ALBEMARLE-PAMLICO CITIZENS WATER QUALITY MONITORING MANUAL

Citizens Water Quality Monitoring Program
Institute for Coastal and Marine Resources
East Carolina University

ALBEMARLE-PAMLICO
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(*Individual sections of manual updated periodically*)

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This manual was developed with the assistance of many information sources. Selected works are not cited in the text to maintain the simplicity and brevity of the document. All references used in the production of this manual are listed in the Appendix. This manual is distributed for educational purposes only.

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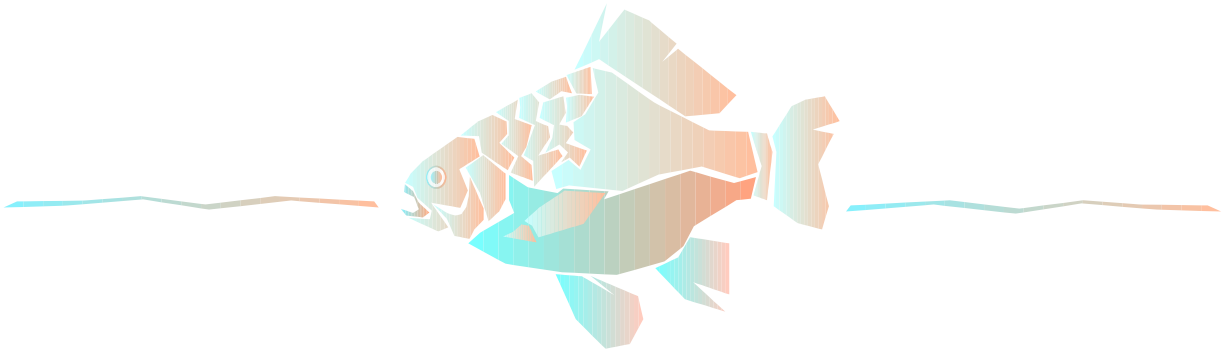

INTRODUCTION

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Background

The Citizens Water Quality Monitoring Program (CWQMP) is a network of private citizens who keep track of ambient, surface water quality in the Albemarle-Pamlico Estuary and its tributaries. The program began as an initiative by the Pamlico-Tar River Foundation and was expanded under the Albemarle-Pamlico Estuarine Study to gather essential data and focus additional public attention on the quality of the fragile water resources of the estuary. Additional activities are described in the accompanying figure.

The CWQMP focuses on three areas:
¬ *Baseline & Trend Monitoring*
∧ *Targeted Monitoring & Surveys*
∨ *Water Quality Education*

Regional environmental groups help the CWQMP to:

⟩ *identify projects,*
⟩ *recruit volunteers, and*
⟩ *serve as advocates for the data.*

The program office of the CWQMP provides:

* *financial support,*
* *equipment,*
* *training, and*
* *data management*
* *data reporting services.*

Participants in the CWQMP primarily monitor the "vital signs" of the estuary. Specifically, volunteers monitor dissolved oxygen, pH, salinity, temperature and turbidity to gauge the general health or quality of the waters in the estuary. Using basic, but quite accurate water quality kits, citizen volunteers analyze water samples, observe qualitative factors such as weather conditions and other visual indicators, and record their results. Occasionally, program volunteers gather water samples and forward them to a laboratory to analyze samples for specific pollutants such as bacteria and nutrients. All data collected are forwarded to the program office where staff organize the information and put the data into report form for citizen and government agency use. Often, these monitoring efforts serve as useful supplements to existing governmental activities.

What is Water Quality Monitoring and Why is it Needed?

Water quality monitoring is the repetitive measurement or observation of a waterbody over time. We measure water quality repetitively to detect changes and trends in water conditions that occur due to natural events or pollution. Often, one or two years of data will not show trends in water quality and will not pinpoint

sources of pollution. Therefore, monitoring is a long term effort. Carefully obtained, quality assured, objective monitoring is very valuable to develop information about a waterbody's baseline conditions. Trained analysts use this data to identify trends and changes in the system's water quality. By not relying on subjective information, monitoring can provide more objective, quantified measures of the past.

What is the Albemarle-Pamlico Estuary and Why Should We Monitor It?

The Albemarle-Pamlico Estuary is one of North Carolina's most important natural resource treasures. Seven sounds make up an estuary that is home to a wide diversity of unique habitats and wildlife. Historically, the estuary has also supported many important northeastern North Carolina industries such as commercial fishing, seafood, recreation and tourism. Not only do we extract resources from the estuary but we also depend on its aesthetic and cultural viability to attract interest and investment in the region.

We monitor water quality in the estuary to determine its state of health and what is impacting it. In fact, the need to monitor has become more urgent. The 1993 Albemarle-Pamlico Estuarine Study comprehensive plan determined that the estuary is degraded to the point that it no longer *fully* supports the uses on which North Carolinians depend. The plan reported that . . .

- eight percent of the freshwater rivers and streams in the estuary region do not fully support fish propagation, shellfish harvesting or recreation; 34 percent of the estuary partially supports these uses while 32 percent of the estuary is threatened;

- approximately 26,600 acres of prime shellfish habitat are closed because of pollution;

- unsafe levels of mercury and dioxin have been found in the tissues of fish in some areas;

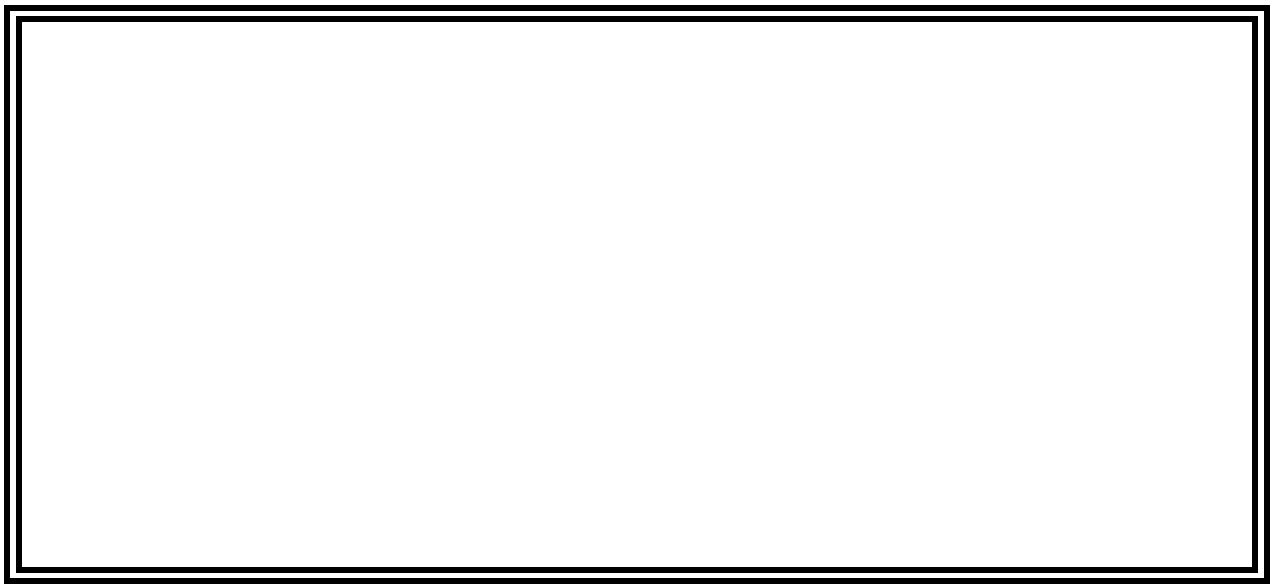
- disease epidemics have been reported for finfish, blue crabs and oysters; and

- throughout the region, wetland draining and filling activities have contributed to the destruction of vital fish, plant and wildlife habitats.

(1993, APES Plan Summary).

Why Should Private Citizens Participate in Water Quality Monitoring?

First, we need your help. The estuary is a large and diverse region and is too big to adequately monitor with government agency resources (See Map next page). The estuary has a 30,000 square mile watershed with more than 9,299 miles of freshwater rivers and streams and 1.8 million acres of brackish estuarine waters. The watershed also contains five major river basins and seven sounds and is the second largest estuary in the United States, second only to Chesapeake Bay. Because the estuary is so large and the impacts are so diverse, the assistance of *everyone* is needed to monitor the estuary. The wide expanse of waters that makes up the estuary is often more accessible to local citizens who live near it. *Citizens* help allows us to "fill the gaps" left open by limited government resources.



The Albemarle-Pamlico Estuary

Second, as a citizen of northeastern North Carolina, you need to know what is happening in your estuary and to be involved in the policy process. Water quality monitoring allows you to observe water conditions firsthand and to learn more about the interactions of water measures and the changes that occur due to natural events and pollution. The new knowledge you gain through water quality monitoring will also help you as an informed citizen and as an advocate for a clean environment.

About This Manual

This manual has been provided as an information resource to Albemarle-Pamlico citizens water quality monitors. Section II, Water Quality Parameters, briefly discusses the concept of pollution and the individual components of water quality (temperature, salinity, dissolved oxygen, etc.). Section III discusses safety tips and offers general advice to conduct tests accurately. ***Please read Section III carefully.*** Section IV is broken up into two subsections, Baseline Water Quality Testing and Specialized Water Quality Testing. Each method details step by step instructions for conducting each water quality test. ***Please review Section IV and use it when you monitor.*** **Please refer to these instructions, not the instructions in the lid of your test kits to conduct each test.** Section V, the Appendix contains a complete listing of all the equipment provided for each test and

technical explanations for each of the methods used. The Appendix also includes a listing of other information that may be useful to you.

You will not have all of the test kits and equipment described and listed in the manual. Some do not apply to your particular region. The extra instructions are included for your interest and education.

Remember, each small contribution can add up to whole lot.

Thank you for your interest and participation.

SECTION II

WATER QUALITY PARAMETERS

WATER QUALITY PARAMETERS

In this section of the manual we will introduce the concept of water pollution. Then we will review each water quality parameter used as an indicator of water health and parameters that exists as specific pollutants. Please refer to this section when analyzing your data and to learn more about specific water quality changes and interactions.

