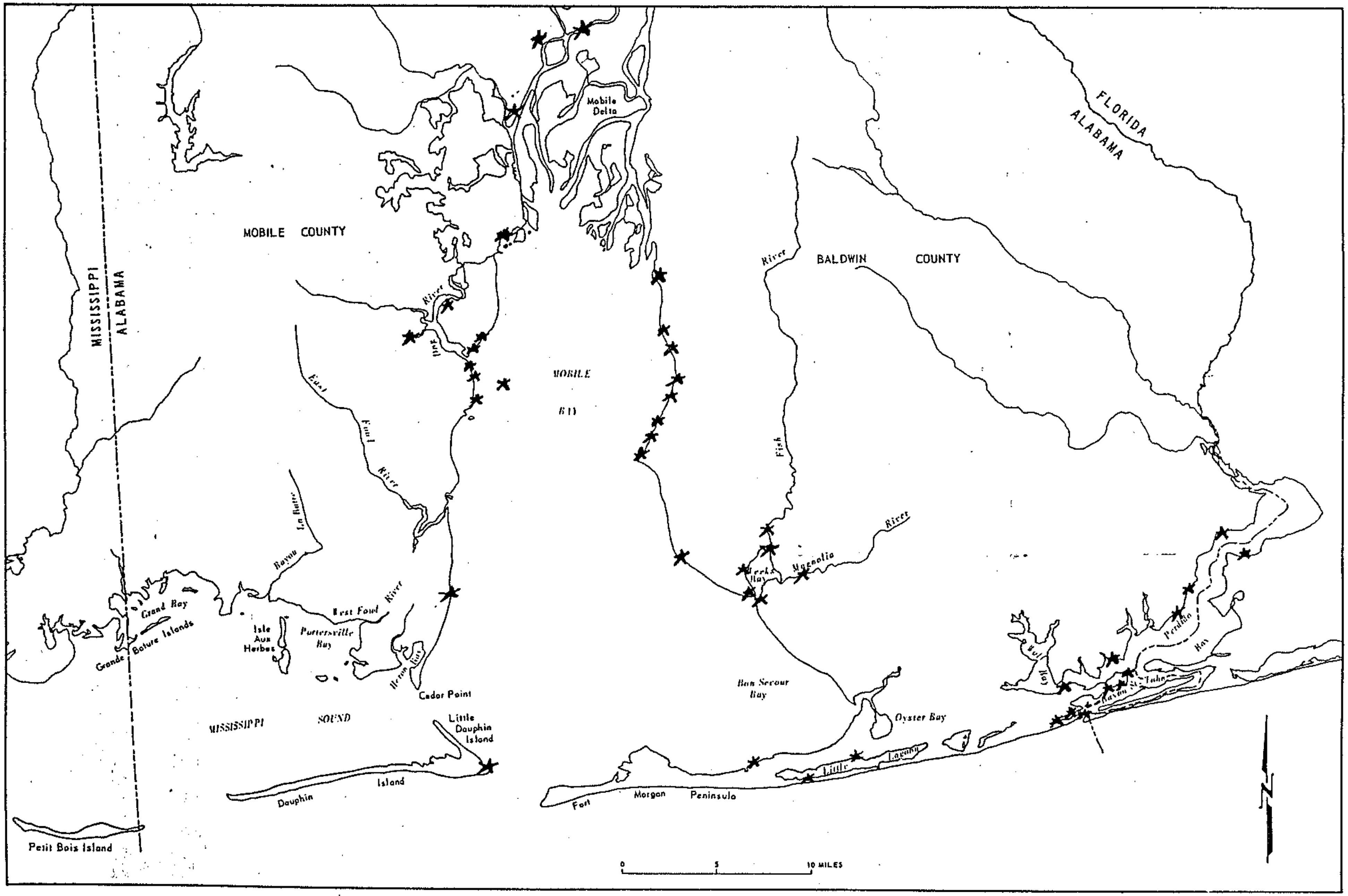
4. SAMPLING PROCEDURES

All data generated in this project involve in situ measurements, or samples collected and analyzed on location.

Open water stations will be buoyed or triangulated with fixed-shore structures. Nearshore stations will be referenced to nearby fixed structures (e.g., end of pier). Onshore sampling will be referenced to a fixed structure (e.g., a home) of known address. Figure 2 shows the location of sites in Mobile Bay and Perdido Bay.

Surface water samples or in situ measurements will be taken at approximately 5 to 10 cm below the surface. Bottom samples or measurements will be taken approximately 0.1 to 0.2 m from the bottom. Samplers that touch the bottom will require at least 30 seconds before the sample is contained or measurement taken to minimize effects of stirring up the bottom. Complete sampling procedures are included in Appendix A.

Figure 2. Active Baywatch study sites in coastal Alabama.



5. SAMPLE CUSTODY

Because only data and not samples are taken from the field, "chain-of-custody" procedures do not apply to this program.

6. CALIBRATION PROCEDURES AND FREQUENCY

Instruments and methods used in this program were chosen based on simplicity, cost and accuracy. All kits and equipment are calibrated under the supervision of the QA Officer once a year prior to a QC audit where they are used by the volunteers to test a given water sample. Faulty equipment is replaced during the calibration sessions. The QA Officer maintains a logbook with calibration information recorded for each piece of equipment, including date of calibration, readings obtained from sampling equipment, readings obtained from a standard, and percent deviation from the standard.

The following protocols will be followed at each calibration session and for the calibration of all new equipment.

TEMPERATURE

Equipment :

2 - NIST certified thermometers that read in 0.1 increments degrees C. (# 6733 certified 8/74 and # 6734 certified 8/74)
1 - Insulated cooler
1 - Wide-mouthed large jar, i.e. 1 quart mayonnaise jar.
String or twine
Ice

Procedures:

Air temperature check.

1. Place a NIST certified thermometer and the field thermometers on flat surface. Let stand 15 minutes to equilibrate.
2. Read NIST thermometer and record value.
3. Read ten field thermometers and record values.
4. Read NIST thermometer and record value.
5. Continue recording the NIST thermometer reading after every 10 field thermometers readings.
6. Upon completion of field thermometers, read NIST thermometer and record value.
7. Allow it to stand another 15 minutes and take a second reading on all thermometers following the above sequence.

Room temperature check.

1. Fill insulated cooler with tap water and let equilibrate inside overnight with NIST certified thermometer in the water.

2. Tie field thermometers to be calibrated together loosely with string and suspend in water in cooler. Do no more than 10 thermometers at a time.

3. Let stand for 15 min.
4. Read the NIST thermometer and record value.
5. Read field thermometers and record values.
6. Upon completion of the field thermometers, read the NIST thermometer and record value.
7. Let stand another 15 min. and take second reading on all thermometers.

Ice point check.

1. Prepare an ice bath in the wide-mouthed jar. Make sure that the ice to water ratio is such that the jar is packed with ice to the bottom.
2. Place NIST certified and no more than 10 field thermometers in the ice bath. If possible, suspend in center of bath by tying string to a cabinet door (or any other higher object being sure that the arrangement is not going to fall over!).
3. Let stand 15 min. Take and record readings making sure to read and record the NIST thermometer before and after every set of 10 field thermometers.
4. When all thermometers have been read once, repeat ice point check to obtain second reading.

   Analyze Results. The thermometers should read to within ± 1.0 degree C of the NIST certified thermometer. Any thermometer outside this range should not be used. (If in doubt, repeat calibration procedure on these. If still out of range, do not use.)

SALINITY

<u>Equipment</u>:

3 - Precision thermometers
3 - 500 ml graduated cylinders (Hydrometer Jars)
2 - liters distilled water
2 - liters standard seawater (34.99 ppt)
Label tape
NIST certified hydrometer (#738744 certified 5/92)
Parafilm

<u>Procedure:</u>

1. Fill three grauated cylinders as follows: (1) distilled water only, (2) standard seawater only (3) equal amounts of distilled and standard seawater. Label accordingly and cover to prevent evaporation.
2. Allow all three solutions to come to room temperaure overnight with a precision thermometer suspended in each cylinder.
3. Place NIST certified hydrometer into the cylinder and record the reading and temperature. Remove hydrometer.
4. Lower each field hydrometer into the cylinder and record reading and temperature for each.
5. Repeat procedure in each cylinder after rinsing and drying hydrometers.
6. After every 10 field hydrometers, record reading and temperature on NIST certified hydrometer.
7. Analyze results. Field hydrometers should read within ± 0.0005 of NIST certified hydrometer. Any hydrometer outside this range should not be used.

