ADOPT a STREAM

SOUTH CAROLINA ADOPT-A-STREAM

VOLUNTEER *TIDAL SALTWATER* MONITORING

SC DEPARTMENT *of* ENVIRONMENTAL SERVICES

Map of South Carolina Major Watersheds

Source: SCDNR

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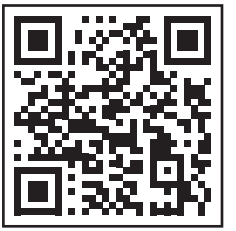
Need Help?

Access resources and answer questions by visiting our website, www.scadoptastream.org.



For questions about adopting a site, where to get monitoring supplies, or help getting started, contact your South Carolina Adopt-a-Stream (SC AAS) program coordinators by emailing scaas@des.sc.gov.

How to become a certified SC AAS tidal saltwater monitor:

Step 1.	**Get** certified at a workshop
Step 2.	**Adopt** a tidal saltwater site
Step 3.	**Monitor** monthly
Step 4.	**Enter** data in the SC AAS Database
Step 5.	**Share** data and educate others
Step 6.	**Renew** certification annually

TIDAL SALTWATER CERTIFICATION

1. I was trained by _____ on _____.
   (trainer name and date of training)
2. I need to renew my annual certification before:
   _____.
   (recertify online or at another in-person workshop.)

WATER QUALITY EMERGENCY?

For evidence of ongoing and dangerous pollution discharges, fish kills, or public health hazards, call the 24-hour SCDES Emergency Hotline:

1-888-481-0125

REPORT A CONCERN!

For nonurgent concerns, visit the SCDES Report It! page (www.des.sc.gov/report-it) to file a report.

Scan to report a concern.

South Carolina Salt Marsh Tidal Creek Ecosystems

SC AAS site SC-2969.

The salt marsh-tidal creek ecosystem is a highly productive coastal wetland where fresh water and salt water mix. Wetland is a term for the transition zone between dry land and water that is covered by water seasonally or permanently. Wetlands naturally filter pollution; protecting wetlands protects overall water quality. The loss of wetlands impacts people, plants, animals, water quality, and water quantity. Filling in even one acre of wetland threatens the value of remaining wetlands and impacts the entire watershed.

Salt marshes are a type of coastal wetland influenced by salt water. The surface of the salt marsh is under water at high tide and dry at low tide. A finger-like network of tidal creeks winds through the marsh, allowing for the movement of tidal water onto the marsh surface and back into the estuary.

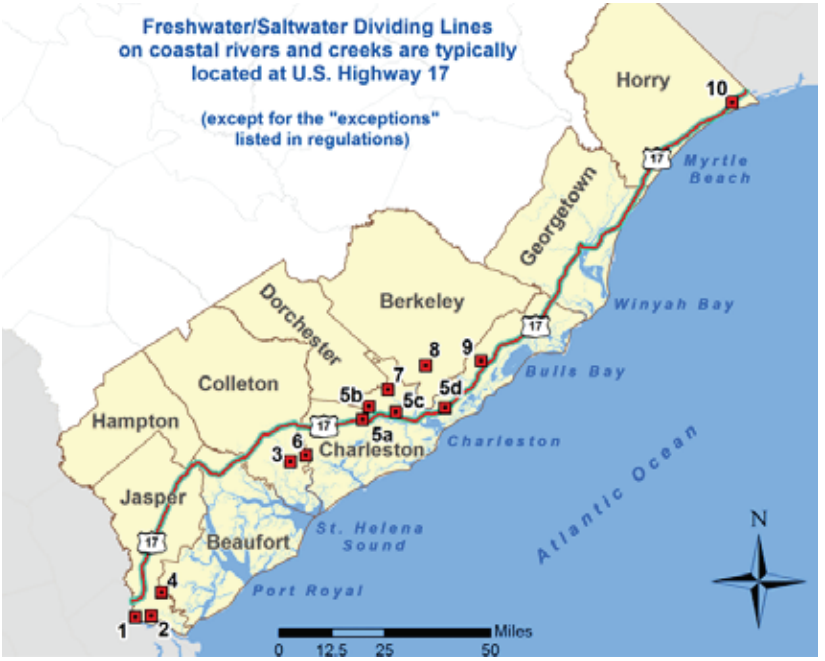
The salt marsh-tidal creek ecosystem has semi-diurnal tides, meaning it experiences two high tides and two low tides each day, each lasting about six hours. Tides result from the gravitational pull of the moon and sun on Earth's oceans. Approximately twice a month, around the new moon and full moon, tides reach their maximum height (spring tides). When the moon is at the first quarter or third quarter, the tide's range is at its minimum height (neap tides).

Estuary:

a semi-enclosed, coastal waterbody where fresh water from rivers and streams mixes with salt water from the ocean.

Tides continually move salt water into and out of salt marsh-tidal creek systems. During incoming tides, the creek and marsh are flooded with higher salinity water, fine sediments, and nutrients. During outgoing tides or periods of heavy rainfall, the creek and marsh can be inundated with fresh water, decreasing salinity. Tides are important in controlling the water quality of salt marsh-tidal creek ecosystems. The plants and animals found here are adapted to the changes in conditions that occur hourly, daily, seasonally, and annually.

Salinity indicates whether a waterway is a tidal saltwater or freshwater ecosystem. Establishing the freshwater-saltwater divide can be difficult as there is a transition zone between the two water types. This zone will shift inland with rising tides and oceanward with heavy rain events. If your waterbody has a salinity greater than 0.5 parts per thousand (ppt), it is considered a saltwater habitat. Ocean water has a salinity of 36.0 ppt and pure fresh water has a salinity of 0.0 ppt.

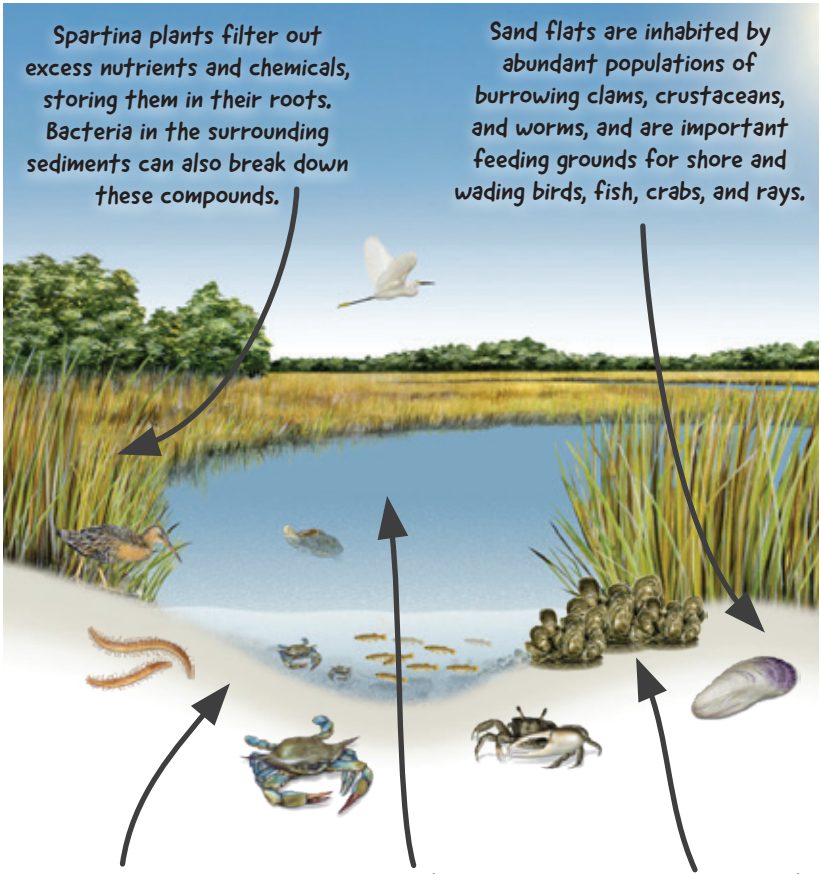


The freshwater/saltwater dividing line for coastal rivers and creeks is located approximately along US Highway 17. Known exceptions are indicated by red squares. Source: SCDNR.

Salt marshes and tidal creeks provide us with a wealth of benefits, referred to as ecosystem services. Oyster reefs and vegetation along creek banks filter out pollutants and help reduce wave energy and current velocity. The salt marsh helps protect upland areas and private property from flooding and erosion. Healthy estuaries not only provide ecosystem services but also support our state's economy. South Carolina's major fisheries are shrimp, shellfish, crabs, and offshore fishing. Without healthy salt marsh-tidal creek habitat, it is unlikely Southeastern fisheries would be as productive.

TIDAL CREEK ECOSYSTEM

Within the ecosystem are diverse habitats and organisms.



Source: SCDNR

WATER QUALITY THREATS

As water travels through the watershed, it picks up various pollutants. There are two main types of water pollution, point source and nonpoint source, that can negatively affect water quality in a watershed.

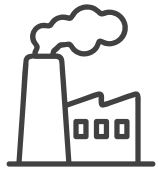
Point source pollution is where you can see or point to the source of the pollution. Examples include industrial discharges and municipal sewage treatment plants. This type of pollution is regulated by the South Carolina Department of Environmental Services (SCDES). Industries, businesses, cities, and counties go through a lengthy permitting process to discharge into a waterbody. The amount and severity of point source pollution has drastically improved since the Clean Water Act was implemented more than 50 years ago.

What Makes Point Source Pollution?