WATER POLLUTION

Water pollution can be divided into two categories: (1) point sources and (2) non-point sources. Point source pollution originates from a single entry point such as a discharge pipe or smoke stack. Point sources are produced by industry, public municipal facilities and in some cases private dwellings. Historically, point sources have been the most damaging to the environment. However, with the success of the federal Clean Water Act, many of our original point source problems have been greatly reduced.

The origin and impact of non-point sources is more complex. Non-point sources originate from the cumulative impacts of land uses. Runoff from urban streets, parking lots and rural farmland carries wastes, nutrient, oils, pesticides and other chemicals. Everything foreign or applied in excess to the land is eventually washed into our public waters. This type of pollution is everyone's problem and is now a greater threat to water quality than point sources.

Water quality parameters help us determine if pollution is occurring and the type of pollution that exists. Most of the water quality parameters described in the following pages are used as indicators. Theses indicators are much like the vital signs (blood pressure, temperature, etc.) of the human body. They tell us how healthy the estuary is at a given time. These indicators include dissolved oxygen, temperature, pH, turbidity, and salinity.

Other parameters help us determine what specific problem exists. These parameters tell us what is reducing the health of the estuary or making the vitals signs abnormally high or low. For example, fecal coliform testing tells us if animal wastes are entering water and generally indicate the potential for disease pathogens and viruses. Other parameters such as nutrients are specific pollutants that can reduce water quality. It is important to note that all of these parameters occur naturally in the environment. In general, they become problems when they exist excessively. Therefore, monitoring can also help us determine the natural

background levels of the indicators and potential pollutants. These levels serve as bench marks for future water quality assessment.

As you read this section of the manual, try to put into context the difference between pollution measures and measures of water health. In addition, note some of the relationships between each parameter and what the interactions of one or more tell us about the health or problems of our rivers and estuary.

POLLUTION AND THE WATER CYCLE

The three primary stages in the hydrologic cycle are: (A) Evaporation, (B) Condensation, and (C) Precipitation. Factors that alter the composition of water include:

1. Dust particles and gases are filtered from the atmosphere and trapped in falling snow.
2. Radioactivity in the atmosphere is carried by minute dust particles at high altitudes.
3. Flowing water erodes rock and soil increasing turbidity of water.
4. Trees transpire moisture.
5. Mine acid wastes entering streams affect pH and chemical composition.
6. Industrial gases are washed from the atmosphere by rain and snow.
7. Crop dusting adds to air and water contamination.
8. Rainwater leaches chemicals from the soil and decaying vegetation into surface and ground water.
9. Natural aeration of rainfall, waterfall and wind induces dissolved oxygen.
10. Industrial waste water enters public waters as a potential point source.
11. Dust particles drift with wind long distances.
12. Large quantities of fertilizer, pesticides, and salts, leave poorly managed crop fields (a non-point source) through soil erosion and unchecked runoff.
13. Barnyard wastes entering a stream cause organic and chemical pollution.
14. Dysfunctional septic systems pass to ground water and eventually surface waters.
15. Over use of ground water by wells near estuaries and oceans introduce undesirable brines into the water table.
16. Heated water power plants can promote thermal pollution.
17. Protected wetlands provide critical estuarine breeding areas and promote water quality.
18. Municipal water treatment plants must be managed carefully to prevent untreated sewage from entering public waters.
19. Storm sewers add non-point source runoff into public waters.
20. Natural wave action from tides and storms promote water quality impacts and potential shoreline erosion.
21. Automotive exhausts add hydrocarbons to the atmosphere.
22. Potential oil and fuel leaks from shipping can produce disastrous impacts.

TEMPERATURE

Although temperature may be one of the easiest measurements to perform, it is probably one of the most important parameters to be considered. Both air and water temperatures dramatically affect the rates of chemical and biological activities that occur in the environment. In fact, many biological, physical, and chemical principles are temperature dependent. Among the most common of these are the solubility of compounds in water, distribution and abundance of organisms, rates of chemical reactions, density, inversions and mixing, and current movements.

Water temperature in the estuary is a parameter that is subject to many factors. Because our sounds are so shallow, its capacity to store heat over time is relatively small. As a result, water temperature fluctuates considerably between seasons. The surface and subsurface of water also affect water temperature. With the increase of water depth, water generally becomes colder. In the deeper parts of the sounds, the vertical temperature profile is fairly predictable.

The thermal stratification of deeper water and surface water leads to density differences that vary from season to season and that greatly affect the distribution of organic and inorganic materials. During the spring and summer months, the surface waters are warmer than the deeper waters due to the warmth of the sun. In the fall, the warming radiation of the sun begins to diminish and as the surface water cools, it increases in density and becomes heavier. Once the surface water becomes colder and denser than the water toward the bottom, it begins to sink and vertical mixing occurs. Wind speeds up the process. This mixing action can bring nutrients and materials essential to the growth of organisms, up from the bottom and into higher water levels. This "turn-over" makes the nutrients available to phytoplankton and other organisms inhabiting upper water levels. During the winter, water temperature becomes relatively constant from surface to bottom until March, when the process of surface warming begins again.

Temperature must be measured accurately to properly measure and understand other parameters. All pH, dissolved oxygen and salinity measurements are affected by temperature. Without temperature, most environmental and chemical measurements would be meaningless.

Temperature is generally measured in degrees Celsius (Centigrade) and is estimated in the field by liquid filled and electronic thermometers. The following table lists temperatures in Fahrenheit equivalent to various degrees Celsius.

Degrees Celsius	Degrees Fahrenheit
0	32
0.5	32.9
1	33.8
1.5	34.7
2	35.6
2.5	36.5
3	37.4
3.5	38.3
4	39.2
4.5	40.1
5	41
5.5	41.9
6	42.8
6.5	43.7
7	44.6
7.5	45.5
8	46.4
8.5	47.3
9	48.2
9.5	49.1
10	50
10.5	50.9
11	51.8
11.5	52.7
12	53.6
12.5	54.5

Degrees Celsius	Degrees Fahrenheit
12.5	54.5
13.5	56.3
14	57.2
14.5	58.1
15	59
15.5	59.9
16	60.8
16.5	61.7
17	62.6
17.5	63.5
18	64.4
18.5	65.3
19	66.2
19.5	67.1
20	68
20.5	68.9
21	69.8
21.5	70.7
22	71.6
22.5	72.5
23	73.4
23.5	74.3
24	75.2
24.5	76.6
25	77
25.5	77.9

Degrees Celsius	Degrees Fahrenheit
26	78.8
26.5	79.7
27	80.6
27.5	81.5
28	82.4
28.5	83.3
29	84.3
29.5	85.1
30	86
30.5	86.9
31	87.8
31.5	88.7
32	89.6
32.5	90.5
33	91.4
33.5	92.3
34	93.2
34.5	94.1
35	95
35.5	95.9
36	96.8
36.5	97.7
37	98.6

37.5	99.5

38	100.4

38.5	101.3

TURBIDITY

Turbidity is the amount of *suspended* particles (not necessarily water color) that prevent the penetration of light through water. Turbidity, or reduced water clarity, is often caused by phytoplankton (single-celled algae), or sediment in the water column. Algal turbidity occurs when warm temperatures, sunlight and nutrients promote the rapid growth of phytoplankton. Although this growth is helpful and necessary in some environments, in excess, it can be very detrimental. Sediment turbidity occurs when poorly managed eroding crop fields, construction sites and other bare soil areas produce silt-laden runoff after heavy rains. It is also produced by shoreline sediments and bottom sediments that are eroded or dislodged by wind or boat generated waves.

Excessive turbidity can have a harmful effect on aquatic life in rivers and estuaries.

1. *Algal or sediment turbidity interferes with the penetration of sunlight.* Submerged aquatic vegetation (SAV) needs light for photosynthesis. If suspended particles "block out" light, photosynthesis---and the production of oxygen for fish and aquatic life---will be reduced. SAV provides essential food, nursery, shelter and habitat for diverse communities of shellfish, waterfowl, and fish. If light levels get too low, photosynthesis may stop altogether and algae and SAV die. (See figure on next page for relationship between SAV, aquatic life and other water quality)

2. *Sediment turbidity causes large amounts of suspended matter to impact organisms directly and indirectly.* For example, sediment turbidity clogs the gills of fish and shellfish and kills them directly. Sediment turbidity affects aquatic life indirectly by clogging or covering the floor of streams and rivers, thus silting over essential breeding and shelter habitat.

3. *Sediment turbidity may provide a place for harmful microorganisms, chemicals and nutrients to reside.* Many bacteria, disease pathogens, chemical and nutrients found in water originate from land. By controlling erosion and by slowing down the rate of runoff, the harmful impacts of sediments and other constituents attached to soil particles could be controlled.

4. *Turbidity can prevent fish from finding food and from operating effectively within their environment.* Increased turbidity, in an environment where aquatic life are adapted to much clearer water conditions, can disrupt normal biological activity.

Turbidity can be measured by a secchi disk (See diagram on next page), which measures the depth of visibility of water in decimeters or meters, or by electronic meters that measure in NTUs (Nephelometric Turbidity Units). The secchi disk has proven to be a very cost effective and reproducible method. Trained observers with proper viewing scopes have observed secchi disk readings of up to 35 meters in very clear lakes.

Measuring Turbidity with the Secchi Disk

Aquatic Plants and Animals and Effects on Water Quality Parameters

pH

The pH of water is a measure of how acidic or basic (alkaline) a solution is. In any given solution, some atoms of water dissociate to form hydrogen ions (H^+) and hydroxyl ions (OH^-) ($H_2O = H^+ + OH^-$). The pH scale is a means of showing which ion has the greater concentration. At a pH of 7.0, the concentration of both hydrogen ions and hydroxyl ions is equal and the water is said to be neutral. Pure water has a pH of 7.0. When the pH is less than 7.0, there are more hydrogen ions than hydroxyl ions and the water is said to be acidic. When the pH is greater than 7.0, there are more hydroxyl ions than hydrogen ions and the water is said to be basic or alkaline.

The numeric value of pH represents the negative logarithm of the hydrogen ion concentration. This means that the concentration of hydrogen ions does not increase or decrease in a linear fashion; that is, a pH of 3 is not twice as acid as a pH of 6. Increases are in powers of 10. At a pH of 5 there are 10 times more H^+ than at a pH of 6. A change in pH of one whole number is therefore quite a large change.

