RiverTrends
Volunteer Water Quality Monitoring Program Manual

Alliance for the Chesapeake Bay
May 2007

Preface

Since the Chesapeake Bay Citizen Monitoring Program, now known as *River Trends,* began in 1985, the Alliance for the Chesapeake Bay has grown into a leader of volunteer monitoring programs in the Chesapeake Bay region. Over 500 volunteers with the Alliance's *River Trends* program have performed water quality tests at over 400 sites to track the conditions of the water quality of the Chesapeake Bay and its tributaries. *River Trends* has demonstrated that citizen volunteer water quality monitors can collect water quality data that meet strict standards and supplement state and federal databases. The coordinators of the program also share sampling procedures and data collection with environmental groups across the country.

The *River Trends* program has also led to major developments in the restoration of the Bay. For example, in 1990, ammonia data collected near Jordan Point on the James River were used to reevaluate the permit of the Hopewell Regional Sewage Treatment Plant. Since 1992, citizen monitoring data have been included in the *Virginia Water Quality Assessment 305(b) Report* to EPA and Congress. Data collected by the program are available to the general public, educational institutions, and all levels of the government. These results are the reason that this Program is a vital component of efforts to protect and restore the Bay.

Understanding the ecosystems of the Chesapeake Bay and its tributaries is imperative if we are to restore the Chesapeake Bay to health. This manual was prepared to assist volunteers performing chemical water quality monitoring. This manual contains background material and instructions for measuring air and water temperature, dissolved oxygen, water clarity, pH, bacteria, nutrient sampling, and use of a Hydrolab to sample water quality.

For further information on the *River Trends* program, please visit the Alliance for the Chesapeake Bay's web site at: **www.acb-online.org** or contact the following:

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1. Introduction: The Importance of the Chesapeake Bay and Its Rivers

Sixteen million people live, work, and play in the Chesapeake Bay's watershed. Everyone in the watershed lives just a few minutes from one or more of the100,000 streams and rivers draining into the Bay. Thus, each individual affects the Bay whether by adding waste, consuming resources, or changing the characteristics of the land, air and water that surrounds it. As one of the country's most productive estuaries, the Bay has provided the United States with an abundance of resources, but its productivity has been affected by human uses of the Bay, its tributary rivers, and the way we live on and use the land in the entire watershed.

In recent years, the rate of population growth in the Chesapeake Bay watershed has accelerated to the point where scientists and land planners have concern that the watershed may no longer be able to sustain all of the living resources that make up the Bay's ecosystem, including humans. Between 1970 and 1997, the region's population grew 28%. By 2020, it's expected that nearly 18 million people will live in the region. In order to accommodate these new residents, more homes will be built. And, if the current development pattern holds, many of these new houses will be located farther away from existing infrastructure, such as schools, businesses and wastewater treatment facilities. This pattern of sprawl development has taken hold all over the Bay region and now ranks among the top threats to the Bay's recovery. [1]

It is our responsibility to protect this great waterway, so that it can continue to sustain healthy aquatic life forms that have been so important in the development of the ecosystem in this region. Becoming a volunteer water quality monitor is one way to contribute to understanding the ecosystem and help in its protection and restoration.

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1 Chesapeake Bay Program, "Land and People," December 12, 2005, <http://www.chesapeakebay.net/land.htm>, captured November 26, 2006.

2. Before You Begin

2.1 Safety, Equipment List, and Volunteer Responsibilities

2.1.1 Safety – General Precautions

- Always perform water-monitoring activities under the guidance of an adult.
- Read all instructions to familiarize yourself with the test procedure before you begin. Note any precautions in the instructions.
- Keep all equipment and chemicals out of the reach of young children and pets.
- Avoid contact between chemicals and skin, eyes, nose and mouth.
- Read the label on each LaMotte reagent container prior to use. Some containers include precautionary notices or antidote information on the back of the container.
- In the event of an accident or suspected poisoning, immediately call the Poison Control Center phone number in the front of your local telephone directory or call your physician. Be prepared to give the name of the reagent in question and its LaMotte code number. LaMotte reagents are registered with POISINDEX, a computerized poison control information system available to all local poison control centers.

2.1.2 Protect Yourself & Your Equipment: Use Proper Technique

- Wear safety goggles or glasses when handling reagent chemicals.
- Use the test tube caps or stoppers, not your fingers, to cover test tubes during shaking or mixing.
- When dispensing a reagent from a plastic squeeze bottle, hold the bottle vertically upside-down (not at an angle) and gently squeeze it (if

a gentle squeeze does not suffice, the dispensing cap or plug may be clogged).

- Wipe up any reagent spills, liquid or powder, as soon as they occur. Rinse area with a wet sponge, and then dry.

- Thoroughly rinse test tubes before and after each test. Dry your hands and the outside of the tubes.

- Tightly close all reagent containers immediately after use. Do not interchange caps from different containers.

- Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect them from extremely high temperatures. Protect them from freezing.

2.2 Equipment List

- Bucket with rope attached
- Armored thermometer
- Dissolved Oxygen kit
- Secchi disk with measured line attached or transparency tube
- pH kit
- ***Volunteer Citizen Monitoring Program Manual*** with instructions, data sheets, clipboard and pencil (<u>not</u> pen)
- Disposable camera (optional)
- Refractometer or hydrometer and hydrometer jar (optional)
- Nutrient sampling kit (optional)
- Bacteria kit (optional)
- Hydrolab (optional)

2.3 Volunteer Responsibilities

<u>Choose a regular sampling day</u>: Choose a convenient day of the week for sampling. Samples should be taken at regular weekly intervals. If it is not possible to sample on the same day each week, try to sample within 2 days

(either side) of your regular day spacing the sampling dates, 5 to 9 days apart. Also, try to sample at the same time of day each week.

Characterize your site: Describe your site in detail, preferably taking a **photograph**. This will enable you to note any changes in the area, such as erosion caused by a major storm.

Record your test results: Record data on a data collection form provided by the Alliance for the Chesapeake. Always record the test results as you go along. Keep a copy of the data collected for your records and to provide a backup copy should the original be lost.

Provide comments as necessary: The "Comments" section can be used to record general observations about the site especially changes due to erosion, loss of dock, etc.), recent notable weather, and any problems you had with the sampling procedures.

Submit data to database: If you have access to the internet, submit your data to the Alliance's online database. Your trainer can tell you how to do this.

Send datasheets once a month. Mail the data sheets to the Alliance or your Watershed Coordinator once a month so that we can maintain a current database.

Stay certified: Attend a recertification session every year to maintain your skills and learn new information and techniques.

3. Why You are Performing These Tests

3.1 Water Clarity

Material that becomes mixed and suspended in water will reduce its clarity and make the water *turbid (*dirty). In summer, plankton are growing and multiplying rapidly in the warm, nutrient-rich water. During periods of heavy rain, run-off from land can carry large amounts of silt into streams. Silt is often related to nutrient enrichment of a river because nutrients such as phosphorus cling to soil particles. Fine sediment can become re-suspended in more shallow waters during heavy winds and tidal action. In addition, unprotected shoreline will erode and contribute suspended particles to the water. In shallow areas, wind-generated waves and boat wakes stir up sediments. Wind and boat generated waves breaking on shore also contribute to turbidity.

Turbidity affects fish and aquatic life in the following ways:

- Suspended materials interfere with the penetration of sunlight. Submerged aquatic vegetation (SAV) needs light for photosynthesis. If suspended particles "block out" light, photosynthesis, which produces oxygen for fish and aquatic life, will be reduced. SAV provides essential food, nursery areas, shelter and habitat for diverse communities of shellfish, waterfowl and fish. If light levels become too low, photosynthesis may stop altogether and algae will die.