Municipal Separate Storm Sewer Systems (MS4s)

Wastewater Treatment Plants

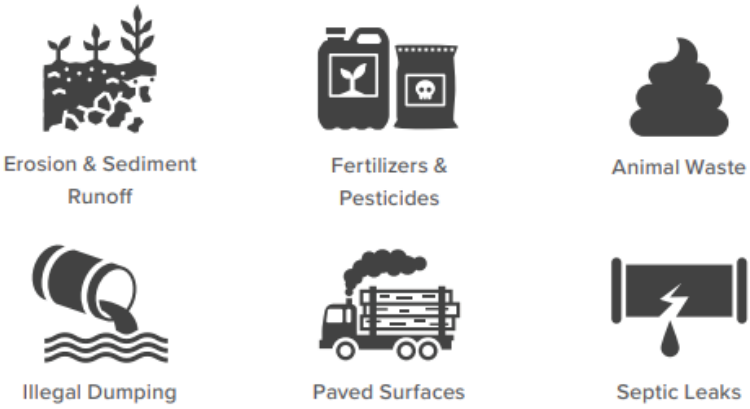
Power Plants



Factories

Nonpoint source pollution is the leading cause of water quality problems in South Carolina. Nonpoint source pollution means an individual source cannot be identified. Water running into the creek following rain events, called runoff, often carries nonpoint source pollution with it. Examples of nonpoint source pollution include runoff from erosion and loose sediment, excess application of fertilizers and pesticides, oil from cars, car washing detergents, and human and animal wastes. Many impaired waterways have multiple sources of this type of pollution, making it difficult to address.

What Makes Nonpoint Source Pollution?



In addition to nonpoint source pollution, our waterbodies are also threatened by litter, invasive species, harmful algal blooms, and increasing urban development. Litter can pose a risk to animals, serve as a breeding ground for bacteria, and negatively impact tourism. Invasive plants and animals can outcompete native species and damage the ecosystem. Harmful algal blooms (HABs) produce toxins that can be deadly to people and pets. Urban development can increase nonpoint source pollution through stormwater runoff from impervious surfaces.

Volunteers can play an important role in monitoring water quality and sharing information about local water resources with their communities.

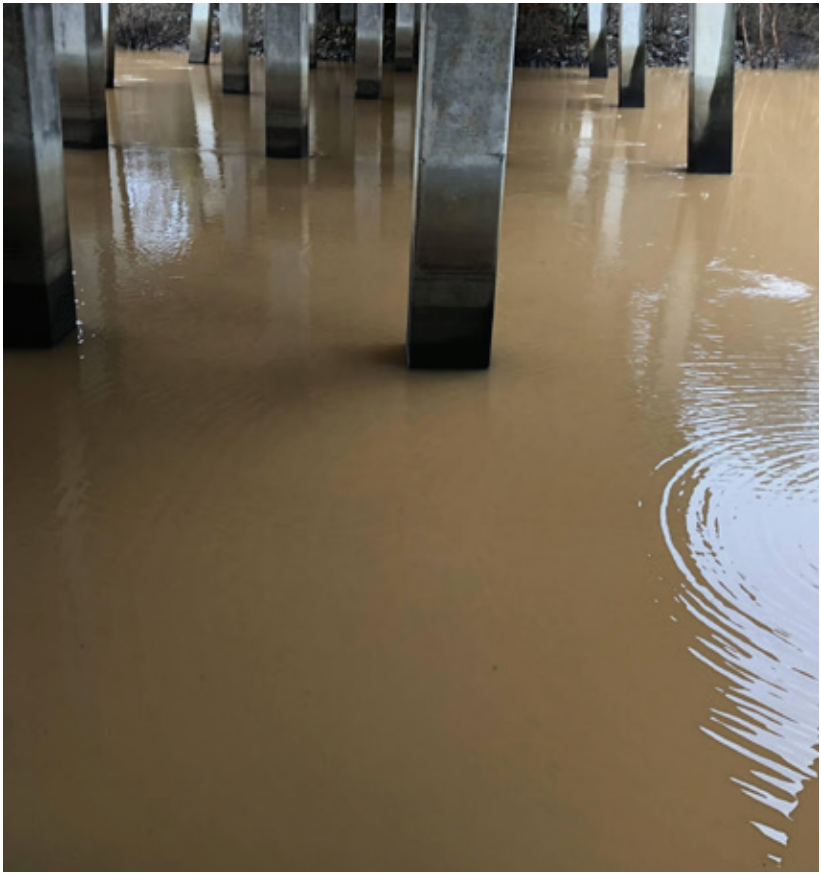
POLLUTANTS

Many “pollutants” in a stream are natural and are only considered a pollutant when their presence is impairing a waterway’s ability to maintain life or threatening users. Monitoring helps identify possible pollution or water quality changes. Some common pollutants affecting salt marsh-tidal creek ecosystems are nutrients and sediments.

Nutrients such as nitrogen and phosphorus are natural and needed for plant and algal growth and reproduction. Nutrients come from many sources, both natural and unnatural. In the aquatic environment, nutrients can enter waterways from failing septic systems, fertilizer runoff (from agriculture, golf courses, and commercial and residential properties), and general stormwater runoff. Nutrients become pollutants when they are too concentrated in the waterway.

Excess nutrient input can lead to harmful algal blooms.

Sediments in the water are also an important component of the salt marsh-tidal creek system. Pollutants like nutrients and bacteria will often adhere to sediments suspended in the water and settle on the marsh surface where they can be processed. Some sediment is good to sustain the marsh elevation, but too much can limit sunlight penetration and decrease photosynthesis rates. When this happens, the sediment itself becomes a pollutant.



Excess sediment can make water opaque.

When pollution levels are too high for too long and a waterbody fails to meet South Carolina's water quality standards, that waterbody is placed on a 303(d) list of impaired waters. The name of the list comes from Section 303(d) of the Clean Water Act, which mandates that all states create a list of impaired waters. If water quality improves, the waterbody could be removed from the 303(d) list. If a waterbody is not included on the 303(d) list, it does not necessarily mean the waterbody has achieved water quality standards. If you want to learn more about waters in South Carolina that don't meet state standards or see shellfish restrictions, explore SCDES's 303(d) list of impaired waters.

WATERSHEDS

To better understand how pollution impacts salt marsh-tidal creek ecosystems, it is important to understand where the water entering the system is coming from.

A watershed is an area of land and water from which water, sediment, and pollution drain to a common point such as the inflow of a reservoir, mouth of a bay, or any point along a stream channel. Ridges and hills that separate two watersheds are called drainage divides. Rain and runoff from these divides drain to the streams in the watershed, then to outflow points such as lakes, reservoirs, bays, and oceans.

The word watershed is sometimes used interchangeably with river basin or catchment.

Watersheds vary in size, and larger watersheds contain many smaller watersheds with different outflow points. It is important to remember that we all live in a watershed. Understanding the boundaries of your chosen tidal creek and how it is affected by the larger watershed provides insights on how land use, permitting, and other occurrences in the watershed may result in changes in your data and observations at your site.

There are eight major river basins in South Carolina: the Savannah, Saluda, Broad, Catawba, Pee Dee, Edisto, Santee, and Salkehatchie. Of these, the Savannah, Pee Dee, Edisto, Santee, and Salkehatchie include coastal waterways. Source: SCDNR.

Landscape scene of a salt marsh in South Carolina.

Program Overview and Goals

SC AAS volunteers at a workshop.

South Carolina Adopt-a-Stream (SC AAS) is a statewide volunteer water quality monitoring program where participants learn to assess the health and water quality of their local waterways. The program offers certification in four different protocols: freshwater stream, tidal saltwater, macroinvertebrate, and lake monitoring. Anyone interested in protecting South Carolina's waterways can be directly involved by monitoring with SC AAS.

SC AAS strives to educate communities about the health of waterways statewide, encourage behavioral changes, and create opportunities for watershed stewardship. Volunteer water quality monitors help our state by collecting data on waterways that may not be regularly monitored otherwise. These data establish baseline conditions, indicate possible water quality concerns, and are used for education. The data collected through SC AAS are not regulatory in nature and are not to be used for targeting neighbors or businesses.

Volunteers ADOPT sites to Actively collect Data Outdoors in order to Protect our waterways Together.

Data collected through the SC AAS program are publicly accessible for viewing and exporting from the SC AAS Database. The Database creates alerts for any data collected that fall outside of expected ranges. SC AAS program coordinators can help connect volunteers with water quality professionals or local partner groups when unusual data are submitted to the Database.

By joining SC AAS, you are agreeing to represent the program with integrity by:

- Following the SC AAS monitoring methods
- Fully and accurately documenting observations
- Reporting data to the Database in a timely manner
- Accurately and respectfully discussing the program with others

SC AAS monitoring protocols have been approved by an Environmental Protection Agency (EPA) Quality Assurance Project Plan. Volunteers must pass a certification test and be recertified annually. Only certified volunteers can upload to the Database.

ADOPT a STREAM

A

ACTIVE
Volunteers are actively monitoring across the state.

D

DATA
Baseline data are collected and stored for public use.

O

OUTDOORS
Monitoring is a good excuse to get outdoors.

P

PROTECT
Data helps the protection of streams.

T

TOGETHER
Monitoring helps improve waters together.

Selecting a Site

Example of an SC AAS dock site.

SC AAS volunteers are asked to sample monthly at the same location, at roughly the same time of day, during daylight hours. Sampling at the same time of day ensures you will collect data at different tide stages throughout the course of the year. Choose a site that is accessible at both high and low tide.

Adopted sites must meet the following criteria:

- ☑ Safe water access from a dock, pier, landing, bank, or boat
- ☑ Clear location for you to set supplies down
- ☑ Salinity of > 0.5 ppt
- ☑ Written permission to access site if on private property

You can choose where to sample! Adopt a new site or select a historic site where previous volunteers have not continued monitoring. You can choose to adopt more than one site. Ask your trainer or a local water organization for advice on where to monitor.

IF SAMPLING ON PRIVATE PROPERTY:

- Seek written permission to access the property.
- Communicate sampling dates and times or set an agreed-upon monitoring schedule.
- Never misuse or harm private property.
- Share results of monitoring with landowners.
- Share the goals of SC AAS and data uses.

SAFETY

The safety of volunteers is of the highest priority. We care more about you than your data!