As water receives mineral substances, aerosols, dust from the air, man-made wastes, and photosynthetic organisms, its pH can change. These pH changes affect the ability of organisms to reproduce and survive. Generally, the ability of aquatic organisms to complete a life cycle greatly diminishes as pH becomes > 9.0 or < 5.0 as indicated in the table at right.

Several natural and unnatural factors affect water pH. Photosynthesis by aquatic plants removes CO_2 from the water, which can significantly increase pH. Therefore, waters with plant life (including planktonic algae), especially low-velocity or still waters, have an increase in pH during the growing season. During the algal blooms in 1993 in the Chowan River, a pH of 9 was recorded by one citizen monitor. Increased leaching of soils or mineral outcrops during heavy precipitation also affects pH downstream. Human activities (e.g., accidental spills, agricultural runoff, sewer overflow) may also change pH, most often increasing hydrogen ions, thus lowering pH levels and increasing acidity. In general, wetlands and other forested waters will have lower pH. River water can normally vary from 6-7 and coastal waters from 7-8.

Water pH is commonly measure by (1) colormetric means (pH paper and liquid indicators) and (2) electronic pH meters. Meters are much more effective due to their capacity to detect changes in pH in decimal increments.

DISSOLVED OXYGEN

Dissolved oxygen (DO) is the amount of oxygen dissolved in water, measured in parts per million or milligrams per liter. Like atmospheric oxygen is to humans, DO is a critical factor for most aquatic organisms and is one of the most important indicators of environmental health. When oxygen levels in water fall below 4 parts per million (ppm), fish and other aquatic organisms become severely stressed; below 2 ppm, many cannot survive.

Oxygen is transferred from the atmosphere into surface waters by the aerating action of wind (See Figure below). It is also added at or near the surface as a by-product of plant photosynthesis. As a result, floating and rooted aquatic plants increase DO levels. Since the existence of plants also depends on the availability of light, the oxygen producing processes occur only near the surface or in shallow waters.

Oxygen is a particularly sensitive constituent because other parameters and chemicals present in the water affect it. For example, biological processes such as the oxidation of organic wastes can deplete oxygen. Therefore, improperly treated wastes originating from waste treatment facilities or food processing plants can greatly reduce the amount of oxygen available to aquatic life as they decompose.

Temperature and salinity also exert a major influence on oxygen availability. For example, think of water as a sponge that absorbs oxygen. Now think of temperature and salinity as the factors that control absorbency. This relationship of salinity and temperature to dissolved oxygen is an *inverse* relationship. As water temperature decreases, the potential of water to hold more dissolved oxygen increases. As water temperature increases, the potential of water for oxygen capacity decreases. Likewise, as salinity increases dissolved oxygen potential in water decreases. Again, the reverse occurs when water salinity decreases.

The influence of temperature on dissolved oxygen helps us understand the fluctuation of dissolved oxygen between seasons. Hence, dissolved oxygen levels decline in the summer and increase in the winter primarily due to temperature. Because of the lower levels of dissolved oxygen in the summer, aquatic activity can be impacted more in warm weather as opposed to cold. As temperature increases, many biological and chemicals activities increase thus increasing the demand for oxygen when it is already low. This is precisely why some industries wait until the cooler months to discharge large volumes of waste water. The mitigating effect of temperature (and sometimes reduced salinities due to increased fresh inflow) reduces the impact of wastes that deplete dissolved oxygen and stress the aquatic environment.

Dissolved oxygen can be measured colormetrically with a spectrophotometer, by an electronic meter or by a Winkler chemical titration procedure. However, dissolved oxygen measurements do not tell how much DO water is capable of holding (i.e., percent DO saturation). As mentioned previously, the potential of water to contain dissolved oxygen is affected by salinity and temperature. Therefore, when water holds all the DO it can hold at a given temperature and salinity level, it is said to be 100 percent *saturated* with oxygen. If water holds half as much oxygen as it can hold at a given temperature and salinity level, it is 50 percent saturated.

Dissolved oxygen saturation is calculated by a mathematical formula using water temperature, salinity and DO. The percent DO saturation can then be used to explain why DO is low. For example, if DO is low and the corresponding DO saturation is high, then it is very likely that something other than temperature and salinity (possibly pollution) is reducing dissolved oxygen.

SALINITY

Salinity is the concentration of dissolved salts in water, usually expressed in parts of salts per 1000 parts of water (ppt or o/oo). Freshwater contains few salts (drinking water usually has a salinity of less than 0.5 ppt), while seawater averages

35 ppt. Estuaries are defined as a place where the rivers meet the sea. Therefore, salinity is a key factor affecting the physical make-up of an estuary.

Since seawater enters the estuary through inlets along the Outer Banks, salinity is highest at that point and gradually diminishes as one moves inland towards the headwaters of streams flowing into the estuary. The salinity levels within the estuary vary, depending on the volume of freshwater that flows into it. Salinity declines generally in the estuary in the spring when rainfall and groundwater cause large increases in freshwater inflows. Note the differences in salinity between December and April on the enclosed maps.

Salinity levels are graduated on a horizontal plain from one end of the Bay to the other (See Maps next page). Salinity levels are also graduated vertically from top to bottom. Since the presence of salts increases density, the lighter freshwater tends to remain at the surface. Winds and tidal action can cause mixing of bottom and surface waters, particularly in shallow areas. In general, where the river flows into the estuary, salt wedges form in the bottom layers. This stratification is maintained if the volumes of freshwater are high and low mixing occurs.

Perhaps the most important aspect of salinity is its effect on the distribution and well-being of the various biological populations living in the estuary. Some species of fish spawn in fresh water and live part of their lives at sea; others do the opposite. Bottom dwelling species such as oysters and crabs are tolerant of salinity variations but will decline when salinity conditions change. Increased freshwater flow created by wetland drainage and land clearing impact salinity levels by introducing fresh water into areas that were historically brackish. Likewise, increased dredging of ocean inlets introduces salt water in higher volumes causing impacts to areas where salinity has been historically lower. These constant changes in the natural environment obviously produce unstable conditions that result in the loss of species that can't maintain normal biological activities due to constant changes in the environment.

Salinity is measured by several means: (1) a hydrometer (measuring specific gravity); (2) salinity titration (measuring chloride and bromide ions); (3) a refractometer (light refraction); and (4) a conductivity meter. Citizen monitors most often use the first two. In the Albemarle-Pamlico Estuary, salinity titration kits have been found most effective in low salinity areas and hydrometers most effective in coastal or high salinity areas.

NUTRIENTS

Nutrients promote growth in plants and humans. In water, algae and aquatic plants use nutrients for healthy growth. These plants provide cover and food for aquatic organisms. In excess, nutrients cause aquatic plants and algae to grow in the extreme, otherwise known as eutrophication. Impacts include algal blooms that reduce light critical to fish habitat; increased nuisance plants that reduce recreational and navigational activities; and increased plant growth that die and decay, robbing critical oxygen from aquatic life.

Nutrients occur in water in organic and inorganic states. Organically bound nutrients usually originate from organic wastes that decompose and release nutrient in various forms. Inorganic nutrients are more readily available for plant use and usually result from man made fertilizer, chemical sources or biological processes.

Nitrogen is one type of nutrient that promotes plant growth. Nitrogen occurs in natural waters as nitrate (NO_3), nitrite (NO_2), and ammonia (NH_3) and organically bound nitrogen. Nitrate sources include agricultural fertilizers, sewage, industrial and packing house wastes, and drainage from livestock areas and manure. Nitrate nitrogen is dangerously high in drinking water above 10 mg/l. Generally, unpolluted waters have nitrate levels below 1 mg/l. High levels of ammonia and nitrite nitrogen usually result from organic wastes like animal manure or sewage.

High levels of phosphorus can also cause excessive plant growth. Phosphorus occurs as phosphates (orthophosphates or reactive phosphorus) and organically bound phosphorus. Orthophosphates result primarily from chemical fertilizers. Total phosphorus levels (organic + inorganic) above 0.03 mg/l can contribute to increased plant growth or eutrophication. Total phosphorus above 0.1 mg/l may stimulate plant growth beyond natural eutrophication rates.

Phosphorus and nitrogen are measured in milligrams per liter (mg/l) or parts per million (ppm). A laboratory grade spectrophotometer is the most accurate means of analysis. Some analysis for inorganic forms of nitrogen and phosphorus can be conducted using field grade spectrophotometers and colorimeters. Basic water testing kits are available but usually do not detect low levels commonly existing in estuaries.

Chlorophyll a is another test which gives a picture of the nutrient level of the water. Chlorophyll a is the green photosynthetic pigment found in the cells of all algae. By taking a measured sample of water and extracting the chlorophyll a from the algae contained in each sample, monitors can get a good indication of the density of

the algal population. Basic testing for chlorophyll is easily performed in the field and analyzed in the lab.

BACTERIA - FECAL COLIFORM

Fecal coliform bacteria are found in the feces of humans and other warm-blooded animals. These bacteria can enter rivers through direct discharge from mammals and birds; from agricultural and storm runoff carrying mammal and bird wastes; and from sewage discharged into the water.

Fecal coliform bacteria by themselves are not pathogenic. Pathogenic organisms include bacteria, viruses, and parasites that cause diseases and illness. Fecal coliform bacteria naturally occur in the human digestive tract, and aid in the digestion of food. Because fecal coliform bacteria occur along with pathogenic organisms and because pathogens are difficult and time-consuming to detect, tests are conducted for fecal coliform. If fecal coliform counts are high (over 200 colonies/100 ml water sample), the chance that pathogenic organisms are present and probability of contracting a disease through exposure (swimming etc.) increases. A person swimming in such water could receive disease causing organisms through numerous ways such as cuts in the skin and through the nose, mouth, or ears. Diseases and illness such as typhoid fever, hepatitis, gastroenteritis, dysentery, and ear infections can be contracted in waters with high fecal coliform counts.