- Sediment buries eggs and benthic (bottom dwelling) organisms' habitat.

- Large amounts of suspended matter may clog the gills of fish and shellfish and kill them directly.

- Fish cannot see very well in turbid water and so may have difficulty finding food.

3.2 Temperature

Although water temperature may be one of the easiest measurements to perform, it is probably one of the most important parameters to be considered.

It dramatically affects the rates of chemical and biochemical reaction within the water. Many biological, physical, and chemical principles are temperature-dependent. The most common of are: the solubility of compounds in sea water; distribution and abundance of organisms living in the Chesapeake Bay; rates of chemical reactions; water density; inversions and mixing; and current movements.

Temperature affects feeding, reproduction, and metabolism of aquatic animals; even a week or two of high temperatures may make streams and other shallow water unsuitable for sensitive aquatic organisms, even though temperatures are within tolerable levels throughout the rest of the year. Not only do different species have different requirements, but optimum habitat temperatures may change depending on the stage of life. Fish larvae and eggs usually have narrower temperature requirements than do adult fish.

The temperatures of surface and subsurface water usually differ, resulting in thermal stratification of deeper water and density differences. The Bay's vertical temperature profile is fairly predictable:

- During the spring and summer months, the surface waters are warmed by the sun, while the deeper waters remain colder.

- In the fall, the warming radiation of the sun begins to diminish. As the surface water cools, it increases in density. Once the surface water becomes colder and denser than the bottom waters, it begins to sink, and vertical mixing occurs. Wind may speed up the process. This mixing action can bring nutrients, materials essential to the growth of organisms, up from the bottom and into higher water levels. The turn-over makes the nutrients available to phytoplankton and other organisms inhabiting the upper water levels.

- During the winter, the water temperature becomes relatively constant from surface to bottom.

Causes of temperature change include: weather changes, removal of stream bank vegetation that provides shade; construction of dams and other impoundments; discharge of heated water from industry; urban storm water; and groundwater flows to streams.

3.3 Dissolved Oxygen

Dissolved oxygen (DO) is one of the most important indicators of the quality of water for aquatic life. It is essential for all plants and animals inhabiting the Bay. Oxygen availability throughout the year is influenced by other chemicals present in the water, biological processes, and temperature.

A dissolved oxygen test measures the amount of oxygen dissolved in the water. A dissolved oxygen measurement, however, does not measure the amount of dissolved oxygen the water *is capable of holding* at the temperature at which it was tested. Warmer water is capable of holding less dissolved oxygen than colder water. When water holds the entire DO it can hold at a given temperature, 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, it is 50 percent saturated. Appendix 2 shows the solubility of oxygen at various water temperatures.

Most living organisms require oxygen for their basic metabolic processes. 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. Photosynthesis of aquatic plants releases oxygen into the water. Oxygen is also dissolved in water through diffusion and surface turbulence. Oxygen is poorly soluble in water, roughly 10 parts per million (ppm) () at 0-2 °C compared to almost 1700 ppm for carbon dioxide at the same temperature. When oxygen levels in the water fall below 3-5 ppm, most fish and marine organisms are stressed and cannot survive.

In general, oxygen levels during mid-day at the surface are near saturation (the maximum level sustained at the temperature) and drop as the water depth increases. Dissolved oxygen levels are an indicator of water quality. Oxygen levels may be reduced because of warm water temperatures and poor flushing. Run-off from farms or lawns containing fertilizers and other nutrients can over-fertilize aquatic plants. At first, aquatic vegetation will flourish and raise the dissolved oxygen levels found in the water. As the plants begin to die, the process of decomposition will deplete the oxygen content of the water. *Eutrophication* is the term used when high nutrient levels cause an excess of phytoplankton.

3.4 pH

pH 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-). The pH scale is a means of showing which ion has the greater concentration. At a pH of 7.0, the concentrations of hydrogen ions and hydroxyl ions are 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.

pH is defined as 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 just twice as acid as a pH of 6. Increases are in powers of 10. At pH of 5, there are 10 times more hydrogen ions than at a pH of 6. A change in pH of one whole number is therefore quite a large change.

Water dissolves mineral substances it contacts, picks up aerosols and dust from the air, receives man-made wastes, and supports photosynthetic organisms. All these processes affect pH. The buffering capacity of water, or its ability to resist pH change, is critical to aquatic life, as it determines the range of pH. Generally, the ability of aquatic organisms to complete a life cycle greatly diminishes as pH becomes as high as 9.0 or as low as 5.0.

Photosynthesis by aquatic plants removes carbon dioxide from the water, which can significantly increase pH. Therefore, in waters with plant life (including planktonic algae), especially low-velocity or still waters, an increase in pH can be expected during the growing season. During the 1983 algal bloom in the Potomac River estuary, a pH of 10.0 was recorded.

The turbulence of flowing water promotes gaseous interchange between the atmosphere and water. The carbon dioxide content of water in rivers and streams is less likely to change; but activities in the watershed may affect pH. Increased leaching of soils or mineral outcrops during snowmelt or heavy precipitation affects pH downstream. Human activities such as accidental spills, agricultural runoff (pesticides, fertilizers, soil leachates), and sewer

overflow may also change pH.

3.5 Salinity

Salinity is a key factor affecting the physical make-up of the Bay. The definition of salinity is the total amount of dissolved salts per 1000 units of water, usually expressed in parts per thousand (ppt). (Percent, or parts per 100, is shown as o/o whereas parts per 1000 is shown as o/oo.) Freshwater contains few salts (drinking water usually has a salinity of less than 0.5 ppt.. Seawater averages 35 ppt. Bay salinity near Annapolis in the fall is about 13 o/oo, while the salinity in the James River varies from a mean of 8-19 o/oo in the lower estuary to a mean of 0.1 o/oo to 0.3 o/oo in the tidal fresh waters. Appendix 3 shows the salinity zones found in the Bay and its major tributaries.

Since seawater enters the Bay from the Atlantic Ocean through its mouth (located at the southeastern edge), the salinity is highest at that point and gradually diminishes as one moves northward. Salinity levels also vary depending on the volume of freshwater that flows into the Bay. Salinity declines in the spring when rainfall, groundwater and melting snow cause large increases in freshwater inflows. For example, the volume of the Susquehanna River, which contributes about 50% of the Bay's freshwater, can vary 15 fold on a seasonal basis. In the fall, when freshwater inflows are greatly reduced, high levels of salinity extend farther up the Bay.

Salinity levels are graduated in a horizontal plane from one end of the Bay to the other. They are also graduated vertically from top to bottom. Since the presence of salts increases density, the lighter freshwater tends to remain at the surface, while salinity increases with depth. However, the relationship between depth and salinity is not constant. Winds and tidal action can cause mixing of bottom and surface waters, particularly in shallow areas.

Perhaps the most important aspect of the Chesapeake's graduated salinity levels is their effect on the distribution and well-being of the various biological populations living in the Bay. Some species of finfish (e.g. rockfish) spawn in fresh water and live part of their lives at sea; others (e.g. bluefish) do the opposite. Bottom dwelling species (oysters) are tolerant of salinity variations.