DISSOLVED OXYGEN

Dissolved oxygen measurements obtained with each HACH DO kit are compared to measurements with an Orion Model dissolved oxygen meter or with a Hydrolab water quality meter at the Dauphin Island Sea Lab, each calibrated in accordance with their manuals. Data quality was established using results from one operator (the Program Manager) using the kit over several months (duplicate samples each week). A quality control chart was constructed to determine the upper control limit and the upper warning limit for this method. (See Figure 3.) If the difference between the Hydrolab reading and the Hach kit reading is greater than the upper control limit, the kit will be eliminated from the program until acceptable readings can be obtained.

The strength of the sodium thiosulfate titrant will be checked every six months against an iodate-iodide solution equivalent to 10 mg/l dissolved oxygen. High results (> 11 mg/l) indicate the titrant should be replaced. Powder pillows will also be supplied every six months. Upon receipt of the chemicals, monitors are asked to carry out comparison titrations on ambient water samples with old and new reagents.

SECCHI DEPTH

Secchi disks with black and white quadrants and measuring 8 inches (21 cm) in diameter are used to determine the limit of visibility. A line marked off in 0.1 meter intervals is tied to each disk by the Training Officer prior to distribution to the monitors. When the Secchi depth is greater than the water depth at that particular reporting time, Secchi depth is recorded as the same as the water depth. The accuracy of the depth markings is checked against a meter stick before initial use and annually thereafter.

YSI METERS

Calibration procedures for the YSI meters are given in Appendix B.

Figure 3. Precision Quality Control Chart (Shewhart Construction Method).

Parameter: Dissolved Oxygen
Units: ppm
Method: Micro-Winkler Titration
Instrument: Hach
Conc. Range: 0-20+ O_2 in 1.0 ppm increments
Analyst: G. F. Crozier
Date Prepared: 1/21/92

$\bar{R}$: 0.5
Upper Warning Limit: 1.255
Upper Control Limit: 1.635

n	Sample No.	Replicate 1	Replicate 2	$[d_i]$	Steps taken when out-of-control
1	5/17/91	9	9	0	
2	6/8/91	9	10	1	
3	6/14/91	9	10	1	
4	6/21/91	7	7	0	
5	7/5/91	8	8	0	
6	7/25/91	8	9	1	
7	8/2/91	8	8	0	
8	8/23/91	8	9	1	
9	8/30/91	9	9	0	
10	1/10/92	13	14	1	
11					
12					
13					
14					
15					
16					
17					
18					
19					
22					
21					
23					
24					
25					

$\Sigma |d_i| = 5$

$\bar{R} = (\Sigma |d_i|)/n = 5/10 = 0.5$

$UWL = 2.51(\bar{R}) = 1.255$

$UCL = 3.27(\bar{R}) = 1.635$

7. ANALYTICAL PROCEDURES

Analytical procedures are outlined in Appendix A, Field Methods Manual for Baywatch; A Citizens Volunteer Monitoring Program.

8. DATA REDUCTION, VALIDATION AND REPORTING

Field monitors are supplied with forms (Figure 4) on which data are recorded. The forms provide a carbonless copy which is mailed to the Dauphin Island Sea Lab after each weekly sampling in addressed stamped envelopes provided by the Program Manager. The original is kept by the monitor in the event of loss in the mail and to facilitate any later questioning about data reported.

Data sheets are logged in as received by the Assistant Program Manager. This log documents week by week activity at active sites. At this time, data sheets are reviewed for completeness (i.e. missing values or illegible handwriting) and accuracy (i.e. obvious outliers or improper decimal placement). Monitors are contacted immediately to check on data gaps or missed sampling.

Data are entered into records in a dBase file with a structure similar to that of the data form. Specific gravity readings and water temperature are entered; conversion to salinity is carried out by a computer program. Duplicate DO results are entered and the average is computed. Dissolved oxygen values that are beyond the upper control limit are not entered into the file. A monitor that reports dissolved oxygen values at or above the upper warning limit two weeks running is contacted and reminded of the protocol to conduct a third titration when the duplicates differ by greater than 1.25 mg/l.

Once the data has been entered, each record is listed and checked against the originals. Plots of each value against time are examined for outliers. When data entry errors have been identified and corrections made, corrected lists and plots are generated and rechecked. A data set checklist (Figure 6) is completed by data entry personnel and the Program Manager office and returned to the QA Officer.

Figure 4. Data collection form.

Baywatch
Citizen Monitoring Program
Data Collection Form

____
Water Body

Collection Date: ____________ Monitor Number: ____________

Time of Day: ____________ Site Number: ____________

Monitor Name: ____________

Site Name: ____________

Air Temperature: ____________ C

Secchi Depth: ____________ m

Water Depth: ____________ m

Water Temperature: ____________ C
(In bucket)

Hydrometer Reading: ____________

Water Temperature: ____________ C
(In hydrometer jar)

Surface Dissolved Oxygen: Test 1: ______ Test 2: ______

Bottom Dissolved Oxygen: Test 1: ______ Test 2: ______

Water Surface: (Circle One)

1 = Calm 2 = Ripple 3 = Waves 4 = White Caps

Weather: (Circle One)

1 = Cloudless	2 = Partly Cloudy	3 = Overcast	4 = Fog
5 = Drizzle	6 = Intermittent Rain	7 = Rain	8 = Haze

Other: (Circle ones that apply)

1 = Jelly Fish	2 = Dead Fish	3 = Dead Crabs	4 = SAV
5 = Oil Slick	6 = Dead Dolphin	7 = Debris	8 = Erosion
9 = Foam	10 = Bubbles	11 = Odors	12 = Dead Marine Turtles

Water Color: (Circle one and describe) NORMAL ABNORMAL

Comments: (Observations about your site)

Signature ______________________ Date ______________

Figure 5. Data Set Checklist.

DATA SET CHECKLIST

Date of Entry: ______________________

Person Entering: ______________________

dBase Record Numbers: __________ - __________

Listed Data Compared to Originals by:

Name: ______________________________ Date: ____________

Plots Examined for Outlier by:

Name: ______________________________ Date: ____________

Corrections Compared to Originals by:

Name: ______________________________ Date: ____________

Final Plots of Corrected Data Examined by Program Manager's Office:

Name: ______________________________ Date: ____________

9. INTERNAL QUALITY CONTROL CHECKS

Volunteers attend an initial training session. This session includes a discussion of water quality testing and a demonstration of techniques followed by an opportunity to practice. Volunteers who are unable to attend a session are trained by the Program Manager individually.

The Quality Assurance Officer will conduct one QC audit per year in combination with a training review session. If a volunteer does not attend the QC audit, the QA officer will make a site visit to assure that the individual is correctly following procedures. If a monitor is unable to meet the data quality objectives but wishes to continue monitoring, their data will not be entered into the computer file.

At the QC audit, all volunteers are asked to test the same water with their own, recently calibrated, equipment. Results are compared to those obtained by the Program Manager and to values recorded by a Hydrolab Surveyor calibrated according to instructions. Data collected at the QC sessions are used to assess and update the accuracy and precision of the data collected in this program.

10. PERFORMANCE AND SYSTEM AUDITS

No performance and system audits beyond the described QC sessions are planned. The activities included in the QC exercises basically constitute performance and system audits.

Attempts will be made to go over the results recorded at a QC audit with the participants before they leave. A discussion of any difference in results obtained can clear up difficulties and differences in technique without embarrassing or putting a particular individual on the spot. Defective equipment or outdated reagents can be replaced on the spot. When it is not possible to go over the results at the QC session, a copy of an individual's results compared to the reference standard is sent to each participant. It will be necessary to contact monitors whose results are unacceptable by phone or in person.

The results recorded by the individual monitors at QC audits are kept by the QA Officer.

11. PREVENTIVE MAINTENANCE

The major causes of missed observations in a volunteer program are: 1) broken equipment; 2) monitor runs out of reagent and replacements are not requested or do not reach the site before the next sampling time; 3) volunteer is ill, goes on vacation or gets too busy to sample at the regular time.

Each monitor is encouraged to contact the Program Manager or their Baywatch Center as soon as possible if instruments fail to operate. The training session should emphasize the proper handling and cleaning of equipment.

The Program Manager will replacement equipment and reagents on hand at all times and provide requested replacements. One can anticipate the amount of reagent needed for most tests and see that they are received by monitors before the current ones are used up. Reagents should not be stored more than six months.

We have assumed that all monitors will take a vacation and may miss a couple of weeks for other reasons during the year. If someone plans to be away for an extended period of time, particularly in the summer, we encourage them to find a reliable substitute to collect the data. Neighbors can plan to share a site. Substitute monitors should be trained and checked out by the Program Manager or the Training Officer. In actual practice, this may prove difficult due to lack of notice and travel time.

Table 2. List of Equipment and regeants.