Water Categories	Water Quality Standards
Drinking Water	NC Standard - 0 FC/ 100 ml
Total Body Contact (swimming)	NC Standard - 200 FC/ 100 ml
Partial Body Contact (boating)	Other States - 1000 FC/ 100 ml
Treated Sewage Effluent	NC Standard - not to exceed 200 to 1000 FC per 100 ml sewage effluent. (specific standard is site specific; subject to water uses, dilution

available, etc)

SECTION III

SAFETY & GENERAL INFORMATION

Λ SAFETY FIRST, ACCURACY SECOND 7

PLEASE READ THIS SECTION CAREFULLY
TO USE YOUR EQUIPMENT SAFELY AND ACCURATELY

SAFETY & GENERAL INFORMATION

***First**, safety must be your focus. Some of the testing kits contain hazardous, poisonous or flammable chemicals. Some objects in the kits can pierce or cut the skin if broken or misused. Additionally, you may conduct tests around slippery or unstable piers, docks, boats or shorelines. Please, take your time and be cautious. No data is worth an accident. Please understand each kit and the associated safety warnings detailed in the Appendix.*

***Second**, in some parts of the country citizen monitoring is a very viable and acceptable practice. However, in our region of the country, citizen monitoring is still a relatively new concept. Therefore, it is very important that you gather your data precisely, neatly and accurately. Please conduct each test, each week, with patience and precision. Watch out for potential errors and mistakes. Within acceptable limits, we want to prove in North Carolina and Virginia that citizen data is accurate and useful information.*

GENERAL INSTRUCTIONS AND PRECAUTIONS

1. Volunteers must attend training sessions before beginning sampling. Contact the CWQM program director at (252) 328-1747 for a schedule or appointment for training sessions.

2. Sample with a partner. This allows one person to record data while the other person measures them. Sampling with a buddy is a safety precaution, reduces errors and is fun.

3. Observe boating safety rules and regulations.

4. Always bring life preservers and an anchor when you sample from your boat.

5. Be familiar with your instructions and procedures before going out in the field. Prepare data sheets and test equipment at home before you go into the field.

6. **Keep all equipment and reagent chemicals out of the way of small children or pets.** *These chemicals are poisonous!*

7. **If you have a chemical accident or are subject to poisoning call the Duke University Poison Control Center at: 1-800-672-1697**

8. We recommend that you wear gloves and goggles when you conduct all tests. This prevents exposure to chemicals and potentially polluted water. At a minimum, always wash skin with full lather when skin contacts polluted water or chemicals.

SAFETY (continued)

9. Use caps or stoppers, not your fingers while handling reagent chemicals.

10. Store and secure all waste chemicals and return them to the program office for disposal.

11. If you anticipate sampling from shore, always obtain written permission from the landowner. Please be courteous and respectful of individual property rights. However, sampling off shore from a boat is entirely legal in public waters.

PROPER ANALYTICAL TECHNIQUES AND TECHNICAL PRECAUTIONS

1. Hold squeeze bottles upside down, not at an angle, when dispensing reagents. This will insure that the drops are the same size, thus the amounts in each test are equal.

2. Use a magnifying glass to read the measuring equipment more accurately if needed.

3. When conducting a test, please take your time and follow the steps in this manual religiously. We have altered many of the kit procedures to make them more accurate.

4. Wipe up spills when they occur. In the field, wash spills with a bucket of water if they are on the ground.

5. Tightly close all reagent containers immediately after use. Air can degrade the chemicals.

6. Protect equipment and reagents from prolonged exposure to direct sunlight, and extreme
temperatures.

7. Periodically, wash all glassware (especially titration and test tubes). Please keep your kits clean and tidy.

SECTION IV
PART A

INSTRUCTIONS FOR BASELINE MONITORING

CONDUCT TESTS IN THE ORDER LISTED ON THE DATA SHEET

PREPARING TO CONDUCT WATER QUALITY TESTS

STEP 1: *Before You Leave to Sample*: Retrieve data sheets and pen. Prepare all materials to run tests. Make sure all glassware and bucket are reasonably clean before using. Use soap sparingly and scrub each item thoroughly when cleaning equipment.

STEP 2: *At the Site*: Fill out the data sheet for time and date and begin air temperature test.

STEP 3: Obtain bucket of water for water temperature and other chemical tests after rinsing bucket three times. Pitch water downstream of water being sampled.

STEP 4: Conduct tests in the order listed on your data sheet. During waiting periods you can proceed to other tests. Proceed to the temperature, pH, and DO tests quickly to prevent the water sample from changing.

STEP 5: When all tests and observations are complete, make sure you sign the data sheet and write down comments that may help us analyze the data.

INSTRUCTIONS FOR USING THE *LIQUID FILLED* THERMOMETER

(There are 7 steps for this method.
Λ Do not place thermometers in the sun.

For Air Temperature

STEP 1: Place the thermometer in the shade. (A tree, pier post; any object to block sun.)
It is best to hang the thermometer by a string or nail dangling in the air.

STEP 2: Wait a *minimum* of **5 minutes** before reading thermometer.

****HELPFUL HINT**** *Proceed to other tests.*

STEP 3: Retrieve thermometer and read *immediately* to the nearest 0.5E C. Record result.

For Water Temperature

STEP 1: If using a bucket, collect a fresh sample for test. Rinse thermometer with water if it has been subjected to extreme temperatures while in storage.

STEP 2: Hold top end and submerse bottom of the thermometer into the stream, river or sound. If using a bucket of water place the whole thermometer in bucket.

STEP 3: Wait *maximum* of **3-5 minutes** (**no more than five for water**).

STEP 4: Read thermometer in water if possible. If using bucket retrieve thermometer and read *immediately*. Read and record to the nearest 0.5E C.

Special Note: *If the liquid in the thermometer splits, insert the thermometer into a dense bath of ice cubes and water. If the*

liquid does not re-join, forward the thermometer to the program office and ask for a replacement.

INSTRUCTIONS FOR USING THE LaMOTTE DISSOLVED OXYGEN TEST

(There are 16 steps for this method.

Ω;Ω Hazardous Materials: Read bottle labels or see materials list in Appendix before use.

Λ Please cap or stopper all reagents immediately after dispensing into sample.

STEP 1: Rinse bucket three times with water and fill.

STEP 2: To avoid contamination, rinse **two** water sampling bottles [0688-DO]and caps **three** times with water to be sampled. Discard the rinse water into the waterbody.

STEP 3: Holding both of the bottles in one hand, upside down, place into bucket. Take to bottom, turn right side up and place on the bottom. Allow to fill.

STEP 4: **Gently** tap sides of bottle to remove any remaining air bubbles. Replace cap on submerged bottle while under water.

STEP 5: **Gently** retrieve bottles, invert and examine carefully for air bubbles. If air bubbles are present pour water out and repeat **STEP 3**. If no bubbles are present proceed immediately with following steps.

NOTE: *Avoid introducing air to sample when adding reagents by capping carefully and mixing the sample gently.*

STEP 6: Make sure you hold the reagents **upside down, perpendicular**, to the sampe bottles when releasing drops. (First) Add 8 drops of MANGANOUS SULFATE solution [4167] and (Second) add 8 drops of ALKALINE POTASSIUM IODIDE AZIDE solution [7166] to each sample **in this order**. Cap bottle and mix by inverting gently **25** times and then place on flat surface.

STEP 7: Allow precipitate to form and settle below shoulder of each bottle. Invert bottles **ten** more times and allow precipitate to settle again.

****HELPFUL HINT**** Proceed with other tests while waiting for precipitate to settle.

STEP 8: Using 1 g. measuring spoon [0697], add one level measure of SULFAMIC ACID powder [6289] to both sampling bottles. *If your kit has the liquid sulfuric acid version, add 8 drops of SULFURIC ACID, 1:1 [6141 WT]. Make sure you hold the reagent perpendicular over the sample bottle when releasing drops into the sample bottle.* Cap each bottle and gently shake to mix and dissolve precipitate. A clear yellow/brown or orange color will develop, depending on oxygen present. Some precipitate may not dissolve.

The sample is now "fixed" and no longer in danger of air bubbles. The following steps should however be completed within 8 hours.

STEP 9: Set one bottle aside. Pour ***small amount*** of the solution from **first** sample bottle into glass titration tube [0299] to rinse. Now pour solution from bottle to the titration tube until it measures ***20 ml.***

****HELPFUL HINT**** *Use small plastic pipet to add last few drops to titration tube until 20 ml.*

STEP 10: Fill small titrator (syringe) [0377] to 0 mark with standard SODIUM THIOSULFATE solution [4169] for the *titration* step.

STEP 11: *Titration:* Add 1 drop of sodium thiosulfate to test tube; **swirl the test tube** to mix. Add another drop of sodium thiosulfate and **swirl tube**. Continue titration process one drop at a time until yellow-brown solution in test tube turns to a pale or lighter yellow. Compare the tube to the sample bottle to notice color change. Remove cap with titrator intact and carefully set the sodium thiosulfate aside for a moment.

STEP 12: Add 8 drops of STARCH INDICATOR SOLUTION [4170-G] to test tube and swirl tube to mix. The solution should turn dark blue. Replace cap with titrator intact back on the titration tube.

STEP 13: Now continue titration process *slowly* (described in Step 9) with remaining Sodium Thiosulfate. Swirl and note when solution tries to turn clear. Add drops until test tube solution turns from blue to clear. **Do not add any more Sodium Thiosulfate** when color changes.

STEP 14: Using scale on side of syringe, count total number of units of sodium thiosulfate used in experiment. Each subunit equals 0.2 parts per million (ppm) or milligrams per liter (mg/L) of oxygen in water. This is a direct reading titrator. 1 = 1mg/L. Record result as test one.

****HELPFUL HINT**** *Use a magnifying glass to read titrator more easily and accur ately.*

STEP 15: Repeat **Steps 9-14** on ***second*** sample bottle.

STEP 16: Record the result of test two and subtract from test one. If difference is **greater** than 0.6 ppm or mg/l then repeat test on another sample bottle. If difference is **less**, then average results of the two tests and record as final DO.

INSTRUCTIONS FOR USING THE LaMOTTE pH
INDICATOR COLORMETRIC METHOD (Wide Range)

(There are 4 steps for this method.

STEP 1: Rinse sample test tube supplies (contained in pH kit) three times with water from bucket.

STEP 2: Fill sample test tube to mark with water from bucket.

STEP 3: Add ten drops of wide range indicator. Mix sample thoroughly.

