Department of Natural Resources
Environmental Protection Division
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Georgia
Adopt-A-Stream
Volunteer Water Quality Monitoring

WETLAND MONITORING MANUAL



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Georgia

Adopt-A-Stream

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INTRODUCTION

The Georgia Adopt-A-Stream Wetland Monitoring program is designed to heighten awareness of the nature, functions, and values of wetlands in Georgia. The *Wetland Monitoring Manual* guides volunteers through the process of monitoring wetlands with Georgia Adopt-A-Stream (AAS). This involves getting to know the wetland and its watershed, learning the importance of wetland functions and values, and monitoring wetland hydrology, plants, and soils.

Download a copy of the *Getting to Know Your Watershed* manual from the AAS website to use as a guide for monitoring in conjunction with the *Wetland Monitoring Manual*.

What is a Wetland?

Wetlands are areas where water is the primary factor in controlling the environment and the associated plant and animal life.

These transitional habitats occur between upland and aquatic environments where the water table is at or near the surface of the land, or where the land is covered by shallow water that may be up to six feet deep (U.S. Fish and Wildlife Service). Legal definitions may be broad, including areas which meet the following criteria: vegetation like that of traditional wetlands, soils heavily influenced during some portion of the year by water, and complete ground or surface water saturation during a portion of the growing season.

Georgia Wetlands

Various assessments of Georgia's wetlands have identified from 4.9 to 7.7 million acres, including more than 600,000 acres of open water habitat found in estuarine, riverine, palustrine, and lacustrine environments. Estimates of wetland losses since colonial settlement beginning in 1733 and expanding over the next two and one-half centuries are between 20-25% of the original wetland acreage.

Georgia has approximately 100 miles of shoreline along the south Atlantic, with extensive tidal marshes separating the barrier islands from the mainland. Georgia's coastline and tidal marshes are well preserved compared to other South Atlantic states.

Georgia's interior ranges in elevation from sea level to 4,788 feet in the Blue Ridge Mountain Province. At the higher elevations, significant, pristine cool-water streams originate and flow down steep to moderate gradients until they encounter the lower elevations of the Piedmont Province. Many of the major tributaries originating in the mountains and

piedmont have been impounded for hydropower and water supply reservoirs. These man-made lakes constitute significant recreational resources and valuable fishery habitat. Palustrine wetlands in floodplains and beaver ponds are found in Piedmont River corridors. At the fall line, streams flowing southeasterly to the Atlantic Ocean or south - southwesterly to the Gulf of Mexico have formed large floodplains as each encounters the soft sediments of the upper Coastal Plain.

Other significant wetlands found in the state are associated with blackwater streams originating in the Coastal Plain, lime sinkholes, springheads, Carolina bays, and the Okefenokee Swamp, a bog-swamp covering approximately one-half million acres in South Georgia.

In the flatwoods of the lower Coastal Plain, seven tidal rivers originate at ancient shoreline terraces and sediments of the Pleistocene age. Scattered throughout the flatwoods are isolated depressional wetlands and drainages dominated by needle-leaved and broad-leaved tree species adapted to long hydroperiods.

Due to considerable variation in topography, hydrology, geology, soils, and climatic regime, the state has one of the highest levels of biodiversity in the eastern United States. It provides a diversity of habitats for nearly 4,000 vascular plant species and slightly less than 1,000 vertebrate species. Numerous plant and animal species are endemic to the state, and of these, many of the rarer species are dependent upon wetlands for survival.

GETTING STARTED

Before monitoring a wetland, it is importance to understand the history of its waters and the functions it provides. Volunteers will become familiar with wetlands through visual assessments and watershed identification. They will work with local partners and municipalities to foster community and support involvement in the protection and study of wetlands. Participants should commit to monitoring a wetland for at least one year, but data collection over several years allows for a better analysis of changes.

Selecting a Wetland

Wetlands are not as common or as easy to find as other waterways may be. For this reason, Georgia AAS recommends working with a local partner who may own land where a wetland is located or contact local government agencies for permission to work on publicly owned land. Determine if a wetland is present by purchasing a USGS topographical quadrangle of the area of interest. Another estimation of wetland locations can be found on a map from the National Wetland Inventory (NWI). These quadrangles correlate to the USGS topographic maps and are specifically designed to identify and classify wetlands. Both the topographic and NWI maps can be purchased from the State Geological Survey office. For more details on maps, review the Getting to Know Your Watershed Manual, found on the AAS website.