Do not sample during a storm. Wait until it has stopped and strong water flow has subsided.


Wear proper attire including gloves and closed toed shoes.


Use the “buddy system.” Sample with someone, even if they are not a certified volunteer, or tell someone else that you are going out into the field and how long sampling should take.


Use caution when near a waterway and DO NOT enter the marsh! It can harm you as well as the marsh ecosystem.


Be aware of surroundings including traffic, wildlife, harmful plants, stinging insects, slippery surfaces, and other people.


Wash your hands after sampling. Your site may be contaminated with bacteria or other pollutants.


Rinse with fresh water and dry equipment before storing. This helps prevent the transfer of invasive species and helps your equipment last longer.

Remember, if you believe that your monitoring location is experiencing an ongoing significant or harmful pollution event, do not sample and call the SCDES Emergency Hotline at 1-888-481-0125.

Monitoring Protocol: Observations

SC AAS volunteers at a workshop.

Observations should be made before any other tests are conducted. Visual monitoring allows you to identify problems or changes that may be impacting the salt marsh-tidal creek ecosystem. Observing both physical and biological factors gives a snapshot in time of your site conditions. For your safety as well as for ecosystem protection, do not disturb the habitat.

Weather

At the time of your sampling event, record the present weather condition: **sunny, partly cloudy, intermittent rain,** or **steady rain**. In the Database, record rainfall accumulation as inches in the past 24 hours.

Sunny weather can increase plant photosynthesis while cloudy weather can reduce it. The amount of photosynthesis that occurs alters dissolved oxygen (DO) in the water. Precipitation can greatly affect water characteristics. Rain may dilute point source pollution and lower salinity levels. Rain may increase surface water runoff which carries nonpoint source pollution, causing skewed baseline data. Floods, droughts, or other climatic extremes can change the estuary's characteristics dramatically by creating sandbars, pools, widening a channel, and more.

Do NOT sample during or just after rain events. How long you wait to sample after rainfall will depend on your watershed size. We recommend waiting at least 24 hours, or until high flow has subsided, before sampling. Instead of skipping a month of data collection, simply move your sampling date to avoid rain events.

Water Surface

Conditions at the water surface can alter chemical and physical measurements. Note if any of the following are present:

Oily sheens can be caused by petroleum or chemical pollution, or they may be natural by-products of decomposition. To tell the difference between petroleum spills and natural oil sheens, poke the sheen with a stick. If the sheen swirls back together immediately, it may be petroleum. If the sheen breaks apart and does not flow back together, it is likely from bacteria or decomposition of plants and animals.

Rainfall Data

You can find recent rainfall data on most weather websites; however, CoCoRaHS is the recommended resource because it gives local amounts instead of regional ones. Learn more about this volunteer science program at **cocorahs.org**

Oily sheen on water.

Surface foam is common and can be naturally occurring. Vegetation can produce surfactants which can cause surface foam. Human-induced surface foam may be an unnatural color (red, pink, blue, yellow, or orange) and have a fragrant smell. This colorful foam is most likely generated by household detergents and may be a sign of a failing septic drain field or an illegal discharge. You can also use the stick method to determine if surface foam is natural or manmade.

Naturally occurring foam on water surface. Source: NOAA.

Algae are important to aquatic ecosystems, but excessive growth can occur when human activities introduce excess nutrients to the waterway. They can grow on the surface or form thick mats, impacting other organisms in the environment.

Algal Bloom

If there are algae present at your monitoring site, note how widespread they are. In a balanced ecosystem, algae provide beneficial food and oxygen for the aquatic ecosystem but can cause issues when overgrowth occurs. When algae die and decompose, oxygen is decreased, which affects other aquatic life and the water chemistry. Rapid growth of algae is called an algal bloom and can be associated with foam, scum, or thick layers of algae on the water surface.

When blooms contain toxins that affect the health of people, animals, and the environment, they are known as Harmful Algal Blooms (HABs). For HABs to grow and form they need sunlight, slow-moving water, nutrients (specifically nitrogen and phosphorus), and a warm water temperature. HABs are more likely to occur from late spring to early fall and are less likely to occur in winter months.

Algal bloom on water.

Water Color

The color of the water can provide you immediate clues to a waterway's condition. Looking directly into the waterway will not give you an accurate observation because depth, vegetation, and the bottom of the tidal creek can influence how you see water color. Instead, fill a clean, clear container (such as glassware from the monitoring kit) with sample water to determine water color. Collect your sample below the water surface to avoid any algae, pollen, or debris that may be present.

- **Clear** water does not necessarily mean clean water but can indicate low levels of suspended or dissolved substances.
- **Brown/muddy** water is usually due to heavy sediment loads.
- **Green** water is often the result of excessive algae growth or the presence of phytoplankton.
- **Milky/white** water may be caused by salts in the water or can be a sign of an illicit discharge.
- **Tannic** water is natural in certain South Carolina waters and gets its "sweet tea" appearance due to the decomposition of leaves in the water that produce tannins.
- **Other** water colors can have a number of causes. If you believe an unusual water color to be the result of an ongoing pollution event, do not sample and call the SCDES Emergency Hotline. Make sure to take photos of the water.

Tannic water in blackwater streams has a reddish-brown color but is transparent when placed in a clear container.

Water Odor

Water odor can also provide immediate clues about water quality. Make sure you are smelling the water from your sample cup and not the air. This should be one of the first things you observe upon visiting your site so that you do not acclimate to the smell and become "nose-blind."

The rotten egg/sulfuric odor common in salt marsh-tidal creek systems is natural and should not be marked on your data form. This smell is due to hydrogen sulfide gas, a by-product of anaerobic (without oxygen) decomposition in areas with large quantities of organic matter. This odor is heightened as the tide recedes.

- **Gasoline** or any petroleum/chemical smells may indicate serious pollution problems from a direct source, such as a factory, parking lot, boat, marina, or storm sewer runoff.
- **Sewage/manure** smells can be common in the air but should not be what our water smells like. Both can be an indication of an ongoing pollution event.
- **Fishy** odors may be a sign of dead and decomposing fish in the water.
- **Chlorine** smells may be a sign of pollution and will smell like a swimming pool.
- **Other** odors can be from a wide variety of causes. Look around your sample site to identify any potential odor causes.

Water Clarity

Clarity is a measure of how far light can penetrate into the water. Suspended sediment or algae in the water column can impact water clarity. Note if the water appears clear, cloudy, or opaque when looking through your clear sample cup.

Clear water vs. opaque water.

Water Conditions

Observe whether the water is **calm** or has **ripples**, **waves**, or **white caps**. Typical tidal creek conditions will appear calm with the surface looking smooth or flat. With winds or tide changes, you may see ripples or waves. White caps will likely only appear during poor weather conditions, in which you should not be monitoring!

Tide Level

Check your local tide schedule to determine the current tide level of your site: **high**, **mid**, or **low**. Changes in tides can be drastic or unnoticeable depending on your site location. Daily tide cycles are ever changing and will alter the water conditions.

Visit NOAA's Tides & Currents Map at **tidesandcurrents.noaa.gov** to access data on local water levels, tides, and current predictions. SCDES also offers yearly tide change tables in collaboration with NOAA data which you can download or print.

Trash Cleanup

It is a good idea to bring a garbage bag when sampling. If litter that you can discard is present, please clean the site. If there are tires or other large, potentially hazardous materials present, take photos and record **concern of illegal dumping**. This will generate an alert to PalmettoPride, our litterbug busting partners.

Illegal dumping is defined as more than fifteen pounds of solid waste, litter, deceased animals, or other materials which create a hazard to public health and welfare. Careless, scattered littering of smaller items is not considered illegal dumping.

Get litter clean up supplies from palmettopride.org.

Outfall Flow

Pay special attention if pipes are flowing during dry spells. This could be an illegal discharge or pollution event.

Security and Hazards

Note any security issues or hazards at your site. These could include evidence of **drug abuse**, **vagrancy**, **dangerous animals**, **a steep bank**, **fast current**, **harmful waste**, or **other issues**. If you ever feel unsafe while sampling due to factors such as these, please consider adopting a new site.

Be aware of wildlife or other potential hazards at your site.

Photos

Photos are VERY important to collect and upload. Take photos in the **upstream** (inland) and **downstream** (oceanward) direction, as well as a picture of the water height. Be consistent with photos to see changes over time. **Water height** photos help determine if the water level at your site is normal, high, or low. Make sure to choose a stable landmark on the shoreline or a landmark that does not move with the water level to include in the photo for reference.

The posts on this fixed dock act as a water height reference point.

In the **additional photo** field in the SC AAS Database, please include images of anything of concern (like litter, hazards, or pollution) or fun group pictures. Additional photos can be sent to scaas@des.sc.gov.

Monitoring Protocol: Habitat Assessment

Salt marsh-tidal creek habitat.

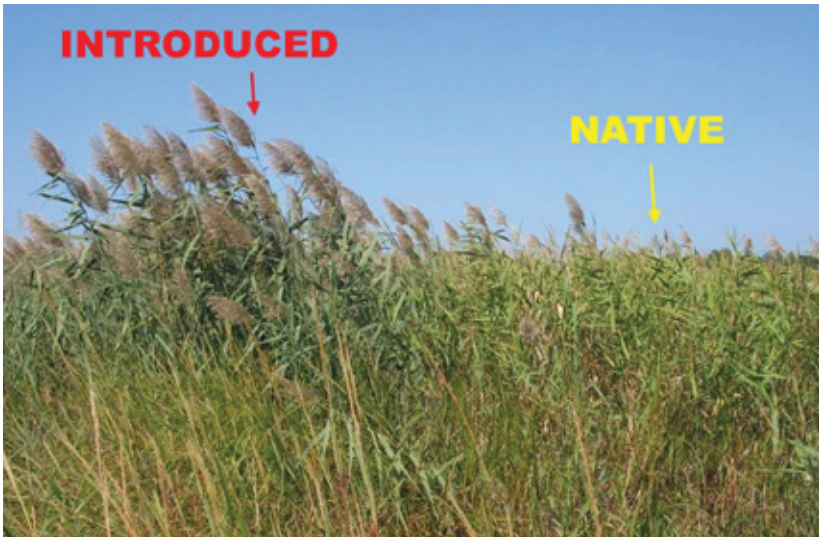
Each time you sample, it is important to assess the area surrounding your tidal creek. Record conditions and note changes.