STEP 4: Put tube in comparator slot and record pH value from color in comparator that most closely matches sample tube color.

NOTE: When color observed is between 2 colors on comparator, the value is reported to one half of units displayed. (For example: If color is between color blocks 6 & 7, then pH = 6.5; if your color blocks measure 0.5 units, then a color between 6.5 and 7.0 = 6.75) **Do not try to estimate less than half of units shown on color blocks.**

****HELPFUL HINT**** *Use the small plastic pipet in your pH kit to remove or add just the right amount of sample water to test tube. Use pipet that has not been used with other test kits.*

INSTRUCTIONS FOR USING THE pH METER

*(**There are 10 steps for this method.***
*Λ **Keep top of meter dry at all times. Do not use in rain.***

STEP 1: Remove protective cap and squirt small quantity of distilled water over electrode only. Gently shake off excess.

STEP 2: Note **pH number** of pH solution in buffer bottle. This number will be used to calibrate meter.

STEP 3: Insert meter into buffer solution capsule so that liquid rises above glass electrode and just above arch.

Do not let any liquid rise above the seal above the elecrode.

Any liquid entering the upper portion of meter may short circuit meter.

STEP 4: Hold meter and container with one hand and turn on meter (slide switch left with readout facing you) with other hand until switch clicks and locks. Swirl buffer liquid around electrode.

DO NOT TURN METER ON WHEN ELECTRODES ARE NOT IN WATER.

STEP 5: After 10 seconds read number on digital readout.

If digital number does not equal buffer solution number then insert your fine tuning or "glasses repair" screwdriver into rear of meter. Turn adjustment screw slowly to change digital readout until it equals buffer number and is stable.

STEP 6: Turn off meter and remove from liquid.
Always turn meter off before removing from liquid.

Rinse meter electrode with de-ionized water and shake off excess and cap buffer.
The buffer should be replaced after four tests.

STEP 7: Now you are ready to test a sample of water.

Completely fill plain capsule with "test water" and discard. Repeat two times.

After previous rinsing, fill half of capsule with test water.

STEP 8: Insert meter into test water capsule immersing electrode completely. Do not allow water above bottom of tape on meter.

STEP 9: Turn on meter. Swirl water in cup around electrode and wait ten seconds. Read digital readout immediately, turn off meter and remove from water sample. Record the reading.

If unsure of reading simply repeat process beginning at STEP 7. The meter will still be calibrated.

*** * * * * * If sample event is last sample day of the month proceed to STEPs 9A and 9B below.**

STEP 10: Rinse meter electrode with de-ionized water and gently shake off excess. Store meter in sealed plastic freezer bag. Add pH buffer to buffer capsule if below bottom of red tape.

Repeat process every week when you test your site. Within same day additional samples may be tested after calibrating meter one time.

Store all chemicals and materials in safe, cool and dry place.

At the End of Each Month:

STEP 9A: Once per month, immediately after conducting site sampling, discard old buffer solution from small red taped container into a commode or sink of running water. Re-fill capsule as done previously.

STEP 9B: Since meter has been calibrated during the same day, insert meter into fresh solution to see if old solution discarded calibrated your meter correctly. If meter does not read within +/- .1 units of buffer solution, contact program office or local coordinator.

Return to STEP 10 above.

Special Notes: *If you get erratic readings with pH meter, batteries may need to be replaced. Please report problems to local coordinator or program office.*

Do not clean capsules with detergent, just rinse with ***distilled water.***

When your meter is not used weekly you should store the meter in the case with a sponge soaked with tap water (only) to prevent the electrode from "drying out".

INSTRUCTIONS FOR USING THE HYDROMETER FOR SALINITY

(***There are 7 steps for this method.***

Λ ***Salinity is determined by measuring specific gravity with a hydrometer, correcting for temperature, and converting specific gravity to salinity at 15 degrees C by means of a table of corresponding densities and salinities.***

STEP 1: Fill hydrometer jar about 3/4 full with water to be tested.

STEP 2: Hang thermometer in jar.

STEP 3: Lower hydrometer into jar. Allow to settle down.

STEP 4: Read and record temperature in jar.

STEP 5: Read and record specific gravity to fourth decimal place. Use diagram of hydrometer stem (at right). Be sure to look at the following examples and hints.

****HELPFUL HINT**** ***To obtain correct hydrometer reading****: Note that water seems to creep up glass stem (See diagram below). The correct reading is at <u>water level</u> not higher point called the meniscus. Be sure to view at eye level to the hydrometer since looking from an angle can give incorrect reading.* **Note diagram on the following page to read the hydrometer correctly. Use magnifying glass to improve view.**

STEP 6: Use LaMotte Table in the following pages to convert your hydrometer reading at a specific temperatures to salinity at 15 degrees C.

EXAMPLE: *Observed hydrometer reading is 1.0110, water temperature in jar is 25 degrees C. Locate observed density of 1.0110 on left hand column. Follow across horizontally until coming to 25 degrees C on top row. See number "16.9". This number is the salinity of your water sample.*

STEP 7: Record results on data sheet.

INSTRUCTIONS FOR USING THE LaMOTTE SALINITY TITRATION TEST

(There are 7 steps for this method.

Ω;Ω **Hazardous Materials**: ***Read safety warnings in Appendix or bottle labels before use.***

STEP 1: Fill titration tube (0648) to the 10 ml line with large deionized water bottle (or other deionized water supply). Use eyedropper to accurately add or remove water.

STEP 2: Fill 1.0 ml Titrator (0376) to 0 mark with water to be tested. Wipe off excess water from Titrator.

STEP 3: Dispense the 1.0 ml of sample water into titration tube by *gently* depressing plunger until it reaches the 1.0 ml mark. Do not try to force remaining liquid out of the titrator. Gently tap titrator to discard clinging droplets into tube.

STEP 4: Add 3 drops of Salinity Indicator Reagent A (7460) to titration tube. Cap and gently swirl to mix.

STEP 5: Fill 0-20 Direct Reading Titrator (0378) with Salinity Titration Reagent B (7461). Insert Titrator in hole of cap.

STEP 6: Slowly depress plunger and swirl sample after each drop until color changes from yellow to pink-brown. Read test result directly in ppt Salinity where plunger tip meets scale.

STEP 7: Record whole number and additional divisions where indicated on data form.

****HELPFUL HINTS****

- *When color tries to appear, make drop size equivalent to divisions on titrator for more accurate measurement.*
- *Rinse titration tube with deionized water after completion of testing.*

INSTRUCTIONS FOR USING THE SECCHI DISK FOR TURBIDITY

(There are 4 steps for this method.

NOTE: The Secchi disk is a 20 centimeter (8 inch) diameter disk, with black and white quadrants. Attached to the center is a line measured and marked in 0.1 meters.

STEP 1: Take reading without sunglasses while standing and with sun to back. If on a boat, move well forward, clear of stern propellers and read on shaded side.

STEP 2: Lower disk into water until disk barely disappears from sight. Note depth reading, in meters, based on length of submerged suspension line.

STEP 3: Slowly raise disk and record depth at which it reappears (barely perceptible).

STEP 4: Choose the average of the two depth readings obtained from above. The average of two readings is considered to be limit of visibility, or index of transparency.

****HELPFUL HINT**** *Tie a wrist loop in end of disk line to prevent loss of disk.*

SECTION IV
PART B

INSTRUCTIONS FOR
TARGETED MONITORING

INSTRUCTIONS FOR TAKING A CHLOROPHYLL SAMPLE

The procedure for monitors will include the following steps:

Step 1 - Perform this test when performing your regular weekly sampling. Take aluminum foil and cut into 3" by 5" pieces. **Fold in half with dull side facing out.** Using permanent marker, write sample location, volume filtered (# cc's) , date and monitor name on label provided and place on back of each one.

Step 2 - Obtain bucket of water for chlorophyll test. (Rinse bucket three times and pitch water away from water sample site.)

Step 3 - Remove filter from zip lock bag **using forceps.** Place filter using forceps into the in-line filter holder. **Do not touch the filter with your fingers.** If you must touch filter, use back of fingernail. Make sure the assembly is tight and water will not leak out the sides. The O- rings are very tight at first and extra caution is needed to make sure the in-line filter does not leak.

Step 4 -Place drops of magnesium carbonate solution, enough to wet the filter (5 $\pm$ drops)
in the same hole which the syringe is placed over for the next step. This allows the drops to disperse over the filter just like the water.

Steps 5 - Fill syringe with sample water and empty syringe into the on-line filter holder **three (3)**
times. If a heavy algae bloom, filter as much water as possible and **note amount of cc's** filtered on aluminum foil.

Step 6 - Fold filter in half, folding the darkened (chlorophyll) side onto itself.. (This can be done
while filter is still on in-line holder or after placing it on the aluminum foil) **Make sure the**
chlorophyll in inside the fold. Place folded filter inside aluminum foil. Fold edges of foil
over to seal filter inside. Place into zip lock **Freezer** bag into your freezer. Keep in your
freezer until pick-up is arranged by your regional coordinator. **This must be kept frozen.**

Procedure for analysis of chlorophyll sample in the laboratory will be done in accordance with the NC Division of Environmental Management's Laboratory so the data will be able to be used by that department.

NOTES:
If a heavy algae bloom,, filter as much water as you can, and note amount of *cc*'s filtered on aluminum foil.

Make sure that the in-line filter holder is tightly screwed together, or else water will come out the sides and you will be performing the procedure incorrectly.

INSTRUCTIONS FOR COLLECTION OF SURFACE WATER SAMPLES FOR COLIFORM ANALYSIS

GENERAL PRECAUTIONS - Please read this section *before* sampling begins.

1. Wash your hands before beginning the collection procedures, handling the bottles or handling the labels. This is especially important if you have recently used the toilet, cleaned an animal cage, handled pets, spread organic fertilizer, or worked in a garden.

2. Do not let your fingers touch the rim or inside of the bottle, or interior of the cap.

3. Completely fill out the sample collection sheet immediately before collecting the sample.

4. Do not open the bottle until you are ready to fill the bottle with the sample.

5. Minimize the time that the bottle is open. While collecting the sample you should not allow the interior of the lid to come in contact with any non-sterile surface. You may choose to hold it in one hand while collecting the sample with the other, or place it top side down on a reasonably clean surface such as a dock, post, or boat deck, etc.