EQUIPMENT AND REAGENTS	CATALOG/ NUMBER
ASTM 111H Hydrometer (60°F/60°F)	VWR 35125-647
Secchi Disc	LaMotte 0171
Thermometer	Fisher 14-985-5b
Dissolved Oxygen 1 Reagent Powder Pills	Hach 981-99
Dissolved Oxygen 2 Reagent Powder Pills	Hach 982-99
Dissolved Oxygen 3 Reagent Powder Pills	Hach 987-99
Sodium Thiosulfate, Stabilized, Standard Solution, 0.0109N	Hach 24089-37
Bottle, Dissolved Oxygen, glass-stoppered	Hach 1909-02
Bottle, square, mixing	Hach 439-06
Clippers	Hach 968-00
Stopper, for dissolved oxygen bottle	Hach 1909-01
Tube, measuring 5.83 mL	Hach 438-00
Starch Indicator Solution (not included in kit)	Hach 349-37
Cylinder, 500 mL	Hach 1949-00
YSI Dixxolved Oxygen Meter	YSI 57
YSI Oxygen Temperature Probe	YSI 5740
YSI S-C-T Meter	YSI 33
YSI S-C-T Probe	YSI 33111

12. SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

DISSOLVED OXYGEN

The precision of dissolved oxygen measurements obtained with the HACH kit is stated as n mg/l $\pm$ 1.635 and was developed from a Precision Quality Control chart (Shewhart Construction Method). (See Figure 4). This chart is based on replicate samples taken by the Program Manager over a period of time. It computes an upper warning limit of 1.25 and an upper control limit of 1.64. Monitors titrate two samples at each sampling time. They are instructed to do a third titration if the difference between the first two is greater than 1.25 mg/l. The average of the two closer values is recorded. If values differing by more than 1.64 are reported with no third test done, the results are not entered in the file. If a volunteer reports values beyond the warning limit two weeks in a row, he/she is called to determine the cause of the problem. A site visit may be necessary.

The precision and accuracy of DO values obtained with three different HACH kits are presented for four values of DO in Table 3.

Table 3. Precision and accuracy of DO measurements with HACH DO Kits.

	MEAN O_2 LEVEL (mg/l) Measured by Orion meter			
	6.95	**7.55**	**9.20**	**10.20**
$\bar{x}$ (mg/l)	**8.0**	**9.0**	**10.6**	**11.8**
c.v. (%)	**0**	**0**	**4.91**	**3.47**
Deviation (%)	**15.1**	**19.2**	**15.2**	**15.7**

TEMPERATURE MEASUREMENT

At the beginning of the project, 47 thermometers were calibrated using NIST certified thermometers. The field thermometers were tested first in air (21.3°C) then placed in two water baths: 1) an ice bath; 2) large beaker of water stabilized at room temperature (18.5 °C). At least two readings were taken on each thermometer in each bath. The overall average difference between the field thermometer reading and readings of the certified thermometer over a range of 0 -22 °C, calculated by summing the absolute value of the individual differences and dividing by the number of observations, was ± 0.404 °C (.763 = s.d.). Precision and accuracy of the air and water treatments are given in Table 4. Since the thermometers read no closer than 0.5 °C, the error in any individual thermometer does not add sufficient bias to warrant the use of individual correction factors or, for that matter, the use of any correction factor. A protocol has been developed to test all thermometers purchased for use in the project and a basis for rejection is stated (see Section 6).

Table 4. Precision and accuracy of temperature measurements using Fisher thermometers.

	Temperature as Measured by NIST Thermometer	
	Air (21.3 °C)	**Water bath (18.5 °C)**
$\bar{x}$ (°C)	**21.3**	**18.7**
c.v.	**2.3**	**2.0**
Deviation (%)	**0**	**1.08**

SALINITY DETERMINATION

Specific gravity hydrometers will be used to determine salinity. . The individual hydrometers will be used to measure specific gravity of three concentrations of seawater ranging from 0-35 o/oo. Because thy hydrometers have scales graduated on a 60 °F/60 °F basis, specific gravity will be converted to density by subtracting 0.0009; density will then be converted to salinity at a standard reference temperature (15 °C) based on the temperature of the sample using the following algorithm:

corrected density = .00385734
- .0000018 x water temperature
+ .0000053 x (water temperature)^2
+ .9950385 x hydrometer reading

then at 15 °C
salinity = 1,304.6670601 x corr. density -1303.58929105

Forty hydrometers were calibrated using a NIST certified hydrometer. Field hydrometers were placed in solutions of standard seawater and distilled water at calculated salinities of 0, 17.5 and 35o/oo. The overall error, calculated by summing the absolute value of individual differences and dividing by the number of observations, was 1.08o/oo. Precision and accuracy of the 17.5 and 35 o/oo treatments are shown below in Table 5.

Table 5. Precision and accuracy of salinity calculated from field hydrometer readings and Fisher thermometer readings.

	Salinity	
	17.5o/oo	**35 o/oo**
$\overline{x}$ (o/oo)	**19.02**	**35.91**
c.v. (%)	**2.00**	**1.25**
Deviation (%)	**8.7**	**2.6**

LIMIT OF VISIBILITY

Although the Secchi disk is in common use world wide, accuracy and precision values have not been formally established. Intensive practice at group training sessions should optimize accuracy and precision, and may suggest appropriate values for these parameters.

13. CORRECTIVE ACTION FOR OUT OF CONTROL SITUATIONS

The responsibility for deciding to take corrective action rests with the Program Manager. Data collection forms will be reviewed as they are received. Editorial changes may be made at this time so that the data will be entered correctly. If any of the data are questionable, the monitor should be contacted by phone to find out what the problem is and to indicate what should be done to correct the problem. The only measurement for which we have stated upper control and warning limits is the dissolved oxygen test. If a monitor reports duplicate values that are beyond the UCL two weeks in a row or a third test has not been run, he/she will be contacted to see if the results can be improved by more careful techniques.

14. QUALITY ASSURANCE REPORTS

An annual report will be prepared by the Program Manager and presented to the Project Director and the Project Manager for the purpose of apprising them of the status of the Baywatch Monitoring Program. This report will include:

- a status report on the program as a whole;
- results of QC sessions;
- the level of participation for the year;
- a summary of the data with comments on any observed trends.

Appendix A

Field Methods Manual for Baywatch

Field Methods Manual for Baywatch; a Citizens Volunteer Monitoring Program

Introduction

With the increasing public concern over pollution effects, it is not surprising that many areas have begun sponsoring Citizens Volunteer Monitoring Programs. Baywatch was begun to monitor the continued water quality of the Mobile Bay area. Like all Citizen Monitoring groups, the quality of Baywatch data has been questioned by skeptics. To help minimize this criticism, volunteers must try to ensure the precision and replicatability of their samples. In an effort to control variability, this guide has been developed to ensure that all sampling is done in the same manner.

Volunteers are asked to measure dissolved oxygen (DO), Secchi depth, air and water temperatures, and salinity. They are also asked to report on weather conditions, water conditions, amount of rainfall or any unusual occurrences. While some of these methods may seem overly simple and others too complex, please try to follow these directions exactly. If our sample methods conform, we will have any easier time in monitoring small changes in the Bay's health. If we each use our own methods, small changes in data will be assumed to be error rather than a real change.

Due to the nature of our sampling regime, most data is taken quite close to shore, frequently off piers. To ensure a certain degree of ease in sampling, volunteers record data from buckets of Bay water rather than straight from the Bay itself. For each replicate water quality test a bucket of Bay water is collected, data obtained and the sample returned downstream from the sampling site. The most efficient way to accomplish all sampling tasks is to first take the air temperature making sure to record the temperature in the shade and record. The Secchi disc is then used to obtain the amount of light penetration and recorded. Using the Secchi disc, depth of the sampling area will then be determined. A bucket of sample water is then taken from your sample area. First fill your dissolved oxygen (DO) bottles with the sample and set aside. Place the thermometer to the immersion line only. Place the hydrometer into the hydrometer jar as well and, while they are acclimating, add the chemicals to your DO sample and record. While you have done your DO test, both temperature and hydrometer readings will have stabilized make sure to record these readings at eye level. From the water in the bucket, do a second DO test and if necessary a third.

Temperature

Thermometers are easy to use. They are also fragile! To avoid breakage, keep them in their containers when not in use. Damage may also be caused by exposure to full sunlight. The thermometer heats rapidly and may take an excessively long time to equilibrate during use. To avoid this problem, keep the thermometer in the shade of any available object (including your body). Remember to take air temperature before collecting your water sample. If the thermometer is still wet when taking air temperature the water may make your reading too low. If you take water the temperature first by mistake, please remember to dry thoroughly before obtaining the air temperature.

Note: mercury is toxic, if you break a thermometer do not use your hands to clean it up! Use cardboard to roll the mercury together, put mercury and all broken parts in a plastic bag and take to your Baywatch center. If any gets on your skin, wash thoroughly with water.

Air

1. Hold thermometer in the shade at your station. When reading stabilizes, in approximately 30 seconds, record temperature to the nearest half degree Celsius (e.g., 25.5°C).