WETLAND CONDITION AND APPEARANCE

Marsh grass naturally goes through seasonal changes. Generally, marsh grass is green with new growth in the warmer months and turns brown in the colder months. If you notice a sudden, unseasonable change of color, this could be indicative of a problem and should be closely monitored. Record the marsh grass color and note whether the marsh area is **increasing**, **decreasing**, or is the **same as the last sampling event**.

Be on the lookout for invasive *Phragmites*. *Phragmites australis subsp. australis*, the invasive subspecies of the common reed, has been identified along the coast of South Carolina. This aggressive plant has a number of negative impacts including outcompeting native species, dominating ecosystems with thick growth, altering wetland hydrology, and increasing

the potential for fire as it dries out each year. *Phragmites* typically establishes in areas of high nutrient inputs from pollution and urbanization. Report any sightings of *Phragmites* or other invasive species to South Carolina Department of Natural Resources (SCDNR) to help resource managers track the spread.



Invasive *Phragmites* is taller and hardier than native species. Source: Center for Invasive Species and Ecosystem Health.

INVASIVE SPECIES REPORTING

Report suspected invasive species using **SCDNR's Non-native Species Reporting Tool** at non-native-species-scdnr.hub.arcgis.com.

Scan to report invasive species.

LOCATED WITHIN 100 FEET OF WATERWAY

Riparian zones, the areas adjacent to a tidal creek, are important because they buffer waterways from manmade impacts. Vegetated riparian zones slow down stormwater runoff, which increases water infiltration, reduces excess nutrients entering waterways, and traps sediment. In urban watersheds with impervious surfaces that heat runoff, riparian zones allow runoff to cool before it enters the waterway. Riparian zones also provide shade for waterways and habitat for wildlife. They help to stabilize banks and shorelines, protecting them from erosion.

Make note of anything that may be disrupting the riparian zone and non-natural land uses that exist within 100 feet of the waterway, such as:

- **Industrial**
- **Commercial**
- **Agricultural**
- **Residential**
- **Docks**

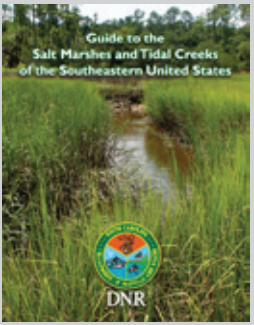
OBSERVED IMPACTS ON MARSH

Both human activities and natural disasters can have adverse impacts on our wetlands. Record significant changes since the last monitoring event and observe evidence of the following:

- **Erosion** and bank loss
- **Dredging** that has deepened or widened the channel
- **Large vegetative debris** in the waterway
- **Algae** on the water surface

WILDLIFE SURVEY

The wildlife survey can be useful in determining the long-term baseline conditions of your site. Many species require a specific set of conditions to thrive, and their presence or absence can provide insight into habitat quality. While you are sampling, make note of any wildlife you observe.



SCDNR's *Guide to the Salt Marshes and Tidal Creeks of the Southeastern United States* is a useful resource that will help you identify organisms and give you more information on these productive and diverse ecosystems. A digital copy is available at **saltmarshguide.org**.

Wildlife you may see in a salt marsh-tidal creek ecosystem.

Monitoring Protocol: Measurements

SC AAS volunteers using monitoring equipment.

Physical and chemical monitoring allows you to gather information about specific water quality characteristics. Volunteers monitor these six parameters monthly:

- Air temperature
- Water temperature
- Transparency
- Salinity
- pH
- Dissolved oxygen (DO)

SAMPLING CONSIDERATIONS

Data Comparison

Regular monitoring enables your data to be compared over time. Be aware that tide stage will significantly impact the parameters you are monitoring, and that baseline data may be different for high tide and low tide. Sampling at the same time of day ensures you will collect data at different tide stages throughout the course of the year.

It is important to understand that water chemistry is very complex and that natural variation in some parameters is not unusual, but actually the norm. The following are some examples of how environmental conditions can influence water chemistry:

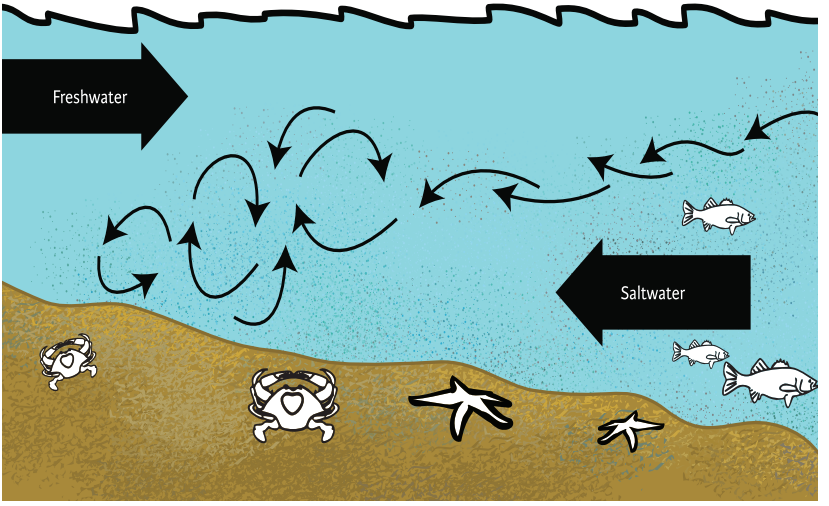
- **Time of Day** – Dissolved oxygen (DO) levels rise during sunlight hours due to increased photosynthesis in aquatic plants and algae. DO levels decrease overnight when photosynthesis is not occurring.
- **Weather** – Runoff from heavy rains can transport pollutants and sediment to estuaries. Freshwater runoff will lower salinity concentrations.
- **Physical Influences** – Tides, wind, and storms affect salinity, temperature, transparency, and more.

Stratification

Fresh water and salt water have different physical properties. Salt water is denser than fresh water, which can lead to periods of time where the lighter fresh water sits on top. This layering is called stratification. Stratification varies based on the tide cycle and the shape of the waterway. When water is stratified, sampling at different depths can lead to variable results of temperature, salinity, and dissolved oxygen. In a well-mixed estuary, the salinity does not change with depth.

Changing seasons, tides, significant rain events, and wind can lead to a mixing of fresh water and salt water. It is best to sample 1 foot below the water surface for a more evenly mixed sample. Use a bucket or sampling pole to collect your sample. Avoid overfilling your bucket, as it may be difficult to pull it back up.

Drill small holes around your bucket to let water out and make it easier to lift.



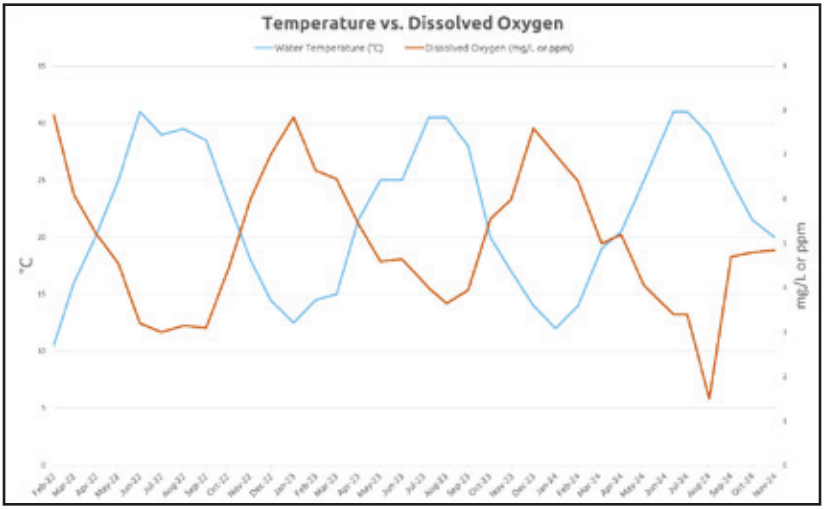
Example of stratification.

TEMPERATURE

Armored case thermometer.

Water temperature is one factor in determining which species may or may not be present in the salt marsh-tidal creek ecosystem. Temperature greatly affects feeding, reproduction, and the metabolism of aquatic animals. A week or two of high temperatures may make the habitat unsuitable for sensitive aquatic organisms, even if temperatures are within tolerable levels the rest of the year. Not only do different species have different requirements, but optimum habitat temperatures may also change for each stage of life. Fish larvae and eggs usually have narrower temperature requirements than adult fish.

Temperature is also very closely linked with how much oxygen a stream can hold. The higher the water temperature, the less oxygen water can hold. Cooler winter waters will have higher dissolved oxygen levels, and hotter summer waters will have lower levels. This is why you may see stories about fish kills in the heat of summer and why temperature and oxygen-sensitive fish species, like trout, can only thrive in cold streams.



Long-term temperature and dissolved oxygen data from SC AAS site WC-2150 in Charleston, SC.

To measure temperature, use an armored case thermometer. Take air temperature first as a reference point for the water temperature. Record measurements in degrees Celsius (°C). A temperature conversion chart is provided in the appendix.

Measuring Air Temperature:

- ALWAYS take air temperature before water temperature.
- Suspend the thermometer in the shade. You can use your body to create shade if none is available.
- Let the thermometer stabilize for at least 60 seconds before reading the result.
  - » It may take longer for the thermometer to stabilize if you are moving it from an air-conditioned location to the hot summer air or if the thermometer has been sitting in direct sunlight.
- Hold the thermometer from the top and away from you. Do not wrap your hand around the bottom of the thermometer when taking the reading as this will increase the temperature.
- Record air temperature in °C.