3.6 Bacteria

In general, bacteria are single-celled microorganisms with no membrane around the nucleus and a single strand of DNA. Coliform bacteria are a group of related species sharing several common characteristics. Coliform bacteria are rod-shaped and utilize lactose for food. Coliform bacteria are found throughout the environment in different ecological niches. Coliform bacteria can occur naturally in soil and water. They can also be found in human and animal waste.

Fecal coliform is a type of coliform bacteria most commonly found in animal intestines and feces. Therefore, the presence of these bacteria may indicate fecal contamination. However, fecal coliform bacteria are not necessarily associated with feces. Some are associated with textile, pulp and paper mill wastes (e.g. klebsiella). Escherichia Coli (E. coli) is a type of fecal coliform bacteria that occurs only in the feces of warm-blooded animals and is highly correlated with the presence of human pathogens. Historically, bacteria monitors have tested for both fecal coliform and E. coli bacteria.

In freshwater E. coli is now favored for detection because it is only found in the digestive tract of warm-blooded animals, whereas, fecal coliform can be found in non-fecal material. Human sewage and agricultural waste are the two primary contributors of fecal coliform and E. coli bacteria. Human sewage enters the water from poorly drained or poorly maintained sanitary sewer systems and wastewater treatment plants. Human sewage can also contaminate water through leaky septic systems and "straight pipes." There are various avenues for agricultural waste to enter the water. One of the main pathways is through "direct deposit" by farm animals. Other pathways include improper manure application and poorly constructed and/or maintained waste lagoons.

Many people wonder: Why not monitor for pathogens directly rather than bacteria? It is impractical to monitor for pathogens because there are too many pathogens. In addition, it is labor intensive, expensive and time consuming. Instead, bacteria monitoring is substituted and is used as an indicator of harmful pathogens.

Enterococcus is another group of bacteria, though not a coliform, is also found in the intestinal tract of warm-blooded animals. Unlike E. coli, these bacteria

are salt tolerant and are used as an indicator of human pathogens in salt water. Enterococcus is used as the best indicator of health risk for humans engaged in marine recreational activities.

It is important to remember that not all bacteria are bad, and many have important roles in the aquatic ecosystem. Bacteria assist in decomposition (break down of plant and animal remains which releases nutrients back into the food web) and are a source of food for other organisms.

4. Measuring Rainfall

4.1 Placement of Rain Gauge

The gauge should stand far enough from trees, hills, overhead power lines and other obstructions to minimize interference with sampling. (Natural and manmade obstructions may cause turbulence and/or contamination, i.e. bird droppings, which can result in non-representative samples.) Specifically, there must be no obstruction above a 45-degree angle from the top of the gauge. This means that a tree 30 feet tall should be at least 30 feet away.

4.2 Installation of Rain Gauge

The gauge should be installed so that the opening is parallel to the ground and at least 1 meter or yard above the ground.

4.3 Reporting Rainfall Amount

Record the amount of rainfall, and empty the gauge after each rain. During heavy storm events the gauge may need to be emptied frequently because it measures only 6 inches or 150 millimeters (mm). The gauge should be read and emptied after it stops raining so that evaporation does not cause false readings, especially during hot weather.

Record the weekly accumulations of rain in millimeters (mm) on the space provided on the data collection form. If there is no measurable rain during a given week, record the number 0.0 on the data sheet.

NOTE: If you are unable to accurately measure the amount of rainfall for a complete week, leave the space blank on the data sheet. It is important to distinguish between no rainfall (0.0mm) and the simple lack of data due to the monitor's absence or inability to accurately record the data.

5. Monitoring Procedures

5.1 Air Temperature Measurement

Equipment: armored thermometer

Temperature is reported in degrees Celsius (°C). The table in Appendix 1 converts Celsius to Fahrenheit. Always measure air temperature before water temperature.

Method:

1. Locate a place near your site and hang the thermometer out of the direct sun.

2. Wait 3-5 minutes to allow the thermometer to equilibrate. (You can begin filling out page 1 of the datasheet while you wait for the thermometer to equilibrate.)

Record air temperature to the nearest 0.5 °C on Page 2 of the datasheet.

5.2 Recording General Observations

Record weather and general observations on page 1 of the datasheet.

5.3 Water Clarity and Water Depth Measurement

5.3.1 Water Clarity Measurement

5.3.1.1 Secchi Transparency Measurement

The Secchi disk provides a convenient method for measuring light penetration below the water surface and is widely used as a basic measure of water clarity. The Secchi disk is a black and white disk attached in the center to a marked line that is used to determine the transparency or limit of visibility of the water. The line is measured and marked in decimeters (tenths of a meter) and meters. When the weighted disk is lowered slowly straight down into the water, the exact depth just before the disk disappears from view is observed. This depth is known as the "Secchi disk transparency." The less algae and silt in the water, the deeper the Secchi disk will be visible. Alternately, shallow readings will occur in water with significant amounts of suspended algae and silt.

Equipment: 8" Secchi disk with attached line

Method:

1. Remove sunglasses if you are wearing them and stand with the sun to your back. Try to lower the disk into a shaded area.

2. Lower the disk into the water until the disk barely disappears from sight. Note the depth reading, in meters, based on the length of line submerged. Each black mark is one-tenth (or 0.1) meter, and each red mark is one (1) meter.

3. Slowly raise the disk and record the depth at which it reappears (i.e. is barely perceptible).

4. Average the two depth readings obtained above. The average of the two readings is considered to be the limit of visibility, or index of transparency. Record this average to the nearest tenth of a meter on your data form.

5.3.1.2 Transparency Tube Measurement

Transparency tubes are a type of equipment used for measuring transparency of water in streams and rivers. They are helpful for measuring transparency in situations where the stream is too shallow for the Secchi disk to be practical and for running waters where flow is too fast that the Secchi disk cannot remain vertical. Sample water collected either directly from the stream or from the sampling bucket is analyzed.

Equipment: Transparency tube

Method:

1. Close the drain tube by squeezing the crimp.

2. Fill the transparency tube with your sample water. Water may be collected directly from the stream in the vicinity of the sampling location if the stream is too small to fill the bucket, or sample water collected in the sampling bucket may be used (See 5.4, "Collecting the Water Sample"). To collect water directly from the stream, point the top of the tube in the upstream direction and collect surface water, being careful not to disturb the stream bed. To analyze water collected in the bucket, pour sample water from the bucket water directly into the transparency tube.

NOTE: Perform this step after water temperature and dissolved oxygen have been measured (after step 5. 6 and before step 5.7).

3. While looking down through the opening of the tube, partially open drain crimp, slowly draw off sample (Control flow by squeezing the crimp).

4. When the black and white pattern begins to appear, immediately tighten the crimp.

5. Record the level of water remaining via the centimeter rule on the side of tube.

5.3.2 Water Depth Measurement

1. At your sampling site, lower Secchi disk into the water until it is resting on the bottom and the line is slack.

2. Record the depth reading, to the nearest tenth, based on the length of line submerged.

5.4 Collecting the Water Sample for Chemical Testing

5.4.1 Directly from the Source

If sampling from a small stream or river, it is appropriate to sample from the center of the stream/creek. Approach the stream from downstream.

Filling dissolved oxygen sample bottles:

1. To avoid contamination, thoroughly rinse the water sample bottles twice with the water to be sampled, discarding the rinse water downstream of your sampling location.

2. Submerge the mouth of the bottle halfway under the surface to allow the water to run in without creating a lot of bubbles.

3. Turn the submerged bottle upright and rotate to dislodge any air bubbles clinging to the inside of the bottle. Submerge the cap and screw it on while the bottle is still submerged.