Surface Water

1. Immerse bulb end of thermometer in the water to the immersion line in a shaded area for about 3 minutes or until stable. While still immersed read to the nearest half degree Celsius and record data.

Bottom Water (as Required)

1. Upon recovery of your bottom sample, put thermometer in the sample for about 3 minutes.

Limit of Visibility - Secchi Disc

This test is a rough measure of water turbidity (cloudiness). The cloudier the water, the less light will penetrate the surface. For the most accurate measurements, the Secchi disc is painted black and white, white is the best reflector of light while black absorbs very well. To keep these readings as accurate as possible, remove your sun-glasses. This will mean a glare, to reduce it, take readings in the **shade** preferably between 9 am and 3 pm.

1. Slowly lower the Secchi disc in the water until it just barely disappears from sight. Record the value to the nearest tenth of a meter, this can be done by counting the number tiewraps and multiplying by 10 (e.g. 1.10m **OR** 11x10=110cm).

2. Slowly raise the disc until it is barely visible. Record this value also to the nearest tenth meter.

3. Take the average of the two numbers and record Secchi depth to the nearest quarter (e.g. 1.10+1.30=1.20m **OR** 110+130=120cm).

4. IF you can still see your Secchi disc while it is on the bottom, record the depth and indicate that it is on the bottom.

Water Depth

Water depth will fluctuate with tide and season, it is important to measure depth each time you sample.

1. Lower the Secchi disc into the water until it hits the bottom.

2. Make sure the line is taut and record the depth to the nearest tenth meter.

Dissolved Oxygen (DO)

This is perhaps the most important of tests. It is also more complex to perform. Because it requires the use of chemicals, and is very sensitive to any accidental air bubbles, we ask that volunteers perform this test at least twice. Dissolved oxygen (DO) fluxes seasonally, a low DO reading should not be regarded with alarm. Only when DO is low for an extended period of time or during the wrong season will it become harmful. Please, take extra care with this test. Our fish and crabs need enough oxygen to breathe, also.

Remember to run this test immediately upon sampling, DO will change over time.

Note: if you come in contact with any chemicals, rinse area liberally with water.

1. Lower glass-stopper DO bottle to the level of water to be sampled and allow the water to overflow for two to three minutes. Stopper bottle carefully under water if sampling from shore. Make sure there are no air bubbles present by gently tipping the bottle.

2. Add the contents of pillow 1 (manganous sulfate powder) and pillow 2 (alkaline iodide azide powder) to the DO bottle. Put in stopper making sure that no air is trapped inside, and shake vigorously. If air bubbles are present, discard sample and take a new one. If oxygen is present, a brownish-orange precipitate (floc) will form. Gently tilt this bottle and slowly insert the stopper. Again, avoid air bubbles.

   Note: Following the addition of reagents 1 and 2 in the field the test may be completed indoors. Test must be completed within 6 hours of sample collection.

3. Allow the sample to stand until the precipitate settles halfway in the bottle, leaving the upper half clear. (In samples of high salt content, such as sea water, the floc will not settle. The test can proceed after allowing the sample to sit for 4-5 minutes.) Shake the bottle again and wait for the same changes.

4. Add pillow 3 (sulfamic acid powder) to the sample and shake. This should cause the precipitate to dissolve and the water to turn yellow if oxygen is present.

5. Pour the sample to the top of the measuring tube, then pour the remaining sample into the square mixing bottle. To the mixing bottle, add 1-2 drops of starch to color the sample blue.

6. While swirling the prepared sample, add the PAO solution (Sodium Thiosulfate Standard Solution) 1 drop at a time while counting the numbers of drops needed to change the sample from blue to colorless. To ensure the correct amount of PAO solution is used, hold the bottle against a white background. Record this number.

   Note: be sure to hold the dropper straight up and down to ensure that the dropper is dispensing the same amount per drop (1 drop=1.0 mg/liter DO).

7. Repeat the test and record its value.

8. If the two values are more than 1 unit apart (Example 9 and 11), do a third test and record the two closest values.

If the results in Step 8 are very low, below 3mg/L it is advisable to obtain a more sensitive test.

9. Use the prepared sample left from Step 5. Pour off contents of the DO bottle until the level just reaches the 30mL mark on the bottle.

10. Add Sodium Thiosulfate Standard Solution drop by drop directly to the DO bottle. Count each drop as it is added and swirl the bottle constantly to mix while adding the PAO (Sodium Thiosulfate Standard Solution). Count the drops needed to make the sample colorless.

11. Each drop of PAO Standard Solution used to bring about this change equals 0.2mg/L of dissolved oxygen. Record.

Bottom DO

Some sites have available to them a DO bottom sampler. All of these sites exceed 2m except during extreme tides and storms. When a deep site exists, the surface water may be oxygenated by the wind while bottom waters may rapidly use up oxygen that is not easily replaced. These are the sites that need bottom samplers.

1. Insert the DO bottle, without the stopper, into the bottom sampler.

2. Put the top on the container and lock down.

3. Lower the sampler gently toward the bottom without touching the bottom. Hold the sampler steady at approximately 10cm above the bottom and maintain there for 2 minutes.

4. Rapidly pull sampler to the surface.

5. Remove the bottle and test sample using the above method.

Water Density - Hydrometer

Salinity is determined by measuring the specific gravity, or density, of water. To do this, a specifically weighted hydrometer is floated in the sample water. Because the density of water changes with temperature (more dense with colder temperatures, less dense with warmer temperatures) it is very important to take temperature simultaneously with your hydrometer measurement.

1. Fill hydrometer jar about 3/4 full with sample water.

2. Hang the thermometer in the jar to immersion line.

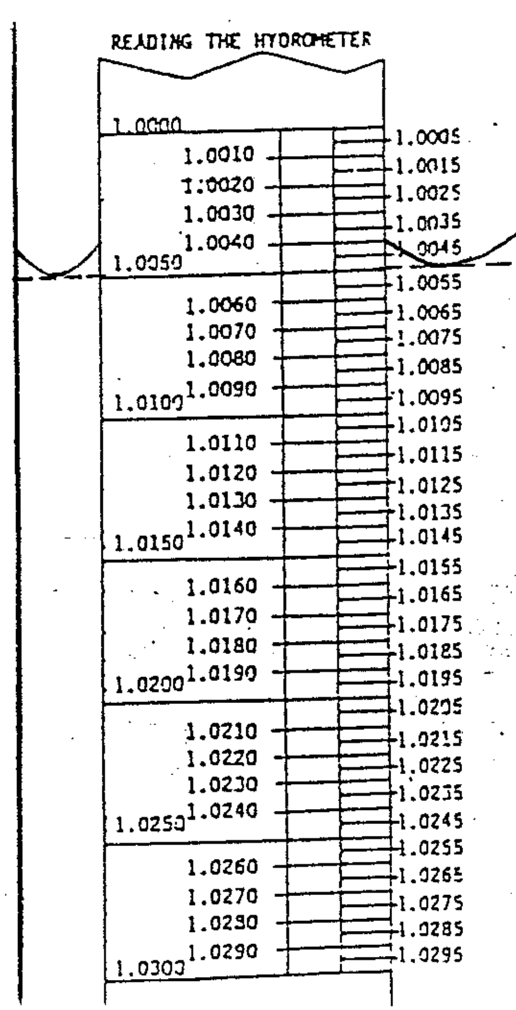
3. Slowly lower the hydrometer into the jar and wait for it to settle down.

4. Read and record the temperature in the jar.

5. Read and record the specific gravity to 4 decimal places (Figure 1).

   Note: The water will rise at the edge to form a dome called a meniscus. This will be higher than the actual water level. It is the water level that is the correct reading! Please read the bottom of the meniscus.

Example: In Figure 1 the meniscus has its base at 1.0050 and domes up to 1.0040. Th : correct reading is 1.0050.



Note: These hydrometers do not read in salinity but in specific gravity, we ask only that you report specific gravity to 4 decimal places. If for your own information you would like to determine salinity, follow the next steps.

5. Use Table 210:I Values for converting hydrometer readings at certain temperatures to density at 15°C to determine the actual density of the sample.

Example: Observed hydrometer reading is 1.0110, water temperature in the is 25°C. Locate observed density of 1.0110 on the left hand column. Follow across horizontally until coming to 25°C on page 105 of Table 210:I. See the number **21**. This number is added to the last two digits (third and fourth decimal places) of the observed reading:

1.0110 Observed density
\+ 21 Correction factor
1.0131 Corrected density

Positive numbers are added; negative numbers are subtracted; when the water temperature is 15°C, no correction is necessary.

6. Once density has been determined, you can use Table II: Corresponding densities and salinities (Density at 15°C-Salinity in parts per 1,000) to determine the actual salinity. Find the corrected density in the table, in the column to the right is the actual salinity.