General guidelines for selecting a wetland to monitor:

- Select a wetland meaningful to the monitoring group
- Ensure it has easy, safe, and legal access
- Choose a project that will be fun!

Wetland Identification

There are several wetland indicators used to determine if an area is a wetland. Wetland professionals look for the presence of water-tolerant plants (hydrophytes), soils that have been saturated with water for long periods (hydric soils), and hydrology. Use the indicators below to determine if an area would be considered a wetland.

Hydrophytic Vegetation

- Buttressing of tree trunks, where the base of the tree is enlarged to provide support
- Knees or other adventitious growth that allows support and/or ability to access

oxygen from the surface
- An abrupt change in plant communities often paired with a visual drop in elevation
- The presence of hydrophytic plants – plant guides and resources can be obtained on the AAS website

Hydric Soils

- Gray, greenish, or blue-gray soil colors
- Surface soils that are dark brown or black in color from decayed organic matter
- Soils that "ribbon" when squeezed
- Soil may or may not be saturated with water, depending on dry/wet seasons

Hydrology

- Standing water or soggy soils
- Dark-colored water marks on tree trunks
- Gray or darkly stained leaves on the ground

Water does not have to be present year round for an area to be considered a wetland. In fact, many wetlands look like dry forests or meadows during the dry season. This is why vegetation and soil are important. If water is present during the growing season, water-intolerant plants will not grow, and water-tolerant plants may grow. When water saturates soil for several days, the soil chemistry changes, causing the characteristics listed above. These characteristics remain long after the water has left, which may indicate long term soil saturation.

The simplest indicator is standing water. Other visual cues include watermarks on tree trunks or rocks and discolored leaves that appear partially decomposed.

As the upland transitions to a lower elevation, plant communities change. Plants commonly seen in wet areas like red maple or cinnamon fern may be present. Some adaptations are obvious like buttressed trees whose base is expanded. Some plants put out roots or knees that rise above the water level to aid in oxygen exchange during flooded conditions.

When soil is saturated for long periods, the soil will develop anerobic conditions with very little or no oxygen. These conditions allow for the adaptations listed above to develop.

Study the area of interest and use this manual for an expanded understanding of wetland soils, vegetation, and hydrology.

Local Partnerships

Local partners can help the project succeed. They can offer technical advice, donate equipment, or facilitate access to a wetland. Contact groups that may be interested in participating in the project, those that could sponsor or donate, or those who can grant access to a property with a wetland.

Examples of local partners with wetland access may include:

- Large private landowners who may have wetlands on property
  - Timber companies
- Government agencies with large management areas
  - Department of Natural Resources Wildlife Resources Division
- Municipalities with wetlands
- Environmental education centers
- Schools with outdoor classrooms near or in a wetland
- Small private landowners

Registering a Wetland

Once a wetland is identified, download the Getting to Know Your Watershed Manual from the AAS website. This manual guides through the steps of identification, naming, obtaining maps, group name, setting goals, and informing local governments about the wetland project. It also provides information on registering a wetland with Adopt-A-Stream. Registration is important so that data collection within the wetland is collected and available in the database.

Wetland Watershed Survey and Map Assessment

A watershed is defined as the entire land area drained by a certain stream or river. Hills and mountains determine the direction of water flow; a drop of rain falling on one side of a hill may end up in a stream, river, or groundwater system that creates a wetland. If the rain drop falls on the other side of the hill, it will follow a path to a different waterway. Land activities that alter hydrology in a watershed can affect a wetland, e.g. dredging and filling in or near a wetland, road building, draining for agriculture, etc. Waterways drain water from land in the surrounding area, so every land activity can have an impact on the waters that feed a wetland.

To conduct a *Watershed Survey and Map Assessment*, download a copy of the *Getting to Know Your Watershed* manual from the AAS website.

Types of Wetlands

Wetland Systems

Determine if the wetland is an open or closed system. An open system wetland is one where the exchange of water, sediment, nutrients, pollution, organisms, and energy with surrounding areas is easy. Most Georgia wetlands are open systems like coastal marshes and river / stream corridors. Open wetlands are more likely to be affected by land use in the watershed.