4. Retrieve the bottle and turn it upside down to see if any air bubbles are inside.

5. Once a satisfactory sample has been collected, fill second bottle.

6. Then proceed to the fixing stage beginning with step 5 under Section 5.6.

Collecting water in test tubes for PH test:

1. Rinse the test tube twice downstream of your sampling location with water to be sampled.

2. Fill the test tube with surface water. Proceed with directions under Section 5.7, Step 2.

5.4.2 Using a bucket to collect sample water

If you are collecting your water sample from a dock or pier, go as far to the end as possible. If you are collecting without a dock or pier, try to wade in or throw bucket out as far as you safely can into the main channel. Try not to disturb the bottom of the water.

1. Using the water to be sampled, rinse the bucket twice downstream of the actual sampling location.

2. Then, gently lower the bucket into the water to avoid splashing and fill it about 2/3 full.

3. Once the sample is collected, be careful not to aerate or jostle the sample. Quickly move on to the other monitoring tests to minimize the time between sample collection and measurement of parameters.

5.5 Water Temperature Measurement

Equipment: armored thermometer

Method (no bucket):

1. If you are not using a bucket, hold the thermometer from the top with the thermometer submersed in the stream.

2. Wait 3-5 minutes to allow the thermometer to equilibrate (but not long enough for water temperature to change).

3. Record water temperature to the nearest 0.5 °C.

Method (with bucket):

If you have collected the water sample in the bucket, hang thermometer in the bucket and follow steps 2 and 3 above.

5.6 Dissolved Oxygen Measurement

Equipment: LaMotte Dissolved Oxygen Test Kit

Sodium Thiosulfate Check:

Prior to **each sampling event** (either the night before or the day of), you must run a test to make sure your Sodium Thiosulfate is still fresh and functional. Sodium Thiosulfate is fairly unstable and can degrade very suddenly, making it necessary to check it before each DO sampling. Here is how you do the check…

1. Rinse the titrating tube (small glass vial with plastic lid with hole in it) with a small amount of **Iodate-Iodide Standard Solution** (in large amber bottle).
2. Pour into waste container.
3. Pour 20 ml of the **Iodate-Iodide Standard Solution** into the rinsed titrating tube.
4. Add 8 drops of **Sulfuric Acid** (hold the bottle vertical to ensure equal drop size) to the 20 ml of solution and mix by swirling. Then place plastic cap (with hole in it) onto titrating tube.
5. Fill titrating syringe to the "0" mark with **Sodium Thiosulfate.**
6. Titrate using the **Sodium Thiosulfate.**
7. When solution turns a pale yellow color, but not clear:
   - Remove cap, leaving syringe in cap.
   - Add **8 drops Starch Solution (white bottle).** Swirl titration sample gently to mix to a uniform blue color. Recap glass tube and continue titration process.
8. Continue adding **Sodium Thiosulfate** until solution turns from blue to clear.
9. Read results on syringe - Record your results under the Dissolved Oxygen (grayed) portion on your field datasheet.
10. If results are less than 9.4 mg/l or greater than 10.0 mg/L, perform a 2nd test and record in the space on datasheet marked "2nd check".
11. Dispose of solution in titrating tube and syringe by pouring down sink and flushing with additional tap water.
12. Keep the amber bottle solution at home- don't need to take into the field.

DO Sampling Method:

NOTE: Duplicate tests are run simultaneously on each sample to guard against error. If the amount of DO in the second test is more than O.6 ppm different than the first test, you should do a third test. Record the average of the two closest results.

Since you will be doing two tests at the same time, thoroughly rinse both water sampling bottles with the water collected in the bucket. Do not return the rinse water to the bucket.

1. Using the first sample bottle, submerge about 1/2 of the bottle opening allowing the water to gently flow into the bottle. Try to fill the bottle without causing a lot of bubbles. Submerge the filled bottle.

2. Turn the submerged bottle upright and tap the sides of the bottle to dislodge any air bubbles clinging to the inside of the bottle. Cap the bottle while it is still submerged.

3. Retrieve the bottle and turn it upside down to make sure that no air bubbles are trapped inside. If any air bubbles are present, empty the sample bottle on the ground and refill (do not return water to bucket). Fill the second sample bottle. Once two satisfactory samples have been collected, proceed immediately with Steps 4 & 5.

4. Place both sample bottles on a flat surface and uncap. While holding the bottle vertical, add 8 drops of Manganese Sulfate Solution followed by 8 drops of Alkaline Potassium Iodide Solution to each sample bottle. Always add the Manganese Sulfate first. Cap each sample bottle and mix by inverting gently several times. A precipitate will form. Allow the precipitate to settle to the shoulder of the bottle. Mix both bottles again and allow the precipitate to settle to the shoulder again.

5. Add 8 drops of the Sulfuric Acid both sample bottles. Cap the bottles and gently shake to mix, until both the reagent and the precipitate have dissolved. A clear-yellow to brown-orange color will develop. If brown flecks are present, keep mixing the samples until the flecks will not dissolve any further.

NOTE: Following the completion of Step 5, the samples have been "fixed," which means that dissolved oxygen cannot be added to the sample bottles. The titration procedure described in Steps 6-13 may be performed at a later time (but must be performed within 8 hours of sample collection). This means that several samples can be collected and "fixed" in the field and then carried back to a testing station for the remaining steps.

6. Pour 20 ml of the solution from one of the sample bottles into one of the glass tubes with a hole in its cap. Fill to white line so that the bottom of the meniscus (the curved surface of the liquid in the tube) rests on the top of the white line. The amount is critical so be sure to use the glass dropper to add or remove the sample solution from the tube. Place cap on the tube.

7. Fill syringe (titrator) to the 0 mark with Sodium Thiosulfate solution. Be sure that there are no air bubbles in the syringe. Refer to kit manual for instructions on how to properly fill syringe.

8. To titrate the solution in the tube, insert the syringe into the cap of tube. Add 1 drop of Sodium Thiosulfate to test tube and gently swirl the glass tube to mix. Add another drop of the Sodium Thiosulfate and swirl the tube. Continue this process one drop at a time until the yellow-brown solution in the glass tube turns a pale yellow (lighter than the original yellow-brown solution but not clear). Once you reach this point, take the cap off while leaving the syringe in the cap.

9. Add 8 drops of Starch Solution to the glass tube. Swirl the tube gently to mix. The solution should turn from light yellow to dark blue.

10. Recap the glass tube and continue the titration process with the Sodium Thiosulfate remaining in the syringe (adding one drop at a time and swirling as described in Step 9), until the test tube solution turns from blue to clear. This is the endpoint. If the solution turns blue again, ignore it. Do not add any more Sodium Thiosulfate than is necessary to produce this first color change. Be sure to gently swirl the test tube after each drop.

NOTE: When the dissolved oxygen level is above 10 ppm, the solution in the tube will still be blue when the plunger tip of the titrator reaches 10 units. If it reaches this 10 unit line, do not go beyond that line. Usually, this will only happen when the water temperature is cold. In this case, refill the syringe to the 0 line from the Sodium Thiosulfate bottle and continue adding a drop at a time and swirling until reaching the endpoint.

11. Using the scale on the side of the syringe, read the total number of units of Sodium Thiosulfate used. Each line is 0.2 units. This number equals the number of parts per million (ppm) or milligrams per liter (mg/l) of dissolved oxygen in the water sample.