6. If you should accidentally touch the interior of the bottle or lid, or drop the lid onto soil, transfer the numbered label tape from the old bottle to the "spare" bottle and use it to collect the sample.

7. After the sample is collected it should be kept cool. Preferably, it should be refrigerated or kept in an ice chest *from the time of collection until it is delivered* to the laboratory. **Above all it should not be left in a hot car!** When keeping the sample in an ice chest it is preferable not to allow the sample to become submerged in ice water. Ice chests are rarely very sanitary and the water may contaminate the area around the rim of the sample.
8. If you wade into the water to collect the sample you should continue wading in a direction *away from any bottom sediments that you may have disturbed* as you collect the sample. If you are in a boat you should avoid any sediments which may be disturbed by a paddle or a motor. You may take a sample while the boat is moving slowly forward.

9. Some judgment may be needed to determine if a sample should be taken. For example, if a pelican, anhinga, or flocks of gulls are observed resting on the end of a dock or piling where the sample is to be taken it would be common for them to defecate as they take flight. A sample taken in the vicinity of the excrement may accurately reflect a momentary peak concentration of fecal coliform but it would not be characteristic of the body of water being sampled. Avoid any occurrences of such activity at the site.

COLLECTING THE BACTERIA SAMPLE

STEP 1: Preparation - Wash your hands thoroughly prior to leaving for the sample site. Avoid petting animals or coming in contact with any potential contaminating source prior to touching the sample bottle.

STEP 2: At The Site - Immediately fill out the sample collection data sheet for the ***bottle number***, date, time, and collector name, etc. Leave the bottle cap closed until you are ready to sample. *Please double check the bottle number and data sheet entry to insure accurate identification.*

STEP 3: When in position for sampling, open the bottle *being careful not to touch the opening, the interior of the bottle, or the interior of the cap.*

STEP 4: Remove the cap and hold it in one hand or place it top side down on a reasonably clean surface.

STEP 5: Do The Following In One Motion - Without delay, hold the bottle *by its base*, invert it, and plunge it neck down into the stream with a thrusting motion toward the current (if it exists). Your hand and the bottle should be fully submerged. As you submerge the bottle (above your wrist) turn the bottle until the opening points slightly upward as it is taken out of the water. The bottle will quickly fill. Bring the brim full bottle above the water surface.

STEP 6: After the bottle is out of the water pour out enough of the sample to leave about one inch of air space and cap it tightly. When using smaller plastic bottles pour off only 1/2 inch.

STEP 7: Immediately place the bottle in a cooler with ice making sure that the bottle will never be submerged below the ice *or* in water.

STEP 8: Please note on the data sheet any interesting observations or deviations in normal activities that you feel are important. Return the data sheet and the sample to the pickup point promptly.

ALL SAMPLES MUST BE PLACED ON ICE IMMEDIATELY WHEN COLLECTED AND ANALYZED BY THE LAB WITHIN 15 HOURS OF TIME OF COLLECTION.

INSTRUCTIONS FOR TAKING A NUTRIENT SAMPLE

PREPARING TO SAMPLE (*At home before you leave*)

STEP 1: Open the in-line filter and separate it into its three parts. Lay the pieces with the white filter surfaces up.

STEP 2: Take the stainless steel forceps and remove a glass fiber filter from its package (without touching the filter with your fingers) and carefully place the glass fiber filter inside the groove on the top of the larger piece of the in-line filter.

STEP 3: Cover the glass fiber filter with the plastic filter cover (fit "dove tail" portion into grooves). Attach the remaining part and tighten the filter *evenly* until sealed.

GETTING YOUR SAMPLE AT THE SITE

STEP 1: Fill out data sheet for date time, and other *important* qualitative information.

Write down your sample bottle number on your data sheet.

STEP 2: Insert the plastic syringe 6" below the surface of river or sound (**Do not use bucket for sample**) and withdraw a small sample. Rinse three times. Discard remains away from where sampling.

STEP 3: Re-insert the syringe into the water and completely fill syringe.

STEP 4: Insert the syringe into the small end of the filter and discharge water slowly through the filter into your sample bottle. Repeat STEP 3 until the bottle is full, just below the top of the square portion of the bottle. **Do not overfill above square neck or the bottle will burst when frozen.**

STEP 5: Re-cap the bottle and place it in a cooler.

STEP 6: **Make sure that you have written down your sample bottle number on your data sheet.** Take the bottle(s) home for freezing and later transfer or to other location for immediate pickup.

SECTION V

APPENDIX

METHODOLOGIES AND EQUIPMENT

In this section, we summarize some of the technical principles for each baseline monitoring test listed in this manual. After each technical summary, all of the materials provided in each kit are listed including specific safety warnings and storage precautions.

Always refer to the chemical container or materials safety data sheets found in your kits when an accident or emergency occurs and/or ***call*** **the Duke University Poison Control Center at 1-800-672-1697.** *Check your phone book for other emergency numbers.*

Please note these symbols in the text. *We recommend that you wear rubber gloves and safety goggles when conducting any chemical test.*

.;. ***Warning****: Potentially harmful chemical/substance, use with caution.*

Ω;Ω ***Danger****: Poisonous or hazardous chemical/substance, use with extreme caution.*

DISSOLVED OXYGEN-MODIFIED WINKLER TITRATION (LaMOTTE)

SUMMARY OF METHOD: The Modified Winkler Titration is a very accurate test for dissolved oxygen (DO) when conducted in a precise and cautious manner. The laboratory version of this procedure is used to calibrate electronic DO meters. Like many quantitative chemical tests, the Winkler Titration measures dissolved oxygen indirectly. In this procedure, iodine is produced in direct proportion to DO present in the sample and measured as DO.

The Modified Winkler procedure can be explained as follows. Manganese Sulfate and Alkaline Potassium Iodide Azide are added to a water sample in a collection bottle free of oxygen bubbles and mixed. An equivalent amount of DO is produced in the form of Manganese hydroxide precipitate. A cloud or flocculent develops in the bottle and is thoroughly mixed to allow complete oxidation of all the oxygen present in the sample. After the flocculent settles below the shoulder of the bottle Sulfamic Acid powder or Sulfuric acid liquid is added to "fix" the sample. The acid disperses and liberates iodide ions in proportion to the amount of oxygen in the original sample.

Now that the element to be measured is equally dispersed in the sample bottle, a representative portion of the sample can be added to a separate container for titration. In the titration step, a known concentration of Sodium Thiosulfate (the titrant; 0.025 Normal) is added in measured quantities to the treated sample. The sodium thiosulfate reacts with the iodine to produce a color change. Starch indicator is added to make the color change more dramatic.

When the solution turns from blue to clear, the end point of the titration is reached. To calculate the amount of dissolved oxygen, we must know the quantity of treated sample, the concentration of the titrant (sodium thiosulfate) and the number of titrant drops added. For simplicity, LaMotte has already calculated this relationship as a direct reading on the glass "syringe" used for the titration. Each drop of titrant therefore equals approximately 0.2 milligrams per liter of dissolved oxygen. We conduct this test twice on two different sample bottles to see if the results fall within a specific range of allowable error (0.6 mg/l). If the two readings are no more than 0.6 mg/l apart, then the average is recorded as the DO content.

ITEMS INCLUDED FOR METHOD:

T*one* 25 ml bottle of Manganese Sulfate Solution (4167-G)
T*one* 25 ml bottle of Alkaline Potassium Iodide Azide Solution (7166-G)
T*one* 50 g bottle of Sulfamic Acid Powder (6286-H);
or, 30 ml bottle of Sulfuric Acid Liquid (6141 WT)
T*one* 50 ml bottle of Sodium Thiosulfate Solution (4169-H)
T*one* 25 ml bottle of Starch Indicator (4170PS-G)
T*two* water sampling bottles 60 ml, glass (0688-DO)
T*one* direct reading titrator (glass syringe) (0377)
T*one* titration tube, 20 ml (0299)
T*one* pipet, plastic, with screw cap (for starch indicator) (0392)
T*one* measuring spoon, 1.0 g (0697) for use with Sulfamic Acid Powder
T*one* plastic transfer pipet, 8.7 cm (Fisher #13-711-41)
T*one* plastic graduated cylinder, 25 ml [Fisher (Nalgene PMP) #08-572-7B]
T*one* bottle of Silicone Grease (to keep titrator working)

Total of 14 Items

SAFETY PRECAUTIONS:

Ω;Ω *Alkaline Potassium Iodide Azide is a POISON.* **Avoid any bodily contact**. *Consult label and materials safety data sheets in your kit for safety instructions.*

.;. *The Manganese Sulfate and Sulfamic Acid Powder \ Sulfuric Acid Liquid are **HARMFUL** chemicals. Avoid bodily contact.*

Λ *Store all kits and chemicals out of the reach of children and pets.*

pH - COLORMETRIC METHOD (LaMOTTE)

SUMMARY OF METHOD: The pH colormetric test uses a liquid chemical indicator to determine pH. When a specific amount of indicator is added to a specific amount of sample water, a color results that correlates to a known pH. Each type of pH indicator has a specific range or level of pH that it can detect.

Because the pH scale is so wide (0-14 in decimal increments) the use of certain pH indicators is limited. For example, the LaMotte Wide Range pH indicator can detect pH from 3.0-10.0 but only in increments of 1.0-0.5 units. Narrow range indicators are more sensitive but are limited to narrow ranges (e.g.; pH from 6.0-7.4 or 8.0-9.4 in increments of 0.2 pH). In most cases we use pH meters because they are not only more accurate but are more versatile. The advantage of the colormetric test is low cost.