If you have an unexpected measurement, check to make sure your thermometer does not have any breaks or air bubbles in the color line.

Measuring Water Temperature:

- Measure water temperature immediately after you collect your sample so that the water in the bucket is the temperature of the waterway.
- Place the bucket in the shade.
- Submerge the thermometer in the bucket and let it stabilize for at least 60 seconds before reading the result.
- If possible, read the thermometer in the water. If not, read immediately after removing from the water. Remember to hold the thermometer from the top and away from you.
- Record water temperature in °C.

TRANSPARENCY

Transparency tube & Secchi disk

Transparency, or the clearness of water, is a measure of light penetration into a waterbody. It is affected by both water color and suspended materials. Transparency is measured using the metric system (meters or centimeters). The terms clarity and transparency can be used interchangeably.

Turbidity, or the cloudiness of water, is a measure of how light is scattered and blocked by suspended materials in the water. Suspended materials may be soil, algae, or phytoplankton. Turbidity is measured in Nephelometric Turbidity Units (NTUs).

Transparency and turbidity are inversely related: the higher the turbidity, the less transparent the water. There are no state standards in South Carolina for transparency, only turbidity. The SC AAS Database automatically converts transparency tube values to turbidity values for data to be related to state standards. Transparency and turbidity can indicate erosion or land use changes in your watershed and may influence a waterway's suitability as a habitat for aquatic organisms.

For SC AAS sampling, there are two tools that can be used for measuring transparency in water – a Secchi disk and a transparency tube. Which tool you use will depend on your specific site conditions. It is recommended to use a Secchi disk when sampling from a dock or boat. However, the water must be deep enough for the disk to disappear, and the rope must remain vertical. A transparency tube can be used at any site as you can collect water directly from the tidal creek or fill the tube with water from your sample bucket.

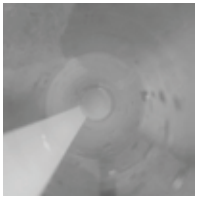
Measuring Transparency - Secchi Disk:

There are 10 cm, 50 cm, and 100 cm markings on most SC AAS kit Secchi disks.

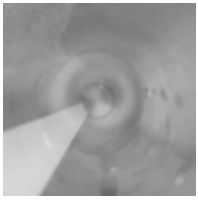
- Remove hats and sunglasses and choose the shadier side of the dock or boat.
- Slowly lower the Secchi disk until it is no longer visible. The Secchi disk should be hanging vertically into the water.
  - » If the current is changing the angle of the rope and moving the disk, the line should be weighted until it remains vertical OR a transparency tube should be used instead.
- Record the depth from the disk to the water surface on your data form in **meters (m)**. This is known as the disappearance depth.
- Slowly raise the disk until it just reappears. Record the depth from the disk to the water surface in **meters (m)**. This is the reappearance depth.
- The Database will automatically average these two readings for you.
- After sampling, rinse any mud or debris from the line with fresh water and allow to dry completely before rewinding and storing.

Measuring Transparency - Transparency Tube:

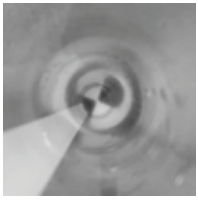
- Remove hats and sunglasses. Perform this test in the shade or indirect sunlight to eliminate glare.
- Be careful not to stir up the bottom sediment when collecting water with the tube or sample bucket.
- Fill the transparency tube to the top. Your sample water should be well-mixed. Stir or shake to resuspend sediments.
- Press down on the tube to slowly release water, stopping at the point where the black and white quadrants can just begin to be discerned.
- Using the ruler on the tube, record your measurement in **centimeters (cm)**.
- After sampling, rinse any mud or debris from the transparency tube with fresh water and allow to dry completely before storing.



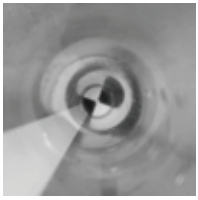
Full tube



Record measurement



Too far



Empty tube

DON'T USE A SECCHI DISK IF:

- The current is too strong and the Secchi disk will not hang vertically
- The Secchi disk reaches the bottom and you can still clearly see it
- The Secchi disk becomes obstructed by vegetation

Use a transparency tube instead!

SALINITY

Using a refractometer to measure salinity.

Salinity is the amount of dissolved salts in water, typically measured in parts per thousand (abbreviated ppt). The symbol for ppt is ‰. Salinity is a major factor in determining which plant and animal species can inhabit the salt marsh-tidal creek ecosystem.

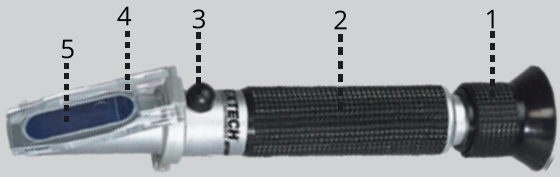
Salinity exists on a gradient with the Atlantic Ocean measuring 36.0 ppt and freshwater measuring 0 ppt. Closer to the ocean it is typical to see salinities of 20.0-35.0 ppt, whereas tidal creeks further inland can have salinities of around 5.0-10.0 ppt. **For SC AAS purposes, any tidal creek with a salinity greater than 0.5 ppt is considered saltwater.**

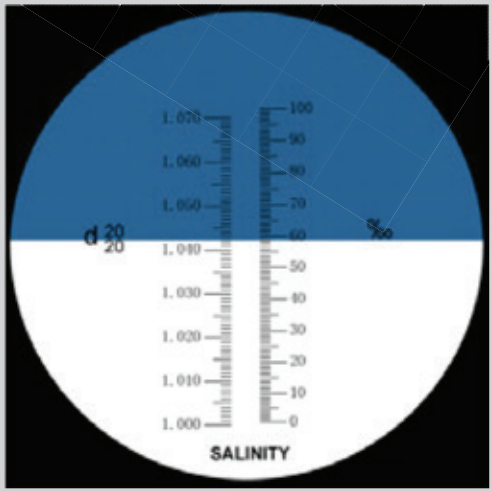
Salinity is naturally altered by tides, rainfall, and extreme weather events. In areas where fresh and salt water mix, salinity tends to be higher at high tide and lower at low tide. During rain events when the waterway is inundated with fresh water, the salts in the water will become more diluted and salinity will decrease. Hurricanes can lead to freshwater inundation, lowering salinity, and increase storm surge, raising salinity.

Human activities can also significantly impact salinity gradients. Development creates impervious surfaces, causing more stormwater to runoff into waterways and decrease salinity. Overpumping groundwater for irrigation, domestic use, and wastewater treatment allows salt water to move into aquifers along the coast. This is known as saltwater intrusion and can make wells unusable as salinity increases. Monitoring salinity can help track impacts to your site's salinity gradient.

Salinity is measured using a refractometer, which reads the change in the way light bends, or refracts, through salt water. A drop of water is placed on the prism of the refractometer and viewed through the eyepiece. The salinity concentration is measured at the boundary of the light and dark fields on the scale in the eyepiece's view. This boundary is known as the shadow line. The right side of the scale measures parts per thousand, indicated by ‰. The left side of the scale measures the specific gravity of the sample and can be ignored.

1. Eyepiece
2. Mirror tube
3. Adjust screw
4. Cover plate
5. Prism





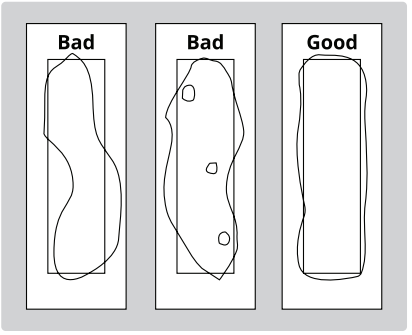
Field of view

Parts of a refractometer.

Measuring Salinity:

Refractometers are fragile. Please handle them with care.

- Remove hats and sunglasses.
- Hold the refractometer in a bright area to maximize contrast of the shadow line.
- Keep the refractometer level so that water does not spill out.
- **You must calibrate the refractometer with distilled water before measuring your sample.**
  - » Add a few drops of **distilled** water to the prism.
  - » Close the cover plate so that the liquid spreads across the surface evenly without air bubbles or dry spots.
  - » Look through the eyepiece and adjust the focus until the shadow line is clearly visible.
  - » Adjust the calibration using the included screwdriver so that the shadow line is even with the zero line.
  - » Wipe off the prism with a cloth.
- Next, measure the salinity of your sample.
  - » Add a few drops of **sample** water to the prism.
  - » Again, slowly close the cover plate to evenly spread the water.
  - » Look through the eyepiece and find the shadow line.
  - » Record your measurement using the salinity side of the scale (‰).
  - » If your screen is all blue, there may not be enough water on the prism, or you may be seeing results of freshwater dilution.
- Before storing, rinse the prism with fresh water (not your salt water sample) and dry with a cloth.

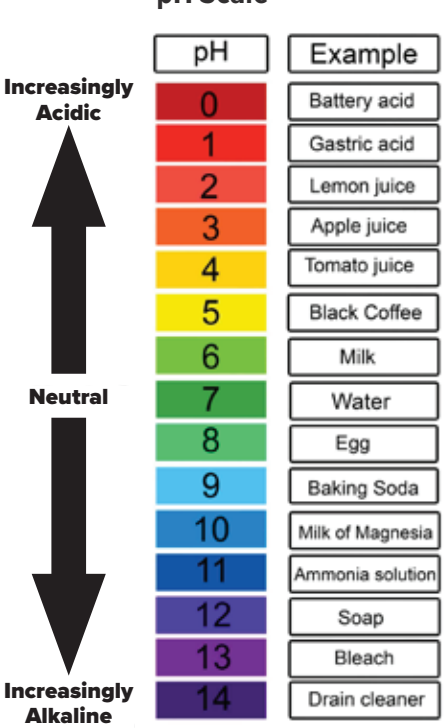


Liquid should completely cover the prism with no air bubbles.

pH

SC AAS volunteers measuring pH.

pH is a measure of how acidic or basic a substance is and uses a scale of 0.0 to 14.0. A pH of 7.0 is neutral, a pH greater than 7.0 is basic/alkaline, and a pH less than 7.0 is acidic. The pH scale is logarithmic, so every unit of change in pH represents a tenfold change in acidity. A pH of 6.0 is 10 times more acidic than a pH of 7.0, and a pH of 5.0 is 100 times more acidic than a pH of 7.0.