12. Carry out Steps 7-12 on second sample bottle and second glass tube.

13. Record the results of the two tests on the data sheet. If the difference between Test 1 and Test 2 is more than 0.6 ppm, you should do a third test and record the two results which are within 0.6 ppm.

NOTE: If using transparency tube to measure turbidity, perform this measurement now.

5.7 pH Measurement

Equipment: LaMotte pH kit

Method:

Look on the front of black box to determine whether you have a wide range pH kit or a narrow range pH kit (i.e. cresol red, phenol red, bromthymol blue, thymol blue).

1. Rinse one sample test tube and cap twice with water from the bucket.

2. Fill the sample test tube to the black line with water from the bucket. The bottom of the meniscus should be even with the line. Use plastic dropper to add or remove water from test tube.

3. For wide range pH kit, add ten drops of the wide range indicator while holding the reagent bottle completely upside down. For narrow range kits, add 8 drops of the indicator while holding the reagent bottle completely upside down.

4. Cap the test tube and mix the sample thoroughly.

5. Slide the tube in the comparator slot and record the pH value from the color in the comparator that most closely matches the sample tube color. When the color observed is between 2 colors on the comparator, the value is reported to the nearest 0.5 unit (for wide range kit) or 0.1 unit for other pH kits.

5.8 Salinity Measurement

5.8.1 Measuring Salinity Using a Hydrometer

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

Equipment: Hydrometer

Method:

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

2. Hang the thermometer in the jar.

3. Lower hydrometer into the jar. Allow it to float.

4. Read and record temperature in jar.

5. Read and record temperature in hydrometer jar.

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

7. When reading the hydrometer, it is easier if you are eye level with the hydrometer. Note that the water climbs the hydrometer stem and should be read at the water level *not* the point where it climbs.

8. You may determine salinity for your own records if you wish. (The Alliance on-line database computes salinity using hydrometer reading and the temperature in hydrometer jar.) Use the LaMotte hydrometer instruction booklet included with the hydrometer to determine the salinity of the sample based on observed hydrometer reading and the water temperature in the jar.

9. Record the salinity (optional).

Example:

Observed hydrometer reading is 1.0110, and the water temperature in the hydrometer jar is 25.5°C. Locate observed density of 1.0110 on the left hand column of Table 1 in the LaMotte hydrometer instruction booklet. Follow the row across until finding the 25.5°C column. The point at which the row and column meet is the resulting salinity of the sample, in this case 17.0 ppt. Observed densities and temperatures falling between those shown in the table may be interpolated.

5.8.2 Measuring Salinity Using a Refractometer

The refractometer must be calibrated before taking salinity measurement.

5.8.1 Calibrate Your Refractometer

1. Check the refractometer with distilled water. If it does not read 0 o/oo, you must calibrate the instrument. DO NOT PERFORM CALIBRATION IN THE FIELD. Calibration must take place in controlled environment at approximately 20 °C (room temperature) using distilled water of the same temperature.

2. Lift the cleat plate and add 1-2 drops of distilled water to the oval blue prism. Hold the prism at an angle close to parallel so the water drops will not run off.

3. Close the plate gently. The water drops should spread and cover the entire prism. Repeat the process if there are any gaps or if the sample is only on one portion of the prism.

4. Look through the eyepiece. If the scale is not in focus, adjust it by turning the eyepiece either clockwise or counterclockwise.

5. The reading is taken at the point where the boundary line of the blue and white fields crosses the scale.

6. If the reading is not at "0" turn the calibration screw with the included screwdriver while looking through the eyepiece until the boundary line falls on "0."

7. When the measurement is complete, the sample must be cleaned using tissue paper and distilled water.

NOTE: The refractometer needs to be at the same approximate temperature as the sample water. If the refractometer has been sitting in an air-conditioned environment prior to sampling, allow it to warm to the outside air temperature.

Method:

1. Rinse the refractometer with water sample.

2. Then apply drops from water sample on refractometer and hold up to light to read salinity (right side of circle).

3. Record as parts per thousand (o/oo) using the scale located on the right hand side of refractometer view scope.

5.9 Testing for Bacteria Using Coliscan Easygel

Equipment Preparation: Perform the following equipment preparations at home the evening before sampling or as indicated below.

1. Take bacteria media solution bottles (2 per sample site) out of freezer and put in refrigerator to thaw.

2. Place ice packs in freezer so they will be cold for the next day.

3. Before going out into the field, put ice packs and media solution bottles in the cooler.

4. Prepare incubator: Turn on a few hours ahead of sampling time to maintain incubator at 37°C (= 98.6°F).

5. Label media bottles with expiration date.

5.9.1 Bacteria Sample Collection

1. Note the amount of rainfall within 48 hours prior to sampling and record in the bacteria section of the datasheet.

2. Collect the water sample.

If collecting by wading: Wade into the main flow of the stream; take a few steps upstream with minimal disturbance; then reach upstream away from your body to collect the sample.

If collecting using a bucket: Make sure not to touch inside of bucket with your hands. If sampling from a dock or pier, go as far as possible to the end of the pier to collect your sample. Throw the bucket out as far as possible in the main channel, and try not to disturb the stream bottom. Rinse the bucket twice with stream water collected downstream of your sampling location. Fill the bucket with the sample water to 1/3 full.

3. Use proper technique to keep pipette sterile: open pipette packet bulb-side first so that you do not contaminate the tip.

4. Pipette the desired volume (1.0 – 5.0 milliliters) of sample water directly into Coliscan media bottle. It is best to dispense 2-ml in two separate allotments for a total of 4 ml while using a 3 ml disposable pipette.

NOTE: Be careful not to let the bottle lid touch anything to prevent sample contamination.

5. Immediately place media bottle on ice in cooler and cap sample.

6. Repeat for replicate #2.

7. Record the expiration date of the media bottle on your datasheet.

8. If collecting samples from more than one site, label each media bottle with the site designation using a permanent waterproof marker.

5.9.2 Bacteria Sample Plating

You will perform this in duplicate for each sample site monitored.

Write the site designation, sample #, date, and time on the top of the Petri dish lid with a permanent marker.

1. Gently mix (do not shake) bottle of Coliscan media containing the sample water, and then pour the entire contents into a Petri dish.

NOTE: Only open the Petri dish long enough to pour in the sample.

2. Gently swirl Petri dish so the Coliscan media covers the entire bottom. For safety purposes, tape the Petri dish shut at this point.

3. Allow the media to solidify for approximately 60 minutes prior to incubation. (Amount of time will vary based on room temperature.)

4. Repeat for replicate #2.
5. Put plates in incubator and try to maintain at 37°C (= 98.6°F) for 24 hours.
6. Record the average incubator temperature on the datasheet as well as the # of hours that the plates were in the incubator.

NOTE: As soon as plates are removed from incubator, they must be scored.

5.9.3 Bacteria Scoring

1. Place the Petri dishes on a white background or in natural sunlight. Count the number of dark blue (NOT TEAL) to purple (NOT PINK) colored colonies larger than pinprick size on each plate. Do not pay attention to halos around the dots, but only the center color.

2. Record this number in the column labeled "Total # of purple or dark blue colonies on plate" on the data form. Repeat for replicate #2.

3. Calculate the number of E. coli per 100 milliliters of water by following the instructions on the datasheet and record.

4. Calculate the average number of E. coli per plate and record on the datasheet. Report this value in the online database.

5.9.4 Bacteria Monitoring Cleanup and Disposal

1. Throw used pipettes in the trash.

2. Rinse empty Coliscan bottles 2-3 times with tap water and dispose of in the trash can. (If media bottles are not rinsed, pathogens could grow in the remaining media.)