5. Read and record specific gravity to the fourth decimal place.

Note: the water will rise at the edge to form a dome called a meniscus. This will be higher than the water level. It is the water level that is the correct reading! Please read the bottom of the meniscus.

TABLE 210:L VALUES FOR CONVERTING HYDROMETER READINGS AT CERTAIN TEMPERATURES TO DENSITY AT 15°C*

Observed Reading	Temperature of Water in Jar, °C												
	−2.0	−1.0	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
0.9960													
0.9970													
0.9980													
0.9990	−1	−2	−3	−4	−5	−5	−6	−6	−6	−6	−6	−5	−5
1.0000	−2	−3	−4	−5	−5	−6	−6	−6	−6	−6	−6	−5	−5
1.0010	−3	−4	−4	−5	−6	−6	−6	−7	−7	−6	−6	−6	−5
1.0020	−3	−4	−5	−6	−6	−7	−7	−7	−7	−7	−6	−6	−5
1.0030	−4	−5	−6	−6	−7	−7	−7	−7	−7	−7	−6	−6	−5
1.0040	−4	−5	−6	−7	−7	−7	−8	−8	−7	−7	−7	−6	−6
1.0050	−5	−6	−6	−7	−8	−8	−8	−8	−8	−7	−7	−6	−6
1.0060	−6	−6	−7	−8	−8	−8	−8	−8	−8	−8	−7	−6	−6
1.0070	−6	−7	−8	−8	−8	−8	−8	−8	−8	−8	−7	−7	−6
1.0080	−7	−8	−8	−9	−9	−9	−9	−9	−8	−8	−7	−7	−6
1.0090	−7	−8	−9	−9	−9	−9	−9	−9	−9	−8	−8	−7	−6
1.0100	−8	−9	−9	−10	−10	−10	−10	−9	−9	−8	−8	−7	−6
1.0110	−9	−9	−10	−10	−10	−10	−10	−10	−9	−9	−8	−7	−6
1.0120	−9	−10	−10	−10	−10	−10	−10	−10	−10	−9	−8	−7	−7
1.0130	−10	−10	−11	−11	−11	−11	−11	−10	−10	−9	−8	−8	−7
1.0140	−10	−11	−11	−11	−11	−11	−11	−11	−10	−10	−9	−8	−7
1.0150	−11	−11	−12	−12	−12	−12	−11	−11	−10	−10	−9	−8	−7
1.0160	−12	−12	−12	−12	−12	−12	−12	−11	−11	−10	−9	−8	−7
1.0170	−12	−12	−12	−13	−13	−12	−12	−12	−11	−10	−9	−8	−7
1.0180	−13	−13	−13	−13	−13	−13	−12	−12	−11	−10	−9	−8	−7
1.0190	−13	−13	−14	−14	−13	−13	−13	−12	−12	−11	−10	−9	−8
1.0200	−14	−14	−14	−14	−14	−13	−13	−12	−12	−11	−10	−9	−8
1.0210	−14	−14	−14	−14	−14	−14	−13	−13	−12	−11	−10	−9	−8
1.0220	−15	−15	−15	−15	−15	−14	−14	−13	−12	−11	−10	−9	−8
1.0230	−15	−15	−15	−15	−15	−15	−14	−13	−12	−12	−10	−9	−8
1.0240	−16	−16	−16	−16	−15	−15	−14	−14	−13	−12	−11	−10	−8
1.0250	−16	−16	−16	−16	−16	−15	−15	−14	−13	−12	−11	−10	−8
1.0260	−17	−17	−17	−16	−16	−16	−15	−14	−13	−12	−11	−10	−8
1.0270	−18	−17	−17	−17	−17	−16	−15	−14	−14	−12	−11	−10	−9
1.0280	−18	−18	−18	−17	−17	−16	−16	−15	−14	−13	−11	−10	−9
1.0290	−19	−18	−18	−18	−17	−17	−16	−15	−14	−13	−12	−10	−9
1.0300	−19	−19	−19	−18	−18	−17	−16	−15	−14	−13	−12	−10	−9
1.0310	−20	−19	−19	−19	−18	−17	−16	−16	−15	−13	−12	−10	−9

* Add tabular values to the last decimal of observed reading. For example, an observed reading of 1.0000 at 10.0°C is converted to 1.0000 + (−0.0005) or 0.9995 at 15°C.

TABLE 210:I. CONT.

Observed Reading	Temperature of Water in Jar, °C											
	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	18.5	19.0	19.5	20.0
0.9960												
0.9970												
0.9980							3	4	5	6	7	8
0.9990	−4	−3	−2	−1	0	1	3	4	5	6	7	8
1.0000	−4	−3	−2	−1	0	1	3	4	5	6	7	8
1.0010	−4	−3	−2	−1	0	1	3	4	5	6	7	8
1.0020	−4	−3	−2	−1	0	1	3	4	5	6	7	8
1.0030	−4	−3	−2	−1	0	1	3	4	5	6	7	8
1.0040	−5	−4	−3	−1	0	2	3	5	6	6	7	8
1.0050	−5	−4	−3	−1	0	2	3	5	6	7	8	9
1.0060	−5	−4	−3	−1	0	2	3	5	6	7	8	9
1.0070	−5	−4	−3	−2	0	2	3	5	6	7	8	9
1.0080	−5	−4	−3	−2	0	2	3	5	6	7	8	9
1.0090	−5	−4	−3	−2	0	2	3	5	6	7	8	9
1.0100	−5	−4	−3	−2	0	2	3	5	6	7	8	9
1.0110	−5	−4	−3	−2	0	2	3	5	6	7	8	9
1.0120	−6	−4	−3	−2	0	2	3	5	6	7	8	9
1.0130	−6	−4	−3	−2	0	2	4	5	6	7	8	10
1.0140	−6	−4	−3	−2	0	2	4	5	6	8	9	10
1.0150	−6	−4	−3	−2	0	2	4	5	6	8	9	10
1.0160	−6	−5	−3	−2	0	2	4	6	7	8	9	10
1.0170	−6	−5	−3	−2	0	2	4	6	7	8	9	10
1.0180	−6	−5	−3	−2	0	2	4	6	7	8	9	10
1.0190	−6	−5	−3	−2	0	2	4	6	7	8	9	10
1.0200	−6	−5	−3	−2	0	2	4	6	7	8	9	10
1.0210	−6	−5	−3	−2	0	2	4	6	7	8	9	10
1.0220	−7	−5	−3	−2	0	2	4	6	7	8	9	11
1.0230	−7	−5	−4	−2	0	2	4	6	7	8	9	11
1.0240	−7	−5	−4	−2	0	2	4	6	7	8	10	11
1.0250	−7	−5	−4	−2	0	2	4	6	7	8	10	11
1.0260	−7	−5	−4	−2	0	2	4	6	7	9	10	11
1.0270	−7	−5	−4	−2	0	2	4	6	7	9	10	11
1.0280	−7	−6	−4	−2	0	2	4	6	8	9	10	11
1.0290	−7	−6	−4	−2	0	2	4	6	8	9	10	11
1.0300	−7	−6	−4	−2	0	2	4	6	8	9	10	12
1.0310	−8	−6	−4	−2	0	2	4					

TABLE 210:I. CONT.

Observed Reading	Temperature of Water in Jar, °C												
	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.5	25.0	25.5	26.0	26.5
0.9960											19	20	21
0.9970			10	11	12	14	15	16	17	18	19	20	22
0.9980	9	10	11	12	13	14	15	16	17	18	19	21	22
0.9990	9	10	11	12	13	14	15	16	17	18	20	21	22
1.0000	9	10	11	12	13	14	15	16	17	19	20	21	22
1.0010	9	10	11	12	13	14	15	17	18	19	20	21	23
1.0020	9	10	11	12	13	14	16	17	18	19	20	22	23
1.0030	9	10	11	12	13	15	16	17	18	19	21	22	23
1.0040	9	10	11	12	14	15	16	17	18	20	21	22	23
1.0050	10	11	12	13	14	15	16	17	19	20	21	22	24
1.0060	10	11	12	13	14	15	16	18	19	20	21	23	24
1.0070	10	11	12	13	14	15	17	18	19	20	21	23	24
1.0080	10	11	12	13	14	16	17	18	19	20	22	23	24
1.0090	10	11	12	13	15	16	17	18	19	21	22	23	25
1.0100	10	11	12	14	15	16	17	18	20	21	22	24	25
1.0110	10	12	13	14	15	16	17	19	20	21	22	24	25
1.0120	10	12	13	14	15	16	18	19	20	21	23	24	25
1.0130	11	12	13	14	15	16	18	19	20	22	23	24	26
1.0140	11	12	13	14	15	17	18	19	20	22	23	24	26
1.0150	11	12	13	14	16	17	18	20	21	22	23	25	26
1.0160	11	12	13	14	16	17	18	20	21	22	24	25	26
1.0170	11	12	13	15	16	17	18	20	21	22	24	25	27
1.0180	11	12	14	15	16	17	19	20	21	23	24	25	27
1.0190	11	12	14	15	16	18	19	20	21	23	24	26	27
1.0200	11	13	14	15	16	18	19	20	22	23	24	26	27
1.0210	12	13	14	15	17	18	19	21	22	23	25	26	27
1.0220	12	13	14	15	17	18	19	21	22	23	25	26	28
1.0230	12	13	14	16	17	18	20	21	22	24	25	26	28
1.0240	12	13	14	16	17	18	20	21	22	24	25	27	28
1.0250	12	13	15	16	17	18	20	21	23	24	25	27	28
1.0260	12	13	15	16	17	19	20	22	23	24	26	27	29
1.0270	12	14	15	16	17	19	20	22	23	24	26	27	29
1.0280	12	14	15	16	18	19	20	22	23	25	26	28	29
1.0290	13	14	15	16	18	19	21	22	23				
1.0300	13	14	15	16	18								
1.0310													

Corresponding densities and salinities

[Density at 15° C.—Salinity in parts per 1,000]

Table II.