The pH of salt water is influenced by the types of soils in the watershed and the concentration of acids in rain. Acid rain is formed when carbon dioxide from the atmosphere enters falling rain, forming a weak carbonic acid. Typical rainfall in the US is slightly acidic with a pH ranging from 5.0 to 5.6. Very acidic water can react with soils and allow toxic substances, such as ammonia and heavy metals, to leach out. This can have a harmful impact on aquatic communities.

Certain waters in South Carolina's coastal plain naturally have a lower pH. These rivers and swamps are known as blackwater systems. In these slow-moving streams, vegetation decays and adds tannins to the water. These tannins cause the water to become acidic and colored reddish brown to black. An example of this is the Edisto River.

STATE STANDARDS:

In saltwater habitats in South Carolina, pH levels should fall between 6.5 and 8.5 to meet state standards.

Specially designated areas of the coastal plain, such as swamps and blackwater systems, may have lower pH levels due to natural conditions.

pH is measured by adding an indicator solution to a sample of water to produce a color change. The color of the sample is then matched to a color comparator to determine the pH level.

Measuring pH:

- Rinse the plastic tube twice with sample water. Pour the rinse water into your waste container.
- Fill the tube to the 10 mL line with sample water.
  - » Water in your tube will form a curve known as the meniscus. The bottom of the meniscus should align with the 10 mL mark.
  - » To get exactly to the 10 mL mark, it is helpful to flick water out of the tube rather than attempt to pour out excess water.
- Add 10 drops of the pH Wide Range Indicator, holding the bottle vertically.
- Cap and gently invert the tube several times to ensure even mixing.
- Compare the tube to **both** color comparator slides.
  - » Use a white piece of paper behind the comparator for best accuracy.
- Record pH by matching your sample to the closest color on the color comparator.
  - » The pH color comparator scales are in increments of 0.5. **Do NOT estimate between marked increments.**
- Repeat this process with the second tube.
- Both pH results must be recorded in the SC AAS Database.
- **The duplicate precision for pH is ± 0.25.** If your two sample results differ by more than 0.25, resample until your results are within this acceptable range.
  - » Because the pH color comparator scale is in increments of 0.5, your two sample results must be identical.
- Empty both tubes into your waste container. Rinse each tube twice with fresh water.

DISSOLVED OXYGEN

SC AAS volunteer measuring dissolved oxygen.

Like land organisms, aquatic organisms need oxygen to live. Dissolved oxygen (DO) is the oxygen available in water for aquatic species and is measured in milligrams per liter (mg/L) or parts per million (ppm). Tidal creeks naturally have low and fluctuating DO levels that change throughout the day as well as seasonally. You may see a wide range of values during your monitoring trips.

The amount of DO an aquatic organism requires varies by species and life stage. Many species in the salt marsh-tidal creek ecosystem have adapted to withstand its lower DO levels. Fish and invertebrates usually require DO levels of 5.0 to 6.0 mg/L for growth and activity. When DO levels drop below 2.0 mg/L, species who are able to relocate will move to areas with higher DO. Smaller and stationary organisms benefit from the low DO levels because they keep out larger predators, making creeks and marshes good nursery habitat.

Critically low oxygen levels often occur during the warmer summer months when solubility decreases and oxygen demand increases. Living organisms increase their activity in warm water, which requires more oxygen to support their metabolism.

Factors That Influence Dissolved Oxygen

Increases DO

- **Cooler temperatures**, which increase solubility of oxygen
- **Atmospheric diffusion**, which adds oxygen to the water from the atmosphere
- **Turbulent mixing**, which adds oxygen to the water when wind or currents agitate the water's surface
- **Photosynthesis**, which produces oxygen as a byproduct when plants, algae, and phytoplankton use energy from the sun to make sugars

Decreases DO

- **Warmer temperatures**, which decrease solubility of oxygen
- **Higher salinity**, which decreases solubility of oxygen
- **Slow-moving, deep water**, which lacks turbulent mixing
- **Decaying organic matter**, which consumes oxygen when bacteria decompose dead plants and animals

STATE STANDARDS:

For the majority of South Carolina's salt waters, DO levels must have a daily average of 5.0 mg/L and not less than 4.0 mg/L.

Note: In the coastal regions of South Carolina, there are tidal creeks where DO may be very low, which is the natural condition of these waterways. You may regularly record measurements below state standards, especially in the hot summer months. Remember that your measurement is for one point in time and the state standard is based on the daily average.

Dissolved oxygen is measured using the Winkler Titration Method and involves adding a series of chemicals to the sample.

Measuring DO:

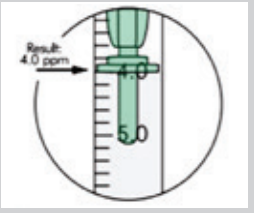
- Wear gloves and closed toed shoes. Protective eyewear is encouraged.
- If sampling from a bucket, pull up a fresh bucket of water and immediately measure DO.
- Rinse both bottles twice with sample water. Pour the rinse water into your waste container.
- Completely fill both bottles with sample water and cap underwater to prevent air bubbles.
  - » Air bubbles will skew your measurements.
  - » Flip your bottles upside down to make sure no air bubbles are hiding in the caps.
- Add 8 drops of Manganous Sulfate Solution (chemical #1) and 8 drops of Alkaline Potassium Iodide-Azide (chemical #2) to each sample bottle.
  - » Hold the chemical bottles upside down completely vertically to dispense drops evenly.
  - » Do not leave the cap off of your sample bottles for longer than necessary, as DO is still fluctuating.
- Cap and gently shake the bottles until a cloudy, white to brownish-orange floc forms. Allow this floc to settle past the shoulder of the bottle before moving on.

Wait for the floc to settle past the curved shoulder of the sample bottle.

- Add 8 drops of Sulfuric Acid 1:1 (chemical #3) to each bottle.
  - » Hold the chemical bottles upside down completely vertically to dispense drops evenly.
  - » Do not leave the cap off of your sample bottles for longer than necessary, as DO is still fluctuating.
- Shake the bottles until the samples are a clear, amber color throughout. DO in your sample is now fixed and will no longer fluctuate if exposed to the air.
  - » If you still see dark solids in the solution, you can add another drop of chemical #3 to both glass bottles and shake again. If they still do not disappear, they could be organic matter from the water. Proceed to the next step.
- At this point, keep both sample bottles and their corresponding glass cylinders and titrator syringes separate. The two samples will be compared to ensure duplicate precision.
- Rinse each glass cylinder twice with your corresponding sample. Pour the sample rinse water into your waste container.
- Fill each glass cylinder with 20 mL of your sample.
  - » Water in your cylinder will form a curve known as the meniscus. The bottom of the meniscus should align with the 20 mL mark.
  - » If you overfill your cylinder, pour off excess into your waste container.
- Firmly insert the tip of the titrator syringe into the Sodium Thiosulfate 0.025N (chemical #4). Turn the bottle upside down and slowly pull back the plunger of the syringe to fill it to the 0 mL mark.
  - » Make sure there are no air bubbles in the syringe. Bubbles can be dislodged by tapping the side of the syringe or by pushing in the plunger until the bubble disappears. Always refill to the 0 mL mark.
- Insert the syringe into the small hole on the glass cylinder's lid.
- Slowly add 1 drop of chemical #4 to your sample and swirl the cylinder. Repeat until the solution is a pale yellow color.
- Remove the syringe and glass cylinder lid. Set the syringe safely to the side as you will need it again.
- Add 8 drops of Starch Indicator Solution (chemical #5) to the cylinder. Cap and swirl the cylinder until the solution is an even, purple-blue color.

Once you add chemical #5, your solution will change from pale yellow to dark purple or blue.

- Reinsert the syringe into the cylinder lid and again dispense 1 drop of chemical #4 to your sample. Swirl thoroughly after every drop. Repeat until the solution is clear.
  - » Once the solution is a pale purple color, check it against a white piece of paper after each drop so it is obvious when it turns fully clear.
  - » If you have dispensed your entire syringe and the solution is still not clear, refill the syringe to the 0 mL mark and continue to add drops until the solution turns clear. Add 10.0 mg/L to your final DO measurement to account for the first syringe.
- Remove the syringe from the cylinder and hold it with the tip pointing down. Read the syringe from the bottom of the solid green ring. Each division on the syringe is 0.2 mg/L.



Read the syringe from the bottom of the green ring. In this example, the result is 4.0 mg/L or ppm.

- Record your DO values for each sample to one decimal place in mg/L or ppm.
- Both final results must be recorded in the SC AAS Database.
- **The duplicate precision for DO is ± 0.6 mg/L**. If your two sample results differ by more than 0.6 mg/L, resample until your results are within this acceptable range.

- Empty all bottles, cylinders, and syringes into the waste container. Rinse bottles and cylinders twice with fresh water. Do not rinse the syringe or take off the tip.

For a visual walkthrough of the DO titration process, see the appendix.