3. Add bleach or rubbing alcohol to each Petri dish to completely cover the solid media. Allow dishes to stand for at least 10 minutes to ensure all bacteria have been killed.

4. Place the plates in a zip-lock bag and dispose of in the trash.

5.10 Nutrient Sampling Procedures

Equipment Preparation: The following preparations can be performed at home the evening before or morning of sampling.

1. Check to see that the water bottle in your equipment is full (if using demineralized water). You can use tap water to fill the water bottle.

2. Add nutrient filtering equipment to normal sampling gear and equipment.

5.10.1 Nitrate-Nitrogen Test

1. Add nutrient filtering equipment to normal sampling gear and equipment.1. Grab a fresh bucket of sample water. (Remember to rinse bucket several times and pour rinse water downstream or on the stream bank.)

2. Rinse nitrogen test tube and cap (inside and out) one time using water from the bucket. Discard rinse water on ground or downstream.

3. Fill test tube to the 5-mL line with sample water. Use plastic dropper to add or subtract water from the test tube, and discard additional sample water from the dropper. DO NOT return it to the bucket.

4. Add one nitrate tablet #1.

5. Cap the test tube and mix until the tablet dissolves.

6. When the tablet has dissolved, add one Nitrate tablet # 2 to the test tube.

7. Cap and mix until the tablet dissolves.

8. Once dissolved, wait 5 minutes for the reaction to occur.

9. In the meantime, insert the nitrate-nitrogen octa-slide into the viewer.

10. After 5 minutes insert the test tube into the octa-slide viewer and match it to a color sample.

11. Record the value on your datasheet in parts per million (ppm).

5.10.2 Phosphate Test

Setting up the Axial Reader

1. Find a flat surface to set up the comparator and axial reader.

2. Position the comparator so that the side with the numbers is towards you.

NOTE: The axial reader should be on the back of the comparator and should slide freely up and down.

3. Place the ampoule of distilled water in the square hole on the left side of the comparator.

5.10.2.1 Filtering the Sample

If turbidity is low (approximately >60 cm on turbidity tube), filtering is not required. Proceed to procedures for preparing the blanks 5.10.2.2. If turbidity is high (approximately <60cm on turbidity tube), filtering is recommended using the following procedure:

1. Fill syringe with sample water.

2. Place filter apparatus on the bottom of the syringe.

3. Eject syringe water, discarding it on the ground to rinse the syringe and filter apparatus.

4. Remove filter apparatus from the syringe then unscrew the top portion of the apparatus.

5. Using forceps, place one (1) filter pad on screen inside filter apparatus and screw apparatus back together.

6. Fill the syringe with sample water.

7. Place filter apparatus onto the bottom of the syringe.

The sample is now ready to be filtered. Proceed to "preparing the blanks."

5.10.2.2 Preparing the Blanks

1. Rinse two tests tubes once with filtered water or sample water and dispose of rinse water.

2. Fill the two test tubes with filtered water or sample water to the white line using the extra pipette. These test tubes are the blanks.

3. Place the two test tubes into the axial reader behind the colored slots on either side of the ampoule.

5.11.2.3 Preparing the Sample

1. Rinse a third test tube with sample water or filtered water.

2. Fill the remaining test tube with water from the filtering syringe or bucket to the white line using the extra pipette to add or remove sample.

3. Using the 1-mL plastic pipette add 2-mL of the VM phosphate, the translucent bottle of reagent.

4. Cap the test tube and invert several times to mix.

5. Wait three minutes.

6. Use the plain pipette and add 4 drops of reducing reagent (white bottle) to the test tube. Cap and mix.

7. Remove cap and place in the middle slot on the axial reader, behind the ampoule.

5.10.2.4 Using the Axial Reader

1. Slide octet comparator up until top is even with the top of the axial reader.

2. Hold comparator so that natural light shines down through the test tubes.

3. Compare the colors by comparing the color in center test tube to colors in top left corner of octet comparator.

    A. If the color of the test sample is less than the color of the lowest value, the result is recorded as "less than" the lowest value.

    B. If the color of the test sample matches one of the color standards in the upper left-hand quadrant, the result is taken as the value of that color standard (in parts per million).

    C. If the color of the test sample falls between these two values, the result is the average of the two values.

    D. If the color of the test sample is darker than the color of the second color standard, move the comparator to a position where the bottom of the axial reader and the bottom of the comparators are even. This movement aligns the mirror with the bottom row of windows in the comparator. The comparator unit should be moved carefully within the reading device to avoid spilling the contents of the tubes. The comparison of the unknown sample is then made with the standard in the lower left-hand quadrant of the octet comparator.

    E. If a color match is not reached with the standards on the left-hand side of the comparator, the test sample and blank tubes

are transferred to the right-hand side of the axial reading device. The ampoule of distilled water is transferred to the hole on the right-hand side of the comparator. Be certain that the test sample is positioned directly behind the ampoule of distilled water with untreated sample (blanks) on either side of the treated sample. The comparison technique is continued as described above.

5.10.3 Nutrient Sampling Cleanup

Field Rinsing

Rinse the syringe and filtering apparatus, extra pipette, reagent pipettes and test tubes in the field with DEMINERALIZED water.

Cleaning Nutrient Sampling Supplies at Home

1. Rinse all nutrient sampling supplies thoroughly with tap water then rinse thoroughly with DEMINERALIZED water and allow to dry.

2. **Never** use detergent to clean any of the monitoring supplies.

3. Fill DEIONIZED water bottle with tap water. If crystals become amber-colored, inform your monitoring coordinator that you need a replacement bottle.

4. Store equipment in a cool, dry place, out of the reach of children and pets.

5.11 Sampling Water Quality with the Hydrolab

5.11.1 Pre Calibration

The following "pre-calibration" methods refer to equipment calibration procedures that takes place prior to taking the water sample.

5.11.1.1 Pre Calibration – Specific Conductance

1. Install the calibration cup on the sensor pack and rinse three times with room temperature deionized water.

2. To create your standard, begin with a stock solution of 1.0M KCL and use deionized water to make either a 1:1000 (SpC = 0.147mS) dilution for fresh water sampling or a 1:10 (SpC = 12.89) dilution for brackish water sampling.

3. Rinse sensors once with the standard solution and place waste in waste container.

4. Mount sensor pack in a calibration platform or ring stand and clamp the pack with sensors pointing towards ceiling. Turn on Hydrolab.

5. Fill calibration cup with standard solution, making sure there are no bubbles in the cell. Record the real-time SpC reading in the "Pre-Cal" row on datasheet.

6. Navigate to the CALIB icon and select it by pressing ENTER. Navigate down to "SpC" and select it by pressing ENTER. The most recent reading appears.

7. Use the right/down and left/up keys to adjust the reading up or down until it matches the SpC of the standard solution (either 0.147 or 12.89mS). Press ENTER to accept.

8. Press ESC (ESCAPE) to confirm that the real-time SpC is consistent with the standard. If it is not, repeat the calibration. If it is the same, record the value on the datasheet in the "Cal" row. Discard the standard in waste container.

5.11.1.2 Pre Calibration – pH

1. Rinse the sensors three times with deionized water.

2. Rinse once with 7.0 pH standard solution, discarding the rinse in waste container.

3. Fill Calibration Cup with 7.0 pH standard solution. Record the "Pre-Cal" reading on datasheet.

4. Move to CALIB mode and select "pH." Adjust the reading to 7.0 and press ENTER. ESCAPE out to SCREEN mode and confirm that the real-time reading is close to 7. Record this as the "Cal" reading on the datasheet. Discard standard solution as waste.