Density	Salinity	Density	Salinity	Density	Salinity	Density	Salinity	Density	Salinity	Density	Salinity
0.9991	0.0	1.0046	7.1	1.0101	14.2	1.0156	21.4	1.0211	28.6	1.0266	35.8
.9992	.0	1.0047	7.2	1.0102	14.4	1.0157	21.6	1.0212	28.8	1.0267	35.9
.9993	.1	1.0048	7.3	1.0103	14.5	1.0158	21.7	1.0213	28.9	1.0268	36.0
.9994	.3	1.0049	7.5	1.0104	14.6	1.0159	21.8	1.0214	29.0	1.0269	36.2
.9995	.4	1.0050	7.6	1.0105	14.8	1.0160	22.0	1.0215	29.1	1.0270	36.3
.9996	.5	1.0051	7.7	1.0106	14.9	1.0161	22.1	1.0216	29.3	1.0271	36.4
.9997	.7	1.0052	7.9	1.0107	15.0	1.0162	22.2	1.0217	29.4	1.0272	36.6
.9998	.8	1.0053	8.0	1.0108	15.2	1.0163	22.4	1.0218	29.5	1.0273	36.7
.9999	.9	1.0054	8.1	1.010[illegible]	15.3	1.0164	22.5	1.0219	29.7	1.0274	36.8
1.0000	1.1	1.0055	8.2	1.0110	15.4	1.0165	22.6	1.0220	29.8	1.0275	37.0
1.0001	1.2	1.0056	8.4	1.0111	15.6	1.0166	22.7	1.0221	29.9	1.0276	37.1
1.0002	1.3	1.0057	8.5	1.0112	15.7	1.0167	22.9	1.0222	30.0	1.0277	37.2
1.0003	1.4	1.0058	8.6	1.0[illegible]3	15.8	1.0168	23.0	1.0223	30.2	1.0278	37.3
1.0004	1.6	1.0059	8.8	1.0114	16.0	1.0169	23.1	1.0224	30.3	1.0279	37.5
1.0005	1.7	1.0060	8.9	1.0115	16.1	1.0170	23.3	1.0225	30.4	1.0280	37.6
1.0006	1.8	1.0061	9.0	1.0116	16.2	1.0171	23.4	1.0226	30.6	1.0281	37.7
1.0007	2.0	1.0062	9.2	1.0117	16.3	1.0172	23.5	1.0227	30.7	1.0282	37.9
1.0008	2.1	1.0063	9.3	1.0118	16.5	1.0173	23.7	1.0228	30.8	1.0283	38.0
1.0009	2.2	1.0064	9.4	1.0119	16.6	1.0174	23.8	1.0229	31.0	1.0284	38.1
1.0010	2.4	1.0065	9.6	1.0120	16.7	1.0175	23.9	1.0230	31.1	1.0285	38.2
1.0011	2.5	1.0066	9.7	1.0121	16.9	1.0176	24.0	1.0231	31.2	1.0286	38.4
1.0012	2.6	1.0067	9.8	1.0122	17.0	1.0177	24.2	1.0232	31.4	1.0287	38.5
1.0013	2.8	1.0068	9.9	1.0123	17.1	1.0178	24.3	1.0233	31.5	1.0288	38.6
1.0014	2.9	1.0069	10.1	1.0124	17.3	1.0179	24.4	1.0234	31.6	1.0289	38.8
1.0015	3.0	1.0070	10.2	1.0125	17.4	1.0180	24.5	1.0235	31.8	1.0290	38.9
1.0016	3.2	1.0071	10.3	1.0126	17.5	1.0181	24.7	1.0236	31.9	1.0291	39.0
1.0017	3.3	1.0072	10.5	1.0127	17.6	1.0182	24.8	1.0237	32.0	1.0292	39.2
1.0018	3.4	1.0073	10.6	1.0128	17.8	1.0183	25.0	1.0238	32.1	1.0293	39.3
1.0019	3.5	1.0074	10.7	1.0129	17.9	1.0184	25.1	1.0239	32.3	1.0294	39.4
1.0020	3.7	1.0075	10.8	1.0130	18.0	1.0185	25.2	1.0240	32.4	1.0295	39.6
1.0021	3.8	1.0076	11.0	1.0131	18.2	1.0186	25.4	1.0241	32.5	1.0296	39.7
1.0022	3.9	1.0077	11.1	1.0132	18.3	1.0187	25.5	1.0242	32.7	1.0297	39.8
1.0023	4.1	1.0078	11.2	1.0133	18.4	1.0188	25.6	1.0243	32.8	1.0298	39.9
1.0024	4.2	1.0079	11.4	1.0134	18.6	1.0189	25.8	1.0244	32.9	1.0299	40.1
1.0025	4.3	1.0080	11.5	1.0135	18.7	1.0190	25.9	1.0245	33.0	1.0300	40.2
1.0026	4.5	1.0081	11.6	1.0136	18.8	1.0191	26.0	1.0246	33.2	1.0301	40.3
1.0027	4.6	1.0082	11.8	1.0137	19.0	1.0192	26.1	1.0247	33.3	1.0302	40.4
1.0028	4.7	1.0083	11.9	1.0138	19.1	1.0193	26.3	1.0248	33.4	1.0303	40.6
1.0029	4.8	1.0084	12.0	1.0139	19.2	1.0194	26.4	1.0249	33.6	1.0304	40.7
1.0030	5.0	1.0085	12.2	1.0140	19.4	1.0195	26.5	1.0250	33.7	1.0305	40.8
1.0031	5.1	1.0086	12.3	1.0141	19.5	1.0196	26.7	1.0251	33.8	1.0306	41.0
1.0032	5.2	1.0087	12.4	1.0142	19.6	1.0197	26.8	1.0252	34.0	1.0307	41.1
1.0033	5.4	1.0088	12.6	1.0143	19.7	1.0198	26.9	1.0253	34.1	1.0308	41.2
1.0034	5.5	1.0089	12.7	1.0144	19.9	1.0199	27.1	1.0254	34.2	1.0309	41.4
1.0035	5.6	1.0090	12.8	1.0145	20.0	1.0200	27.2	1.0255	34.4	1.0310	41.5
1.0036	5.8	1.0091	12.9	1.0146	20.1	1.0201	27.3	1.0256	34.5	1.0311	41.6
1.0037	5.9	1.0092	13.1	1.0147	20.3	1.0202	27.4	1.0257	34.6	1.0312	41.8
1.0038	6.0	1.0093	13.2	1.0148	20.4	1.0203	27.6	1.0258	34.7	1.0313	41.9
1.0039	6.2	1.0094	13.3	1.0149	20.5	1.0204	27.7	1.0259	34.9	1.0314	42.0
1.0040	6.3	1.0095	13.5	1.0150	20.6	1.0205	27.8	1.0260	35.0	1.0315	42.1
1.0041	6.4	1.0096	13.6	1.0151	20.8	1.0206	28.0	1.0261	35.1	1.0316	42.3
1.0042	6.6	1.0097	13.7	1.0152	20.9	1.0207	28.1	1.0262	35.3	1.0317	42.4
1.0043	6.7	1.0098	13.9	1.0153	21.0	1.0208	28.2	1.0263	35.4	1.0318	42.5
1.0044	6.8	1.0099	14.0	1.0154	21.2	1.0209	28.4	1.0264	35.5	1.0319	42.7
1.0045	7.0	1.0100	14.1	1.0155	21.3	1.0210	28.5	1.0265	35.6	1.0320	42.8

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12 East 12 Street

Sampling

Collection times are important. Samples should be taken weekly on the same day and at the same time if at all possible. It is best if samples are taken mid-day to avoid problems associated with the sun being at an angle, particularly for Secchi depth. Scheduling may not permit such sampling to occur all the time but you are requested to follow this sampling pattern as often as possible. If days or weeks are missed, please continue sampling as soon as you are able, our computer program can deal with missing values when necessary.