CHEMICALS AND KITS

Store your kit in a cool, dry place (NOT in a hot car or garage). Check that the chemicals used for pH and DO testing are not expired before sampling. Expiration dates can be found on the labels of each chemical bottle. After your sampling event, rinse your sampling equipment with fresh water and let dry. If you are on a public sewer system, sampling waste can be poured down your sink at home with extra water or flushed down the toilet. **If you are on a septic system, do not dispose of your waste at home.** Return your sampling waste to your kit loan location or dispose of it in a location connected to the public sewer system.

To replenish the chemicals in your SC AAS monitoring kit, consider purchasing kit refills online. Visit our website to view a list of suppliers. Please contact your trainer(s), kit loan location, or the program coordinators at scaas@des.sc.gov for guidance and to return any expired chemicals.

Dissolved oxygen kit and thermometer.

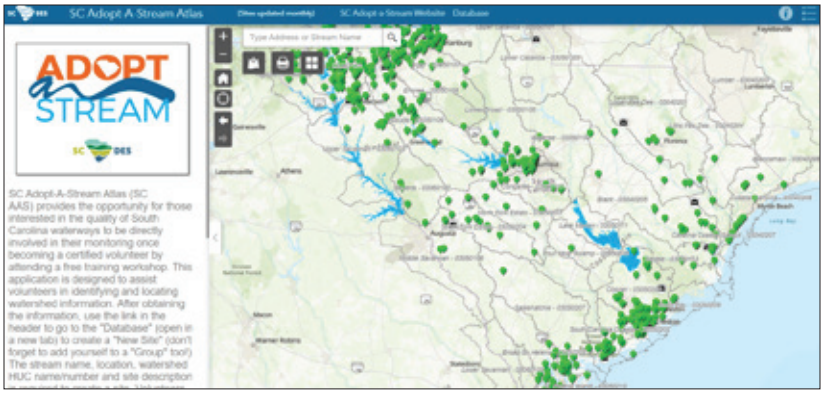
Next Steps

Newly certified SC AAS volunteers.

SC AAS ATLAS

The SC AAS Atlas is designed to assist certified volunteers in identifying watershed information needed for adopting new sites. The Atlas also allows fast look-up of existing monitoring sites and kit loan locations. Please be aware that there may be lag time in displaying new information. The Atlas can be accessed by visiting www.scadoptastream.org.

Watersheds are identified by unique Hydrologic Unit Codes, or HUCs. HUCs are useful for identifying which watershed you want to monitor, as watersheds are not always exclusively contained by a single city, county, or state. The HUC system divides and subdivides areas into successively smaller watersheds. As the watershed area gets smaller, the unique HUC gets longer. The SC AAS Database and Atlas organize sites by 8-digit HUCs.



The SC AAS Atlas.

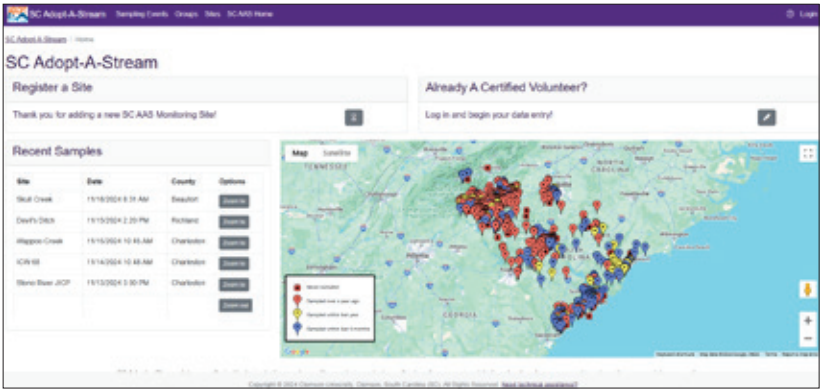
Atlas Tips

- Green pins represent adopted sites. Black and white icons are kit loan locations.
- To find information needed to adopt your site, zoom in to and click the location you wish to adopt. A popup will appear with the waterbody name (if named), watershed name, and 8-digit HUC.
- Popups may have more than one page of information displayed. Use the arrow to toggle through the pages.
- Latitude/longitude coordinates display in the lower left corner of the map window.
- Open the “Information” icon in the upper right-hand corner for additional instructions on tools.
- If the Atlas is missing information, open the “Layers List” to make sure that all layers are turned on (blue check box).

SC AAS DATABASE

Once you become a certified volunteer, you will be added to the Database as a certified user. The link to the Database can be found on our website, www.scadoptastream.org. The Database can be accessed from your phone or from a computer.

Data should be submitted to the Database as soon as possible to be shared with your community. Anyone with internet access can view sampling events, groups, or sites. On those pages, you can use the export buttons to download data, or you can copy and paste the data into a new file. Personal information like your full name and email address are not publicly viewable.



The SC AAS Database.

Register in the SC AAS Database

Following your certification, a registration link will be emailed to you (be sure to check your spam folder). Follow the link to create your account in the Database. The email address you provided for the workshop will become your username.

Create or Join a Group

To create a new group:

- On the SC AAS Database homepage, click the “Groups” tab on the top purple bar. Expand the menu button if you do not see “Groups.”
- Click the purple “Add Group” button next to the search box. A window should appear with the title “Add Group” at the top.
- Enter the group name (this can be something fun and creative), county, date, description, and group members. Leave the “Monitored Sites” field blank.
- Click the purple “Submit” button in the lower right corner of the window. The window will disappear, and you will see a green banner saying, “Successfully saved group” at the top of the page.

To join an existing group:

- Click the “Groups” tab on the top purple bar on the SC AAS Database homepage.
- Type the name of the group in the search box and hit enter.
- Click the gray “ + Join” button to the right of the group name (next to the “ View” button) to add yourself.
- Click the “ View” button to the right of the group name. Your name and email should now appear in the “Members” list.

Register Your Sampling Site(s):

- On the SC AAS Database homepage, click the “Sites” tab on the top purple bar. Expand the menu button if you do not see “Sites.”
- Click the purple “Add Site” button next to the search box.
- Enter the site information.
  - » Waterbody Name: If you are not sure of your waterway’s name, refer to the SC AAS Atlas. If it is unnamed, make sure it fits the criteria for site selection. If it does, you can choose a name. The waterbody name becomes the first part of your site ID (ex: Noisette Creek becomes NC-####).

  - » Watershed Name/Number: Use the SC AAS Atlas to record the 8-digit hydrological unit code (8-digit HUC) in which your site is located.
  - » Latitude and Longitude: You can use the interactive map to drop a pin on your site or use the coordinates that display in the lower left corner of the map window on the SC AAS Atlas.
  - » Monitoring Group: Start typing the name of your group. Select your group from the drop-down list.
- Click the purple "Submit" button in the lower right corner. The window will disappear, and you will see a green banner saying, "Successfully created a site with ID ___" at the top of the page.

KEEP IN TOUCH

If you have any questions or concerns regarding the South Carolina Adopt-a-Stream program, contact the program coordinators by emailing scaas@des.sc.gov.

Follow us on Facebook (SC Adopt-a-Stream) and Instagram (@scadoptastream) to keep up to date with the latest events. Once you have been registered in the Database, you will also be added to our monthly e-newsletter. SC AAS is an ever growing and evolving program, and we hope you join us in monitoring South Carolina's waterways.

SC AAS volunteer and family sampling at site CRTCESC-2962.

INTERESTED IN MORE?

If you would like to explore different volunteer monitoring opportunities, check out our other SC AAS programs! Workshops can be found on our website, www.scadoptastream.org.

Training Types

- **In-person:** 5-6 hours, classroom lesson, outdoor field practice, and open-book certification test.
- **Hybrid:** 3-hour live virtual lesson, 3-hour field day (separate date), and open-book certification test.
- **Online:** Lake monitoring only. Fully online certification.

Additional Programs

- **Freshwater Streams:** Learn to measure temperature, pH, dissolved oxygen, transparency, and bacteria in freshwater wadable streams. Choose a site that flows year-round and is wrist to hip deep. This program is designed for monthly monitoring.
- **Macroinvertebrates:** Learn to collect and identify macroinvertebrates which are visible organisms without a backbone. Monitoring macroinvertebrates gives a good picture of the long-term health of freshwater stream habitat and water quality. Choose a site that flows year-round and is wrist to hip deep. This program is designed for biannual monitoring.
- **Lakes:** Learn to make observations and measure transparency, temperature, hue, and lake level. Keep an eye out for algal growth and report possible invasive aquatic plants. Sample from a dock, boat, or kayak/canoe/paddleboard. Select monitoring sites greater than 5 acres and do not sample engineered stormwater ponds. This program is designed for monthly monitoring.

Other Ways to Get Involved

Another way to protect water quality is to get others in your community involved and educated. Share your data, reach out to local businesses to promote and support SC AAS, and lead community initiatives like litter pick-ups and riparian buffer repairs.

Additional Volunteer Monitoring Programs

CoCoRaHS: The Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) is a non-profit, community-based network of volunteers working together to measure and map precipitation (rain, hail and snow). CoCoRaHS seeks to provide widespread high-quality precipitation data for many organizations and individuals, including The National Weather Service, meteorologists, hydrologists, scientists, engineers, and educators. Visit www.cocorahs.org for more information.

NOAA PMN: The National Phytoplankton Monitoring Network (PMN) is a community-based network of volunteers monitoring marine phytoplankton and harmful algal blooms (HABs). The PMN enhances the nation's ability to respond to and manage the growing threat posed by HABs. Volunteers collect important data about species composition and distribution in coastal waters. Volunteers collaborate with National Oceanic and Atmospheric Administration (NOAA) HAB researchers and state managers. Visit www.coastalscience.noaa.gov/monitoring-and-assessments/pmn/ to learn more.

SCDES MyCoast: MyCoast South Carolina is a portal for the South Carolina Department of Environmental Services (SCDES) to collect and analyze pictures and data relating to coastal events. Information collected through this site is used to visualize the impact of coastal hazards and to enhance awareness among decision-makers and stakeholders. Participants can make reports on king tides, derelict vessels, storm damage, and beach clean-ups. Visit www.mycoast.org/sc for more information.