5. Rinse once with either 4.0 pH or 10.0 pH standard slope solution, discard waste in waste container. Fill Calibration Cup with standard and record the "Pre-Cal" reading. Proceed to the CALIB mode and adjust the reading to 4.0 or 10.0. Escape out to REAL-TIME, check the reading, and record it in the "Cal" row. Discard the standard solution in waste container.

5.11.1.3 Pre Calibration – Dissolved Oxygen

In this step, you calibrate the sensor in air of 100% humidity and double check it against a theoretically predicted DO of 100% saturation. You will also need to calibrate to the current day's barometric pressure (BP) in mm Hg. You can obtain the barometric pressure from a barometer or a local real-time weather report on the Internet. To convert BP from inches or millibars to millimeters of mercury:

BP in mm Hg = 25.4 X BP in inches
BP in mmHg = 0.75 X BP in millibars

1. Rinse three times with deionized water.

2. Mount sensor pack in a calibration platform or ring stand and clamp with sensors pointing towards ceiling. Pour one (1) inch of water into cup.

3. Remove any drops of water from DO sensor by blotting with tissue paper.

4. Place black cap upside down on top of the storage cup and wait 2 minutes to allow the humidity in the cup to reach 100%.

5. Record the reading on screen as "Pre-Cal" DO on datasheet.

6. Move to CALIB mode and select DO%. It will already read 100%, but you may need to adjust the BP reading to today's value, as determined by real-time barometric reading or information obtained from Internet weather report.

7. Press ENTER, then ESCAPE out to SCREEN mode.

8. Record the theoretical prediction by consulting a separate table of 100% saturation values and record it as "Theor Sat DO" on the datasheet. Confirm that the real-time DO reading agrees with the prediction. If it is within 0.005 ppm, record real-time reading as "Cal" DO. If predicted and real-time DC readings are not within 0.0005 ppm, repeat the calibration.

5.11.1.4 Pre Calibration – Depth

1. Go to CALIB mode, select DEPTH, and adjust to zero. Press ENTER.

5.11.1.5 Pre Calibration – Turbidity

1. Refer to User's Manual for periodic calibration of turbidity sensor.

5.11.2 Hydrolab Field Procedures for Obtaining Water Quality Data

NOTE: Avoid jarring the sensor pack and/or the display. Do not twist or turn the cable especially near the connectors at either end. Whenever traveling, replace the storage cup, filling it first with one (1) inch of tap water.

1. Remove the storage cup and place the guard cap on the sensor pack.

2. Hook the cable into the top of the handheld display.

3. Lower the Hydrolab into the water, staying within the first meter of surface water. Press the ESC button to activate the circulator.

4. Press On/Off button (at bottom) to turn on. After a few seconds, the display will show real-time data containing temperature, specific conductance, DO, pH, and depth. Once the values stabilize, record these values on datasheet for the appropriate parameter.

6. Press the ENTER (top button) to switch to the real-time display of battery voltage, salinity, %DO, ORP, and turbidity. Record salinity and turbidity measurements on datasheet.

7. Press the On/Off button to turn off. Remove the Hydrolab from the water then remove the guard cup and place the storage cup on the sensor pack.

5.11.3 Hydrolab Post Calibration Procedures

After sampling, you must go through the same procedures described previously in the **"Pre Calibration Section" (Section 5.11.1)** for calibrating the Hydrolab for SpC, pH, and DO (i.e. rinsing with deionized water, applying standard solutions etc.). Record the readings in the "Post Cal" column on the datasheet.

NOTE: Record these values in real-time readings, not in calibration mode.

5.11.4 Hydrolab Maintenance Procedures

The Hydrolab must be rinsed after each use with tap water. Use tap water and/or soapy water to clean the sensors and their hosing, the storage cup, and the handheld display unit. Always store the Hydrolab sensor pack with an inch of water in the storage cup.

If the Hydrolab is reading accurately in the post-calibration procedures, the sensors are performing optimally. If the post-calibration procedures reveal a discrepancy, you will need to have the Hydrolab serviced according to the User's Manual.

5.11.4.1 Maintain the Hydrolab pH Sensor

Change the electrolyte inside the blue reference sleeve every month, as follows:

1. Move the turbidity sensor out of the way. Gently remove the blue pH sleeve.

2. Rinse the sleeve two (2) times with tap water, then once with Saturated KCL and AgCl electrolyte.

3. Drop in two (2) KCl salt pellets and then refill the sleeve with fresh electrolyte.

4. Hold sensor pack aimed downward and slide the sleeve up until it is just past the first "O" ring. Then, aim sensor pack up towards ceiling and seal the sleeve the rest of the way past the second "O" ring.

5. There must be no air bubbles inside the tube! Rinse sensor pack with tap water to rinse off any spilled electrolyte.

5.11.4.2 Maintaining the Teflon Junction

The teflon junction at the end of the blue sleeve must be replaced twice a year. When junction starts to gray, replace it with a new one.

5.11.4.3 Replacing Hydrolab DO Membrane

1. Mount the sensor pack towards the ceiling. Move the turbidity sensor out of the way.

2. Remove the "O" ring and membrane and discard it.

3. Rinse DO chamber two (2) times with DO electrolyte (2.0 M KCl). Then, refill the chamber until there is a positive meniscus above the rim. There must be no air bubbles!

4. Turn the circulator blade out of the way. Secure a new membrane (holing only the edges). Hold the membrane between both hands and bow it into the small valley. Hold it over the DO sensor, and drop it onto the meniscus of the electrolyte.

5. Drop the "O" ring flat onto the membrane so it is centers over the rim of the DO sensor. Brace your fingers against the sensor pack and with both thumbs, move the "O" ring down around the rim. Make sure the membrane is free of any wrinkles or bubbles. Repeat procedure if necessary to secure the membrane.

6. Rinse sensor pack with tap water to rinse off any spilled electrolyte.

7. The circulator blade should be removed with a small screwdriver and cleaned with soapy water or rubbing alcohol and replaced back on the instrument.

5.11.4.4 Checking Hydrolab Sensors

The temperature probe, conductivity window, and turbidity probe can all be cleaned with soapy water or rubbing alcohol to remove grease, oil, or debris using a soft, non-abrasive cloth. After cleaning, rinse several times with tap water to remove any residue.

6. Cleanup and Storage of Water Monitoring Equipment

1. Rinse the thermometer in tap water and store upright.

2. Pour contents of DO sampling bottles into the sink. Rinse all the bottles and containers thoroughly with tap water. Put all equipment away until next sampling time.

3. Store all chemical reagents in a dark, cool place and out of the reach of children and pets!

4. Save expired chemicals and give them to your monitoring coordinator or trainer at the next recertification event for proper disposal.

NOTE: If you conduct the sampling procedures away from home or on a boat, you need a special container for safe disposal of the test samples. A plastic milk jug or jar is works well and is easy to obtain. Fill this container about ½ to ¾ full with kitty litter to absorb the moisture. When the litter is saturated, place the closed jar in double plastic garbage bags and dispose of in the trash.