It is critical that all data on the data sheet be filled out completely and legibly! Data can be entered by several people who do not know you or your site.

1. Fill out the water body you are sampling from (ex. Mobile, Perdido, Bon Secour)

2. Collection date as month, day and year

3. Time of day in military time. Before noon just add a zero to the beginning of the time (7:45 a.m.= 0745). Noon remains the same (12:15p.m. = 1215). After noon add 12 to the time (1:20p.m. = 1320, 4:50p.m. = 1650).

4. Site number will be assigned to each site.

5. PRINT your name

6. File in site name even if it is the same as your water body name.

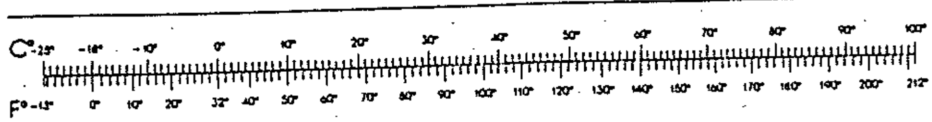
7. Air temperature should be read in half degrees Celsius (25.5^{0}C), even if the temperature is exact (23.0, 15.0) record the .0

8. Secchi depth can be recorded as tenths of meters or as centimeters (1.1m or 110cm) if you use centimeters, use 'c' in front of the 'm'.

9. Water depth is recorded the same as Secchi depth. **Note:** Water depth is always greater than or equal to Secchi depth. It is only equal to Secchi depth when you can see the bottom. Be sure to look at both Secchi and water depths to make sure you recorded each value in the appropriate place.

10. Water temperature in recorded the same as air temperature. Use the below scale to ensure that you are making a logical reading.

Temperature



CELSIUS° = 5/9 (F° − 32°) FAHRENHEIT° = 9/5 C° + 32°

11. Hydrometer readings should be recorded as 1.XXXX where the final number is always 0 or 5. See figure 1 for further instruction.

12. Water temperature must also be taken with the hydrometer reading to obtain the correct salinity. Do not forget to record it. Record it to one decimal point as above.

13. Surface DO should be done 2-3 times and recorded in the lines Surface Dissolved Oxygen Test 1 and Test 2. Make sure your are recording data on the correct line.

14. Bottom DO will only be used at some sites. Record as above if you test for bottom DO otherwise, leave it blank.

15. For Water Surface and Weather circle only **one** number. For instance, do not circle waves and white caps, only circle white caps. Waves are assumed when dealing with white caps. Weather works the same way, it is assumed to be cloudy when it is raining.

16. For other circle as many as apply.

17. Always circle either normal or abnormal and describe the color for water color. KNOW what is normal at your site. Clear water is not necessarily normal.

18. Comments are the only optional item on this sheet. If you feel something is important, write it down.

19. Sign and date the sheet.

Appendix B

Calibration and Operation of YSI Meters

I. Calibration and Procedures and Frequency

DISSOLVED OXYGEN

YSI dissolved oxygen meters are air calibrated with each use. In addition dissolved oxygen measurements, thermistor readings, and cable markings are verifed on an annual basis. Dissolved oxygen measurements obtained with the YSI meters are compared to measurements obtained with a Hydrolab water quality meter which has been calibrated in accordance with the Hydrolab manual. The thermistor readings are compared to readings from an NIST traceable thermometer. If the temperatures differ by more than $3^{o}C$, the thermistor may be faulty, and the probe will be replaced. The markings on the D.O. probe cable are checked with a meter stick to endure that 0.5 meter intervals are maintained. The cable marking are corrected at this time if discrepancies are observed.

SALINITY

YSI S-C-T meters are checked against a Hydrolab water quality meter on an annual basis. Salinity measurements obtained with the S-C-T meter are compared to measurements obtained with a Hydrolab water quality meter which has been calibrated in accordance with the Hydrolab manual. Comparison of salinity measurements will be carried out in fresh, brackish, and sea water. The thermistor readings are compared to readings from an NIST certified thermometer when salinity checks are made. If the temperatures differ be more than $3^{o}C$, the thermistor may be faulty, and the probe will be replaced.

II. Protocol for the use of YSI Meters
(adapted from the Methods Manual for Perdido Bay Citizens Monitoring Program prepared by David A. Flemer, Environmental Research Lab, EPA)

YSI MODEL 57 DISSOLVED OYGEN METER

Dissolved oxygen in milligrams per liter (or parts per million - ppm) is measured in the field with a YSI model 57 oxygen meter calibrated periodically against a Hydrolab. The oxygen meter is air calibrated in the field. Note: a salinity measurements is required as input before dissolved oxygen can be read on the Model 57 system.

Operating Instructions

Instructions are adopted from the YSI Model 57 Oxygen Meter Manual with notes and additional precautions provided. These instructions are involved and require careful reading and familiarity with the instrument. The instrument is rugged but avoid excessive shock (e.g., dropping it on dock or bottom of boat). It can be operated in the rain but as a precaution cover the instrument with a large plastic bag during heavy rain. The instructions are divided into three (3) steps which are described below. However, logic tells us that one must prepare the sensor (probe) before the instrument is functional. For simplicity, these instructions assume that you have gone through the numerous steps to prepare the probe and are ready to take the oxygen meter to the field. Therefore, the instructions are summarized as follows:

Dissolved Oxygen Measurement:

Step. 1 Battery check before taking instrument to the field.

Step. 2 Calibration

Measurement

General Care

Step. 3 Probe preparation.

Step. 1 Before taking instrument to the field, check red-line reading, and batteries including magnetic stirrer batteries.

Step. 2 Calibration, measurement and general care.

1. CALIBRATION

A. Switch instrument to OFF and adjust meter mechanical zero.

B. Switch to RED LINE and adjust.

C. Prepare probe for operation, plug into instrument, wait up to 15 minutes for probe to stabilize. (Keep in shade in air).

D. Switch to ZERO and adjust.

E. Adjust SALINITY knob to FRESH.

F. Switch to TEMP and read (if boatrocking causes needle to swing, then take average but note this event on data sheet notes).

G. Use probe temperature and true local atmospheric pressure (or feet above sea level) to determine correct calibration values from Table I and II. (See pages 13 and 14 of Manual). (Disregard Table II - you are "at sea level".)

EXAMPLE: Probe temp - 21'C. From Table I the calibration value for 21'C is 9.0 PPM.

H. Switch to desired dissolved oxygen range 0-5, 0-10, or 0-20 and with calibration control adjust meter to correct calibration value determined in Step G.

NOTE: It is desirable to calibrate probe in a high humidity environment. See instruction manual for more detail on calibration and other instrument and probe characteristics. Thus, at this stage keep probe in bottomless plastic bottle with damp cotton.

2. MEASUREMENT

A. Adjust the SALINITY knob to the salinity of the sample. (NOTE: you must take a salinity measurement from the water sample collected from the Bay at a known depth. If you have a salinity meter with probe (e.g., YSI Model 33), then tape salinity probe to D.O. probe and tie the two (2) probes and cords to a third support line that is counter-weighted with a kilogram lead sinker. Mark support line as described for Secchi disc. Do not attach this heavy weight directly to electrical cable(s). Salinity probe should be separated by 6 inches from metallic D.O. probe, otherwise you may get an erroneous salinity reading because of electrical interference.

B. Place the probe and stirrer in the Bay and switch the STIRRER control to ON.

C. When the meter has stabilized, switch to the appropriate range and read scale on meter that matches RANGE SELECTOR SWITCH.

E. We recommend the instrument be left on between measurements to avoid necessity for repolarizing the probe; turn to red line and turn off stirrer (it uses up the battery power rather quickly).

3. GENERAL CARE

A. Replace the instrument batteries when unable to adjust to red line. Use (2) Everready No. 935 "C" size or equivalent. Keep a set of batteries on hand.

B. In the BATT CHECK position the voltage of the stirrer batteries is displayed on the red 0-10 scale. Do not discharge below 6.0 Volts. Recharge for 14-16 hrs. if instrument is supplied with a YSI No. 5728 charger or replace batteries as needed.

C. Membranes will last indefinitely, depending on usage. Average replacement is 2-4 weeks. Probe should be stored in humid environment to prevent drying out.

D. Air calibrate hourly, or more often if calibration value drifts from earlier determination. Amount of drift is meter-specific including how well the membrane was prepared.

E. Before putting instrument away, the probe assembly should be rinsed with tap water to remove corrosive sea salt.

STEP 3. Probe Preparation

ALL PROBES ARE SHIPPED DRY - YOU MUST FOLLOW THESE INSTRUCTIONS

1. Prepare the electrolyte by dissolving the KCl crystals in the dropper bottle with distilled water. Fill the bottle to the top.