SCDNR SCORE: The South Carolina Oyster Recycling and Enhancement Program (SCORE) is a community-based habitat restoration and monitoring program of the South Carolina Department of Natural Resources (SCDNR). Oysters play a significant ecological and economic role in South Carolina. SCORE seeks to restore and enhance oyster habitat by planting recycled oyster shells in the intertidal environment to form new, self-sustaining oyster reefs. Volunteering opportunities are available statewide. Visit score.dnr.sc.gov to learn more.

Salt water marsh and the sound behind Pawley's Island, South Carolina.

Appendix

Helpful Resources

- **CoCoRaHS** (precipitation data)
  www.cocorahs.org
- **NOAA Tides and Currents**
  www.tidesandcurrents.noaa.gov
- **PalmettoPride** (anti-litter resources)
  www.palmettopride.org
- **SCDES Abandoned and Derelict Vessels**
  www.des.sc.gov/programs/bureau-coastal-management/beachfront-management/marine-debris/abandoned-and-derelict-vessels
- **SCDES 303(d) List of Impaired Waters**
  www.des.sc.gov/programs/bureau-water
- **SCDES Beach Monitoring** (swim advisories)
  www.des.sc.gov/programs/bureau-water/recreational-waters/swim-safety
- **SCDES Watershed Atlas**
  www.gis.dhec.sc.gov/watersheds
- **SCDNR Guide to Salt Marshes and Tidal Creeks of the Southeastern United States**
  www.saltmarshguide.org
- **SCDNR Freshwater and Saltwater Dividing Line Maps**
  www.dnr.sc.gov/marine/dividingline.html

Helpful Apps

- **iNaturalist App** (species identification and tracking)
  www.inaturalist.org
- **Solocator App** (GPS field camera)
  www.solocator.com/

FIELD CHECKLIST

- [ ] Data form found at www.scadoptastream.org
- [ ] Monitoring kit
  - ○ Bucket on rope
  - ○ Thermometer
  - ○ Transparency tube OR Secchi disk
  - ○ LaMotte pH Kit
    2 plastic tubes
    1 chemical
  - ○ LaMotte Dissolved Oxygen Kit
    2 glass bottles
    2 syringes
    2 glass cylinders
    5 chemicals
  - ○ Refractometer
    Distilled water for calibration
  - ○ Paper towels
  - ○ Nitrile gloves
  - ○ Pen/pencil
  - ○ Rinse bottle filled with fresh water
  - ○ Waste bottle
- [ ] Optional items
  - ○ Clipboard
  - ○ Trash bag for litter
  - ○ First aid kit
  - ○ Sun protection

TEMPERATURE CONVERSION CHART

CELSIUS TEMPERATURE (°C)	FAHRENHEIT TEMPERATURE (°F)
0	**32.0**
1	**33.8**
2	**35.6**
3	**37.4**
4	**39.2**
5	**41.0**
6	**42.8**
7	**44.6**
8	**46.4**
9	**48.2**
10	**50.0**
11	**51.8**
12	**53.6**
13	**55.4**
14	**57.2**
15	**59.0**
16	**60.8**
17	**62.6**
18	**64.4**
19	**66.2**
20	**68.0**
21	**69.8**
22	**71.6**
23	**73.4**
24	**75.2**
25	**77.0**
26	**78.8**
27	**80.6**
28	**82.4**
29	**84.2**
30	**86.0**
31	**87.8**
32	**89.6**
33	**91.4**
34	**93.2**
35	**95.0**

Salt water marsh and the sound behind Pawley's Island, South Carolina.

DISSOLVED OXYGEN INSTRUCTIONS

Dissolved Oxygen Test Procedure

Use test tube caps or stoppers, not your fingers, to cover tubes during shaking or mixing.

Hold dropper bottles vertically upside-down, and not at an angle, when dispensing a reagent. Squeeze the bottle gently to dispense the reagent one drop at a time.

Wipe up any reagent chemical spills immediately.

Thoroughly rinse test tubes before and after each test.

Tightly close all containers immediately after use.

Do not interchange caps from containers.

Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect reagents from extremes of temperature.

Part 1 - Collecting the Water Sample (upstream from where you stand)

1.

Rinse the Water Sampling Bottle (0688-DO) with the sample water.

2.

Tightly cap the bottle, and submerge it to the desired depth.

3.

Remove the cap and allow the bottle to fill.

4.

Tap the sides of the bottle to dislodge any air bubbles.

5.

Replace the cap while the bottle is still submerged.

6.

Retrieve the bottle and make sure that no air bubbles are trapped inside.

Part 2 - Adding the Reagents

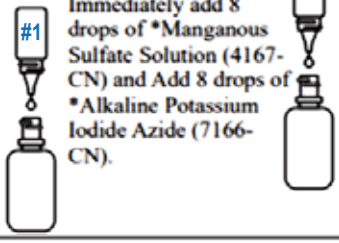
REMINDER: Check expiration dates on chemicals.

NOTE: Be careful not to introduce air into the sample while adding the reagents.

1

Remove the cap from the bottle.

2



Immediately add 8 drops of *Manganous Sulfate Solution (4167-CN) and Add 8 drops of *Alkaline Potassium Iodide Azide (7166-CN).

3

Cap the bottle and mix by inverting several times. A precipitate will form.

4

Allow the precipitate to settle below the shoulder of the bottle.

5

Add 8 drops of *Sulfuric Acid, 1:1 (6141WT-CN).

6

Cap and gently invert the bottle to mix the contents until the precipitate and the reagent have totally dissolved. The solution will be clear yellow to orange if the sample contains dissolved oxygen.

NOTE: At this point the sample has been "fixed" and contact between the sample and the atmosphere will not affect the test result. Samples may be held at this point and titrated later.

***WARNING: Reagents marked with an * are considered to be potential health hazards.**

DISSOLVED OXYGEN INSTRUCTIONS CONT.

Part 3 - The Titration

1

Fill the titration tube (0608) to the 20 mL line with the fixed sample. Cap the tube.

2

Depress plunger of the Titrator (0377).

3

Insert the Titrator into the plug in the top of the Sodium Thiosulfate, 0.025N (4169-CN) titrating solution.

****Leave the plastic tip ON the Titrator**

4

Invert the bottle and slowly withdraw the plunger until the large ring on the plunger is opposite the zero (0) line on the scale.

NOTE: If small air bubbles appear in the titrator barrel, expel them by partially filling the barrel and pumping the titration solution back into the reagent container. Repeat until bubble disappears.

5

Turn the bottle upright and remove the Titrator.

NOTE: If the sample is a very pale yellow, go to Step 9.

****Don't forget DUPLICATE PRECISION. Refer to chapter 5 in the SC Adopt-a-Stream Handbook for more information and FAQs.**

6

Insert the tip of the Titraror into the opening of the titration tube cap.

7

Add 1 drop at a time by SLOWLY pressing the plunger to dispense the titrating solution until the yellow-brown color changes to a very pale yellow. Gently swirl the tube during the titration to mix the contents.

8

Carefully remove the Titrator and cap. Do not disturb the Titrator plunger.

9

Add 8 drops of Starch Indicator Solution (4170WT-CN). The sample should turn blue.

**Or dark purple.

10

Cap the titration tube. Insert the tip of the Titrator into the opening of the titration tube cap.

11

Continue titrating until the blue color disappears and the solution becomes colorless.

NOTE: If the plunger ring reaches the bottom line on the scale (10 ppm) before the endpoint color change occurs, refill the Titrator and continue the titration. Include the value of the original amount of reagent dispensed (10 ppm) when recording the test result.

12

Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record as ppm Dissolved Oxygen. Each minor division on the Titrator scale equals 0.2 ppm.

NOTE: When testing is complete, discard the titrating solution in the Titrator. Rinse Titrator and titration tube thoroughly. DO NOT remove plunger or adapter tip.

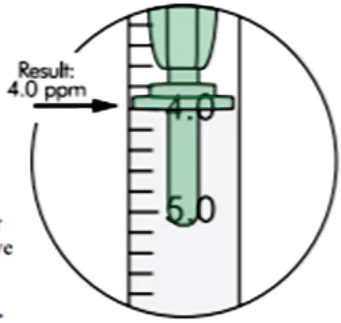


PHOTO ATTRIBUTION

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- **Page 2:**

  8 Major Watersheds of SC
  https://www.dnr.sc.gov/water/waterplan/pdf/Major_Basins_of_South_Carolina.pdf

- **Page 8:**

  Freshwater-Saltwater Divide Map
  https://www.dnr.sc.gov/marine/dividingline.html

- **Page 9:**

  Tidal Creek Ecosystem
  https://www.dnr.sc.gov/marine/sertc/images/spartinaposter.jpg

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- **Page 22:**

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- **Page 29:**

  Phragmites, Invasive vs. Native
  https://www.invasive.org/alien/fact/phau1.htm

- **Page 31:**

  Salt Marsh Guide Cover
  https://www.saltmarshguide.org/
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  Fiddler Crab
  https://scaquarium.org/our-animals/sand-fiddler-crab/

- **Page 41:**

  Refractometer
  Extech RF20 User Manual, available to download as a pdf here: https://www.flir.com/products/rf20/?vertical=condition%20monitoring&segment=solutions

- **Page 42:**

  Prism
  Extech RF20 User Manual, available to download as a pdf here: https://www.flir.com/products/rf20/?vertical=condition%20monitoring&segment=solutions

- **Page 43:**

  pH Scale
  https://www.science-sparks.com/what-is-the-ph-scale/

- **Pages 64—67:**

  Reading Dissolved Oxygen Syringe
  LaMotte Dissolved Oxygen Test Kit Instructions Manual, available to download as a pdf here: https://lamotte.com/dissolved-oxygen-test-kit-5860-01

NOTES

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SC DEPARTMENT *of*
ENVIRONMENTAL SERVICES

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