Appendix 1. Temperature Conversion Table: Degrees Centigrade to Degrees Fahrenheit

°C	°F	°C	°F
0.0	32.0	20.0	68.0
0.5	32.9	20.5	68.9
1.0	33.8	21.0	69.8
1.5	34.7	21.5	70.7
2.0	35.6	22.0	71.6
2.5	36.5	22.5	72.5
3.0	37.4	23.0	73.4
3.5	38.3	23.5	74.3
4.0	39.2	24.0	75.2
4.5	40.1	24.5	76.6
5.0	41.0	25.0	77.0
5.5	41.9	25.5	77.9
6.0	42.8	26.0	78.8
6.5	43.7	26.5	79.7
7.0	44.6	27.0	80.6
7.5	45.5	27.5	81.5
8.0	46.4	28.0	82.4
8.5	47.3	28.5	83.3
9.0	48.2	29.0	84.3
9.5	49.1	29.5	85.1
10.0	50.0	30.0	86.0
10.5	50.9	30.5	86.9
11.0	51.8	31.0	87.8
11.5	52.7	31.5	88.7
12.0	53.6	32.0	89.6
12.5	54.5	32.5	90.5
13.0	55.4	33.0	91.4
13.5	56.3	33.5	92.3
14.0	57.2	34.0	93.2
14.5	58.1	34.5	94.1
15.0	59.0	35.0	95.0
15.5	59.9	35.5	95.9
16.0	60.8	36.0	96.8
16.5	61.7	36.5	97.7
17.0	62.6	37.0	98.6
17.5	63.5	37.5	99.5
18.0	64.4	38.0	100.4
18.5	65.3	38.5	101.3
19.0	66.2	39.0	102.2
19.5	67.1	39.5	103.1

Appendix 2. Solubility of Dissolved Oxygen in Water

Temp °C	Solubility mg/l (ppm)
0	14.6
1	14.2
2	13.1
3	13.8
4	13.1
5	12.8
6	12.5
7	12.2
8	11.9
9	11.6
10	11.3
11	11.1
12	10.9
13	10.6
14	10.4
15	10.2
16	10.0
17	9.8
18	9.6
19	9.4
20	9.2
21	9.0
22	8.9
23	8.7
24	8.6
25	8.4
26	8.2
27	8.1
28	7.9
29	7.8
30	7.7

Appendix 3. *RiverTrends* Program

Field Data Sheet (includes bacteria monitoring, Hydrolab)

Enter data online: www.AllianceChesBay.org/monitoring/login.cfm

Once datasheets have been entered, send original forms to:

Alliance for the Chesapeake Bay PO Box 1981, Richmond, VA 23218 Attn: RiverTrends Coordinator

Site Name and #: _____ format)

Monitor: _____ **Time:** _____ (hh:mm format, military time)

Monitoring date: _____ (m/d/yyyy

OBSERVATIONS/WEATHER

Water surface:

❑ Calm ❑ Ripple ❑ Waves ❑ White Caps

Stream flow rate:

❑ High ❑ Normal ❑ Low ❑ Negligible

Weather Type:

❑ Sunny ❑ Partly Cloudy ❑ Overcast ❑ Fog/Haze

❑ Drizzle ❑ Intermittent Rain ❑ Rain ❑ Snow

Water Color: ❑ Normal ❑ Abnormal _____(Color description)

Tidal Stage:

❑ High ❑ Outgoing (Ebb) ❑ Low ❑ Incoming (Flood)

Other Conditions:

❑ Sea Nettles ❑ Dead Fish ❑ Dead Crabs ❑ SAV ❑ Oil Slick ❑ Ice

❑ Debris ❑ Erosion ❑ Foam ❑ Bubbles ❑ Odor

Rainfall:

_____mm weekly accumulation (if greater than one week, don't enter data results)

rainfall on day of testing: ____mm

rainfall 1 day before testing: ____mm

rainfall 2 days before testing: ____mm

rainfall 3 days before testing: ____mm

rainfall 4 days before testing: ____mm

rainfall 5 days before testing: ____mm

rainfall 6 days before testing: ____mm

Additional Comments (e.g. wind, recent events, anything unusual):_____

_____

Hydrolab Readings

Pre Calibration

SpC: _____ mS pH zero: _____ pH Slope: _____ DO: _____ Theor Sat DO: _____

Calibration

SpC: _____ mS pH zero: _____ pH Slope: _____ DO: _____ Theor Sat DO: _____

Post Calibration

SpC: _____ mS pH zero: _____ pH Slope: _____ DO: _____ Theor Sat DO: _____

Readings

Depth_____m Turbidity_____NTU (Please enter other parameters in appropriate fields on next page, be sure to include meter information.)

RiverTrends Program
Field Data Sheet – Page Two

Has this datasheet been entered on the Alliance's database via the online data entry?
- ❑ **Yes**
- ❑ **No**

Data

1. Air temperature: ___.____ o C (to nearest half degree)

2. Water Clarity and depth:

Secchi depth (average): ___.___m (to nearest tenth of meter)

Transparency tube: ___.___cm (to nearest tenth of cm)

☐ Check box if value actually > than that recorded.

Depth of Water Column (total depth): ___.___m (to nearest tenth of meter)

3. Water temperature: ___.____ ^{o} C (to nearest half degree)

4. Salinity

Instrument:

❑ Hydrometer ❑ Refractometer ❑ Meter

(if meter, indicate type/model: _____)

Water temperature in Hydrometer jar: ___.____ ^{o} C Hydrometer Reading: ___ . ___ ___ ___ ____

Calculation of Salinity using hydrometer (Optional – do not need to report): _____.___ ppt

Salinity reading using refractometer or meter: _____.___ ppt

5. pH

Instrument: (if meter, indicate type/model: _____)

❑ LaMotte narrow range ❑ LaMotte wide range ❑ Meter ❑ Colorfast™ strip

pH value: ____.____ (Std. Units)

6. Dissolved Oxygen:

Sodium Thiosulfate check: ___.___ mg/L **2nd check:** ***(only if results are < 9.4 or >10.0*** ___.___ mg/L

[NOTE: Do not run DO test if 2 Sodium Thiosulfate check results are not within 0.4.mg/L of each other.]

Instrument: (if meter, indicate type/model: _____)

❑ LaMotte test kit ❑ Meter

Test 1 ___. ___ mg/L **Test 2** ___. ___ mg/L

(Note- Tests should be within 0.6 of each other- if not, perform 3rd test and report 2 closest results)

7. E. coli Bacteria Measurement (using Coliscan Easygel™ plate

Were samples collected for state lab comparison? Yes _____ No _____

Rainfall within 48 hours prior to sampling: _____ mm or comment:_____

Incubation time: ____ hours (to nearest hour) Incubation temp: ____.___ ^{o} C (to nearest half degree)

Media expiration date: _____ Rep1 _____ Rep 2

Amount of water sample added to media bottle (max 5 ml per Rep): Rep1:_____(A1)Rep2:_____(A2)

Total # of purple or dark blue colonies on plate: Rep1:_____(B1) Rep2:_____(B2)

Note: disregard any pink, blue-green or white colonies- these are not E. coli bacteria

To calculate the Total Colonies of E. coli bacteria per 100 ml of water:

1. Divide 100 by the ml of water used. 2. Multiply this quotient by the number of purple colonies counted

Rep1: ([100 ÷ A1] * B1) = _____(C1) Rep2: ([100 ÷ A2] * B2) = _____ (C2)

Average of both Reps = (C1+ C2) ÷2 (Report this value) _____

Comments: _____

Total Time Spent Monitoring:(Includes travel to and from monitoring site; equipment preparation; sample collection; water's edge time; and time spent filling out data sheets):_____ hours (Round to nearest 15 min.)

Monitor Signature: _____ Date: _____