ITEMS INCLUDED FOR METHOD:

T*two* test tubes with caps (0230)
T*one* wide range pH comparator (code depends on kit)
T*one* bottle of pH indicator solution (sometimes two; code depends on kit)
T*one* plastic transfer pipet, 8.7 cm (Fisher #13-711-41)

Total of 5-6 Items

SAFETY PRECAUTIONS:

.;. *The pH indicator solution is a **FLAMMABLE** liquid. Keep away from heat or flame. Avoid bodily contact.*

pH TEST - ELECTROMETRIC (FISHER SCIENTIFIC)

SUMMARY OF METHOD: The pH of liquids can also be determined by an electrometric method. The most widely used method at the present time is the glass electrode system which consists of a glass membrane electrode, a reference electrode, and a pH meter (potentiometer). All three components are assembled as one unit in the device used by the CWQM program.. The pH meter measures certain units of electrical charge produced by the hydrogen ion concentration in the sample solution. When inserted into a solution, the glass electrode (or sensor electrode) and reference electrode complete a circuit through the potentiometer to produce a pH reading. The pH meter must be calibrated with a "known" pH

solution (buffer) each test day to insure that it measures the unknown solutions accurately. Because the glass pH electrode is the sensor electrode, it must be kept clean and free of scratches for proper operation. The electrode must also be kept moist using pH buffer or distilled water (only) when not used regularly.

Since pH is subject to temperature affects at certain levels, most meters compensate for temperature. The CWQMP pocket meters are not temperature compensated. A small correction factor however can easily be entered into the data base when needed by using the water temperature readings.

ITEMS INCLUDED FOR METHOD:

T*one* pH meter (containing electrode components) with protective cap
T*one* bottle of pH buffer solution (pH 8.0 for coastal sites; pH 7.0 for inland sites)
T*one* bottle of distilled water (to clean meter electrode)
T*one* empty capsule and lid for calibration (red tape attached)
T*one* empty capsule (no lid) for water sample testing (no tape attached)
T*one* small fine tuning screwdriver (Walmart eye glasses repair kit)
T*one* 8" x 8.75" small plastic freezer bag with protective padding for meter

Total of 7 Items

SAFETY PRECAUTIONS:

.;. *The pH buffer can be harmful. Avoid ingestion or contact with the skin. Please read all safety messages on the packaged bottle provided with the meter.*

SALINITY-HYDROMETRIC (FISHER SCIENTIFIC & LaMOTTE)

SUMMARY OF METHOD: Hydrometers are long stemmed, glass bulbs with a lead weight in the bulb end and a graduated measuring scale in its narrow stem. The measuring scale represents a calibrated measure of specific gravity at a certain temperature. When inserted into a clear cylinder in a specific volume of water, the hydrometer will float. The density of the water determines the buoyancy of the hydrometer. High salinity solutions (i.e., solutions with a large amount of dissolved salts) have a greater density or weight than fresh water. Therefore, when the glass hydrometer is placed in a solution of dissolved salts like seawater, it will generally float higher. The hydrometer simply displaces less water than it would if in lower density fresh water. The level of buoyancy (in

specific gravity) is read on the hydrometer's scale as the stem protrudes from the water. Since the hydrometer was calibrated at a specific temperature, we adjust the specific gravity reading to another reading (in a standard table) based on the true temperature of the water in the cylinder. This number is also used in the table to convert the true specific gravity reading to a salinity measurement.

This procedure also promotes error. The hydrometer may not always measure the specific gravity of water caused by ocean salts. In low salinity areas, hydrometers have often measured specific gravity resulting from dissolved solids from fresh water runoff. This is why hydrometers are best used in coastal areas where specific gravity much more accurately represents sea water.

ITEMS INCLUDED FOR METHOD:

T*one* hydrometer; calibrated @ 60E/60EF range; 1.000-1.070 specific gravity
T*one* Nalgene Hydrometer Jar, 500 ml (Fisher #11-582-1)
T*one* thermometer (same thermometer used for air and water temperature)

Total of 3 Items

SAFETY PRECAUTIONS:

.;. *The hydrometers are made of glass and can produce serious cuts if shattered. Store in a PVC tube provided by the CWQM program. If the hydrometer should break, place the remains in a container and forward to the program office for disposal.*

SALINITY TITRATION (LaMOTTE)

SUMMARY OF METHOD: Seawater contains a large, relatively constant amount of chloride ions. Therefore, chloride can be measured to approximate the sea water content or salinity of a water sample. The LaMotte salinity titration kit uses an argentometric titration to determine salinity. The argentometric method assumes that in a neutral or slightly alkaline solution, potassium chromate (used as the salinity indicator) can determine the end point of silver nitrate (the titrant) for a titration of chloride. The two solutions react to quantitatively precipitate silver chloride before a red silver chromate (a reddish brown color) is formed as the end point.

In the LaMotte salinity titration method, the water sample is diluted. The LaMotte kit uses water that has been de-mineralized with a resin bottle in the kit. In the CWQM program, we provide you with de-ionized water (cleaner than the de-mineralized water produced with the kit) for the dilution. The dilution water must be free of ions (de-ionized or de-mineralized) because it could make the test result higher than normal.

In the CWQM program we also double the recommended water sample portion (from 0.5 to 1.0 ml) used in the analysis. This makes the test more accurate at sites where salinity is usually low. We then divide the result by two because we doubled the sample size that LaMotte recommends. As in the DO test, what we are looking for is measured indirectly. Therefore, since the test measures chloride, LaMotte's direct reading titrator automatically converts the level of chloride to salinity as a direct reading on the glass "syringe" (titrator). We have field tested the kit in Currituck Sound with citizen monitors and while using a salinity meter for comparison. The test kits measured very close (within 0.4 ppt) to the meters. Other programs such as the Indian River Lagoon Citizen Monitoring Program in Florida have used the kits successfully.

SALINITY TITRATION (LaMOTTE) continued:

ITEMS INCLUDED FOR METHOD:

T*one* bottle of 15 ml salinity indicator reagent A (7460)
T*one* bottle of 50 ml salinity titration reagent B (7461)
T*one* titration tube, 10 ml (0648)
T*one* direct reading titrator, 0-20 (0378)
T*one* direct reading titrator, 0-1.0 (0376)
T*one* plastic bottle of deionized water
Tone plastic transfer pipet, 8.7 cm (Fisher #13-711-41)

Total of 7 Items

SAFETY PRECAUTIONS:

Ω;Ω *Silver Nitrate solution (brown bottle, salinity titration reagent B) and Potassium Chromate (small white bottle, Salinity Indicator Reagent A) can be harmful if swallowed.* Also, **LaMotte warns that Potassium Chromate is a possible cancer hazard. Always wear gloves when**

<u>using these reagents</u> *to prevent your skin from being irritated and stained. These solutions* ***will stain*** *clothing and skin.*

WATER CLARITY (TURBIDITY) - SECCHI DISK

SUMMARY OF METHOD: The depth to which light can penetrate water is an important factor of measurement due to its effect on aquatic life and submerged vegetation. The secchi disk is one means for effective and simple measurement. First developed by Professor P.A. Secchi in 1865 for a Vatican-financed Mediterranean oceanographic expedition, the secchi disk has since become a standard of turbidity measurement. The disk is usually weighted, about 20 cm in diameter with four alternating white and black sections on its top surface. The disk is attached to a calibrated cord or line graduated in decimeters for measurement.

The secchi disk measures the depth to which a person can see in water (otherwise known as the transparency of the water). The observer first lowers the disk until it just disappears from sight and then records the measurement of line showing at the surface of the water (the descending depth). Next, the observer lowers the disk a little more and then raises it just until it reappears and again records the measurement of line at the surface (the ascending measurement). We record the *average* of the descending and ascending depths as the secchi depth.

WATER CLARITY (TURBIDITY) - SECCHI DISK (continued)

ITEMS INCLUDED FOR MEASUREMENT:

T*one* secchi disk, alternating black and white surface, 20 cm width (with weight)
T*one* graduated line; measured in increments of 0.1 meters (black 0.1's, red whole No.'s)

Total of 2 Items

SAFETY PRECAUTIONS:

Λ *Watch your footing as you lean over a pier, bulkhead, bridge or boat to view secchi disk.*

TEMPERATURE

SUMMARY OF METHOD: The most commonly used and recommended (by Standard Methods) measuring tool is the NIST certified, mercury filled thermometer, graduated at 0.1 increments. For citizen monitoring purposes, fluid filled (mercury or petroleum distillate) thermometers with graduations of 0.5 units are sufficient. Some digital thermometers are used with good accuracy. However, fluid filled thermometers are the most reliable.

ITEMS INCLUDED FOR MEASUREMENT:

Tone fluid (mineral spirits or petroleum distillate) filled thermometer

Total of 1 Item

SAFETY PRECAUTIONS:

.;. *Keep fluid filled thermometer away from open flame or high heat. The fluid is not hazardous but is flammable. Flush with water if fluid makes contact with skin or eyes.*

GENERAL INFORMATION

WATER FACTS

Water exists . . .	
as a **liquid**	between 0 degrees and 100 degrees Centigrade (32 degrees and 212 degrees Fahrenheit)
as a **solid**	

as a **gas**	at or below 0 degrees Centigrade (32 degrees Fahrenheit) at or above 100 degrees Centigrade (212 degrees Fahrenheit)
One gallon of water weighs	8.33 pounds (3.778 kilograms)
One gallon equals	3.785 liters
One cubic foot of water equals	7.5 gallons (28.35 liters)
One ton of water equals	240 gallons
One acre foot of water equals	43,560 cubic feet (325,900 gallons)
Earth's rate of rainfall	340 cubic miles per day (16 million tons per sec.)
Percent of earth's **fresh water** **salt water**	0.64 percent 99.36 percent (Source: Nace, 1977)
True or False	
It takes 10 gallons of water to make 1/2 can of cola.	True
Every American uses 30 gallons of water per day in their home.	False, about 70 gallons
A non-economy toilet uses 30 percent of home water.	False, about 40 percent
Water is the most common substance on Earth.	True
It takes 115 gallons of water to make one loaf of bread.	True

COMMON CONVERSIONS

TO REPORT . . . (Courtesy of the Neuse River Foundation)

Fish kills, algae blooms, other water discoloration or suspicious odors	*NC Dept. of Environment, Health and Natural Resources* Raleigh - (919) 733-5291 Wilmington - (910) 395-3900 Washington - (252) 946-6481
Plumes of heavy sediment in the water	*NC Division of Land Resources* Wilmington - (910) 395-3900 Washington - (252) 946-6481
Oil spills	*US Coast Guard,* 800-424-8802
Dredging or filling in coastal wetlands	*NC Division of Coastal Mgt.* Morehead City - (252) 726-7021 Washington - (252) 946-6481 Wilmington - (910) 395-3900 Elizabeth City - (252) 264-3901
Dredging or filling **any** wetlands	*US Army Corp of Engineers* Wilmington - (910) 251-4511 Washington - (252) 975-2626
Fishing violations	*NC Department of Marine Fisheries* 800-682-2632