2. Unscrew the sensor guard or stirrer unit from the probe and then remove the "O" ring and membrane. Thoroughly rinse the sensor with KCl solution. (See Figure 1).

3. Fill the probe with electrolyte as follows (this will take practice):

A. Grasp the probe in your left hand. When preparing the YSI 5739 probe the pressure compensating vent should be to the right (for the right-handed). Successively fill the sensor body with electrolyte while pumping the diaphragm with the eraser end of a pencil or similar soft, blunt tool. Continue filling the pumping until no more air bubbles appear. (With practice you can hold the probe and pump with one hand while filling with the other.) When preparing the YSI probes, simply fill the sensor body until no more air bubbles appear.

B. Secure a membrane under your left thumb. Add more electrolyte to the probe until a large memiscus (dome of liquid) completely covers the gold cathoda (sensor). NOTE: Handle membrane material with care, keeping it clean and dust free, touching it only at the ends.

C. With the thumb and forefinger of your other hand, grasp the free end of the membrane.

D. Using a continuous motion stretch the membrane UP, OVER, and DOWN the other side of the sensor. Stretching forms the membrane to the contour of the probe. (This looks easy but it is not for most people; it requires nimble fingers!). The membrane often becomes electrostatically charged and becomes somewhat difficult to control.

E. Secure the end of the membrane under the forefinger of the hand holding the probe.

F. Roll the "O" ring over the end of the probe. There should be no wrinkles in the membrane or trapped air bubbles. Some wrinkles may be removed by <u>lightly</u> tugging on the edges of the membrane beyond the "O" ring.

G. Trim off excess membrane with scissors or sharp knife. Check that the stainless steel temperature sensor is not covered by excess membrane.

4. Shake off excess KCl and screw probe into stirrer.

5. A bottomless plastic bottle is provided with the YSI 5739 probe for convenient storage. Place a small piece of moist towel or sponge in the bottle and insert the probe into the open end. This keeps the electrolyte from drying out. As an alternative the YSI 5739 probe can be stored in a wide mouth bottle containing about 1" water.

6. Membranes will last for days to months, depending on usage. Average replacement is 2-4 weeks. However, should the electrolyte be allowed to evaporate and a bubble form under the

membrane, or the membrane become damaged, thoroughly flush the reservoir with KCl and install a new membrane.

7. Also replace the membrane if erratic readings are observed or calibration is not stable.

8. "Home brew" electrolyte can be prepared by making a saturated solution of reagent grade KCl and distilled water, and then diluting the solution to half strength with distilled water. Adding two drops of Kodak Photo Flo per 100 ml of solution assures good wetting of the sensor, but is not absolutely essential.

9. The gold cathode should always be bright and untarnished. To clean, wipe with a clean lint-free cloth or hard paper. NEVER USE ANY FORM OF ABRASIVE OR CHEMICAL. Rinse the sensor several times with KCl, refill, and install a new membrane.

10. Some gases contaminate the sensor, evidenced by discoloration of the gold. If the tarnish cannot be removed by vigorous wiping with a soft cloth, lab wipe, or hard paper, return the probe to the factory for service.

11. If the probe has been operated for extended periods with a loose or wrinkled membrane the gold cathode may become plated with silver. In this event return the probe to the factory for refinishing.

TEMPERATURE MEASUREMENT:

Use

Deploy thermistor probe which is built into the oxygen sensor as per dissolved oxygen measurement. Set indicator switch to TEMP and record temperature as indicated on the he top scale of the DO meter. An advantage is that this method can conveniently measure dissolved oxygen and temperature at depth.

This instrument is a field-proven system but as for all electronic instruments, it must be handled with care. The instrument actually measures the electrical conductance of the sample. The probe consists of a plastic conductivity cell and a precision thermistor temperature sensor combined in a single unit. Salinity measurements are calibrated within the meter to electrical conductance. Salinity values are manually temperature compensated by direct dial (conductivity measurements are not temperature compensated; however, a temperature function is provided on the instrument to aid with calculation corrections). In tidal water, where conductance is relatively high, the salinity measurement is usually made with this instrument instead of conductance. In fresh water, conductance is usually measured.

The measurement of salinity assumes the sample contains a "standard" seawater salt mixture. In waters highly contaminated with sulfates, halides (e.g., fluorides, bromides, chlorides) or other highly conductive chemical forms (i.e., ions), errors will result. This problem is addressed in the quality assurance and quality control section.

Operating Instructions

(This procedure omits the section in the manual that describes measurement of conductance).

Step 1. Measurement of Salinity.

1. Setup

(a) Adjust meter zero (if necessary) by turning the bakelite screw on the meter face so that the meter needle coincides with the zero on the he conductivity scale. Use a small screw driver or pocket knife.

(b) Calibrate the meter by turning the MODE control to REDLINE and adjusting the REDLINE control so the meter needle lines up with the redline on the meter face. If this cannot be accomplished, replace the batteries. Allow meter to warm up on Redline for 15 minutes.

(c) Plug the probe into the probe jack on the side of the instrument.

(d) Put the probe in the solution to be measured. (See Probe Use).

2. Temperature

Set the MODE control to TEMPERATURE. Read the temperature on the bottom scale of the meter in degrees Celsius. Allow time for the probe temperature to come to equilibrium with that of the water before reading, usually 30 seconds will do.

3. Salinity

(a) Transfer the temperature reading from Step 2 to the "C" scale on the instrument.

(b) Switch the MODE control to the SALINITY position and read salinity on the red 0-40 o/oo meter range.

(c) Depress the CELL TEST button. The meter reading should fall less than 2o/o (example: 0.01 X 20 - O.4 ppt; if reading is 0.5, then you have a measurement error). Clean the probe and re-measure.

Step 2. Probe use.

(a) Obstructions near the probe can disturb readings. At least two inches of clearance must be allowed from non-metallic underwater objects. Metallic objects such a piers or weights should be kept at least 6 inches from the probe. If you inadvertently fill holes in probe with mud, you will not get a true reading.

(b) Weights are attached to the cable of the YSI Probe. The YSI Weights are supplied in pairs with a total weight of 4 ounces per pair. Should it become necessary to add more weight to overcome water currents, we suggest limiting the total weight to two pounds (8 pairs). For weights in excess of two pounds use an independent suspension cable. In either case, weights must be kept at least 6 inches away from the probe.

(c) Gentle agitation by raising and lowering the probe several times during a measurement insures flow of specimen solution through the probe and improves the time response of the temperature sensor but read at desired depth because the oxygen probe has a stirrer and does not need agitation on the line.

Step 3. Probe Calibration and Maintenance

See technical manual.

Maintenance

(a) Cleaning

When the cell test indicates low readings the probable cause is dirty electrodes. Hard water deposits, oils and organic matter are the most likely contaminants. For convenient normal cleaning soak the electrodes for 5 minutes with a locally available bathroom tile cleaning preparation such as: Dow Chemical "Bathroom Cleaner". Horizon Industries "Rally, Tile, Porcelain, and Chrome Cleaner", Johnson Wax "ENVY, Instant Cleaner", or Lysol Brand "Basin, Tub, Tile Cleaner."

For stronger cleaning a 5 minute soak in a solution made of 10 parts distilled water, 10 parts isopropyl alcohol and 1 part HCI can be used. (It is recommended that specialist perform this procedure).

Always rinse the probe after cleaning and before storage.

CAUTION: Do not touch the electrodes inside the probe. Platinum black is soft and can be scraped off. If cleaning does not restore the probe performance, replatinizing is required.

CAUTION: Before proceeding to this step, contact your Baywatch Center.

(b) Re-Platinizing

Equipment Required -

(1) YSI #3140 Plantinizing Solution, 2 fl oz. (3o/o platinum chloride dissolved in 0.025o/o lead acetate solution).

(2) YSI Model 33 or 33M S-C-T Meter.

(3) 50 ml glass breaker or equivalent bottle.

(4) Distilled water.

Procedure -

(1) Clean the probe as in Section (a) - either method.

(2) Place the cell in the beaker and add sufficient YSI #3140 solution to cover the electrodes. Do not cover the top of the probe.

(3) Plug the probe into the Model 33 or 33M, switch to the X100 scale to platinize the electrode. Move the probe slightly to obtain the highest meter reading and continue platinizing for the approximate time shown below:

Meter Readings		Time
umhos/cm	mS/m	(minutes)
30,000	3,000	5

25,000	2,500	6
20,000	2,000	8
15,000	1,500	11
10,000	1,000	16

It is best to store conductivity cells in deionized water. Cells stored in water require less frequent plantinization. Any cell that has been stored dry should be soaked in deionized water for 24 hours before use.

Step 4. Check Battery Condition

Replacement

Use two (2) D-signed alkaline Everready E95 or equivalent. They provide about 200 hrs. of operation. This assumes that they were "fresh" from the store!