REGIONAL ENVIRONMENTAL ORGANIZATIONS
(*Please support your local group*)

Albemarle Environmental Association (Hertford, NC)
Contact: 252-426-9563

Neuse River Foundation / Neuse River Keeper (New Bern, NC)

Contact: 252-637-7972

Pamlico-Tar River Foundation (Washington, NC)
Contact: 252-946-7211

Carteret County Crossroads (Beaufort, NC)
Contact: 252-728-5117

Friends of the Roanoke (Manteo, NC; focuses on the northeastern, North Carolina coastal area)
Contact: 252-473-6365

North Carolina Coastal Federation (Ocean, NC; focuses on all NC coastal counties)
Contact: 252-393-8185

Currituck Sound Area: Yates Barber (local environmental leader; Elizabeth City, NC); 252-338-3557

Chowan River Area: Capt. Alfred Howard; (local environmental leader; Edenton, NC); 252-221-4977

REFERENCES

Rhode Island, Volunteer Monitoring, Water Quality Protocol Manual (Univ. of RI, 1992)

Water Analysis Handbook (HACH Inc., 2nd Edition, 1992)

Standard Methods for the Examination of Water and Waste Water (17th Edition, 1989)

Turbidity, Its Meaning and Measurement (Dr. Charles Renn, 1976)

A Study of Water Quality (Dr. Charles Renn, 1968)

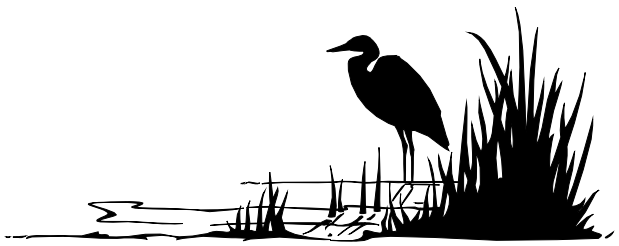
pH, Buffers and Acid Base Titration (LaMotte Inc., Unlisted Date)

Our Environment Battles Water Pollution (Dr. Charles Renn, 1969)

The Monitor's Handbook (LaMotte Inc., 1992)

ALGAL INDEX

Algal Index Range	Category	Description	Use Impairment
0-2	Clear	Conditions varying from no nuisance bloom algae being present to small populations being present in the water column.	Conditions are favorable for all recreational and commercial activities.
3-4	Present	Nuisance bloom algae are present at low to medium population levels. Some may be visible to the naked eye.	Recreational and commercial activities are not significantly impaired.
5-6	Visible	Populations of nuisance bloom algae reach a level at which filaments and/or balls of algae are visible to the naked eye. Possibly some widely scattered, small surface "streaks" of algae.	Color and presence of bloom "streaks" not aesthetically pleasing to swimmers and boaters. No significant effects on recreational or commercial fishing.
7-8	Scattered Surface Blooms	Surface mats of nuisance algae are scattered and may be somewhat heavy in localized areas if calm wind conditions develop. "Streaks" of algae are prevalent.	Algae accumulation has significant adverse effects on swimming and boating activities. Some odor problems. Some impairment of commercial and recreational fishing.
9-10	Extensive Surface Blooms	Large portions of the water body covered by extensive surface mats of the nuisance bloom algae. Windy conditions may temporarily eliminate mats, but they will quickly re-develop as winds become calm.	All activities significantly affected. Odor problems in localized areas. Adult and juvenile fish populations heavily stressed and fish kills are possible.



ALBEMARLE-PAMLICO CITIZENS WATER QUALITY MONITORING PROGRAM
East Carolina University Institute for Coastal & Marine Resources
Mamie Jenkins Bldg. Greenville, NC 27858-4353
Phone: (252) 328-1747 ***Fax*****:** (252) 328-4265

ALBEMARLE-PAMLICO CITIZENS WATER QUALITY MONITORING PROGRAM

Volunteer Liability Wavier

The Albemarle-Pamlico Citizens Monitoring Program(APCMP) relies on the data obtained by its volunteers. **It is stressed that the safety of the volunteers is the first priority of this program. Do not take unnecessary risks to obtain your data.**

I, the undersigned, for myself and on behalf of my heirs and personal representatives, do agree to release and discharge the Albemarle-Pamlico Citizens Monitoring Program from all claims whatsoever which could in any manner arise or grow out of my participation in the APCMP.

I recognize the potential for injury to myself and my personal property, and to other persons and their personal property, which may result from volunteer activities conducted under the APCM program. I agree to assume all risks for any injury to myself and my personal property and any liability to others caused by my actions while participating in this program.

I have been instructed and trained in proper monitoring techniques and equipment use. I have received a manual of prescribed testing. **I have been cautioned that, if there is ever any doubt, I should give safety priority over testing.**

I recognize that this wavier is a precondition to my participation in APCMP. I will attempt to obtain accurate data in a safe manner.

Print Name:_____

Signature:_____

Date:_____

Parent or Guardian:_____
(if volunteer is under 18 years of age)

Date:_____

CITIZENS WATER QUALITY MONITORING PROGRAM
ECU-ICMR/Mamie Jenkins Bldg/Greenville, NC 27858-4353
Phone: (252) 328-1747

DATA REPORT

Numbered items denote Data Base Information
S = # Denotes Sensitivity of Measurement

---------- ***Section A - General Information*** ---------- **CROSS OUT IF NO DATA** ----------

(1) Site Code: (Number and Letter) ..... **(1)** ___ ___ ___ ___ ___

(2) Monitor Name: Please Print Here _____ **(2)** **Monitor #:** ___ ___ ___

(3) Collection Date: ..... **(3)** **Year** __ __**Month** __ __**Day** __ __

(4) Time of Day: (Military Time) ..... **(4)** **Hours** __ __ **: Minutes** __ __

(5) Air Temperature: .....**(5)** ___ ___ **.** ___ **Degrees Celsius**

(6) Bucket Sample Water Temperature: ..... **(6)** ___ ___ **.** ___ **Degrees Celsius**

---------- ***Section B - Turbidity***----------

(7) Secchi Depth: [S = 0.05 M] **(7)** ___ ___ **.** ___ ___ **Meters**
(if secchi depth > water depth, enter water depth for #7 and #8)

(8) Water Depth: [S = 0.05 M] (water depth must be ≥ secchi depth)..... **(8)** ___ ___ **.** ___ ___ **Meters**

---------- ***Section C - pH & Dissolved Oxygen*** ----------

(9) pH: ..... **(9)** ___ ___ **.** ___ **Standard Units**

Begin Dissolved Oxygen Tests
Test 1 (T1) [S = 0.1 mg/l for a tests] ..... __ ___ . ___ mg/l

Test 2 (T2) & difference of T1-T2 (Conduct third test if difference is > 0.6)..... ___ ___ . ___ mg/l Diff. = 0. ___

Test 3 - (If Needed) (Resample and retest if difference is > 0.6)..... ___ ___ . ___ mg/l Diff. = 0. ___

(10) Final (Average) DO Reading: (Average two tests with difference < 0.6) **(10)** ___ ___ **.** ___ **mg/l**

---------- ***Section D - Salinity*** ----------

(11) Please Circle Method Used
Direct Hydrometer Reading: (Observed Density): (leave blank if < 1.0000) **(11A)**_____
or Conductivity Meter reading (Testr 3 or Testr 4) **(11B)** _____

(12) Hydrometer Cylinder Temperature / Water Temp..... **(12)** ___ ___ **.** ___ **Deg. Celsius**

(13) Salinity (use LaMotte Table for hydrometer or Conductivity Chart for meter) **(13)** ___ ___ **.** ___ **0/00 or ppt**

---------- ***Section E - General Observations*** ----------

(14) Wind Direction: 1-N 2-NE 3-NW 4-S 5-SE 6-SW 7-E 8-W **(14)** _____

(15) Wind Speed: **Beaufort Wind Scale:** 0-calm 1-Light Air 2-Light Breeze 3-Gentle Breeze 4-Moderate Breeze 5-Fresh Breeze 6-Strong Breeze 7-Near Gale 8-Gale 9-Strong Gale 10-Storm 11-Violent Storm 12-Hurricane **(15)** _____

(16) Water Surface: 1-Stagnant 2-Calm 3-Ripple 4-Waves 5-White Caps **(16)** _____

(17) Lunar Tide: 1-No Lunar/Ocean Tide Applicable 2-Incoming [High] Tide 3-Outgoing [Low] Tide **(17)** _____

(18) Direction of Current: 1-None 2-Upstream (*Due to Wind or Lunar Tide*) 3-Downstream **(18)** _____

(19) Speed of Current: 1-None 2-Visible Flow 3-Rapid (*Due to Rain Runoff*) **(19)** _____

(20) Water Color: 1-Normal 2-Abnormal (See comment section below) **(20)** _____

(21) Other Signs: 1-Sea nettles 2-Dead fish 3-Dead crabs 4-SAV 5-Oil slick 6-Ice 7-Debris 8-Erosion 9-Foam 10-Bubbles 11-Odor **(21)** _____

(22) Algal Index: **(For monitors who conduct algae watch only)** 0-2 Clear 3-4 Present 5-6 Visible 7-8 Scattered Surface Blooms 9-10 Extensive Surface Blooms **(22)** _____

(23) Weather: 1-Clear 2-Partly Cloudy 3-Overcast 4-Fog/Haze 5-Drizzle 6-Intermittent Rain 7-Rain 8-Snow **(23)** _____

(24) Frequency of Local Rainfall for Past Week: 1-None 2-Scattered Showers 3-Showers 4-Thunderstorms 5-Hurricane Conditions **(24)** _____

(25)Last Date of Rainfall: 1-Today 2-Yesterday 3-Day before Yesterday 4- Earlier in Week **(25)** _____

(26) Weekly Sum of Daily Rainfall Readings for Past Week: **(26)** _____ **Inches**

Comments or Other Observations (If water color is abnormal, describe how the abnormal water color is different from normal water color.)

_____

_____

This data was collected according to CWQMP standards: Signed_____