Closed system wetlands are ones with less exchange processes occurring with their surrounding areas. They generally receive water from precipitation or groundwater, so exchanges are limited. However, contamination of groundwater or changes in groundwater

levels from land disruption can impact the wetland hydrology by drying it up or flooding it. Neither type of system is immune to filling or dredging, so it's important to note activities around the wetland that may contribute to sedimentation or drainage.

Wetland Classification

After conducting the Watershed Survey and Map Assessment, use the chart below to classify a wetland. If a wetland is not associated with a body of water (oceans, rivers, streams, or lakes), it is considered a palustrine wetland.

Wetlands are found on nearly every continent with a variety of characteristics and many aliases (bogs, swamps, fens, pocosins, etc.). They may be shallow, slow-moving water systems, deep riverine systems, or areas that remain dry except for a short time during the growing season. Open wetland systems have significant energy and material flow into and out of them. Substances like sediment, nutrients, pollution, and organisms (dead or alive) make up the material flow. Energy flows refer to sunlight, food energy, and moving water. Most Georgia wetlands are open systems that exchange materials with the surrounding environments. Examples of open systems in Georgia include coastal salt marshes and river or stream corridors.

Closed systems have little or no exchange of materials with the surrounding land. Precipitation is the main source of water, and evaporation is the main loss of water. Nutrients are generally found in the plants and animals within the wetland. Closed systems in Georgia include cypress ponds, granite outcrops, and Caolina bays.

Georgias four major wetland groups are coastal marshes, bog swamps, riverine, and isolated wetlands. The largest and most complex of these is the coastal marsh. Coastal marshes are divided into three functional classes: salt, brackish, and freshwater marshes. The dominant vegetation differs in each class, with *Spartina alterniflora* (saltmarsh cordgrass) dominating salt marshes, *Juncus roemarianus* (needle rush) in brackish wetlands, and a wide diversity of vegetation in freshwater marshes.

The second-largest wetland type found in Georgia is the bog swamp. The most famous bog swamp in Georgia is the Okefenokee swamp, found in the southeastern part of the state. It is approximately 427,000 acres in size and receives about 85% of its water from precipitation.

Riverine or riparian wetlands are usually associated with floodplains or bottomlands adjacent to rivers. Rivers spilling out of their banks during rain events deposit sediment, nutrients, and organic materials in these floodplains. As a result, the soil is nutrient rich and agriculturally desirable. The draining of wetlands for agriculture accounts for the greatest loss of riverine wetlands. Red rivers in the mountains and piedmont region are the most productive riparian wetlands in Georgia. In the coastal plain, the riverine wetland type changes to black rivers, characterized by dark waters from tannic and humic acid inputs.

Wetland Classification			
Major Categories	**Associated Waters**	**General Location**	**Wetland Types**
Marine	Undiluted salt water	***Coastal Wetland*** Open Coast	Shrub wetland, salt marsh, mangrove swamp
Estuarine	Salt / freshwater mix	***Coastal Wetland*** Estuaries (deltas, lagoons)	Brackish marsh, shrub wetland, salt marsh, mangrove swamp
Riverine	Rivers and streams	***Inland Wetland*** River channels and flood plains	Bottomlands, freshwater marsh, delta marsh
Lacustrine	Lakes	***Inland Wetland*** Lakes and deltas	Freshwater marshes, shrub, and forest wetlands
Palustrine	Shallow ponds and freshwater wetlands	***Inland Wetlands*** Ponds, peatlands, uplands, groundwater seeps	Ephemeral ponds, tundra peatland, groundwater spring oasis, bogs

Table 1 Classification system developed by Cowardin (1979) and used by U.S. Fish and Wildlife Service

Wetland Functions and Values

All types of wetlands have functions and values beneficial to human society or are of intrinsic importance.

Wetland functions are processes that occur in a wetland system irrespective of human activity. Depending on the type of wetland, functions may include floodwater storage,

erosion control, water purification, sediment trapping, chemical and organic waste processing, nutrient removal, groundwater discharge and recharge, and habitat availability. These characteristics will continue occurring regardless of anthropogenic intervention.

Wetland values are ecosystem processes with a perceived positive impact on human life. Values may change over time as the perception of human society develops. Wetland values and resources for humans may include food, fuel, timber, fiber, recreation, aesthetics, and education. Wetland functions can and should be valued by society, but that is not always the case.

Use the chart below to determine the function and values of a wetland. Research local history and wetland uses to complete the chart. Local County Soil Surveys can be used to identify land use activities and soil types. Local Extension Service Agents or USDA – Natural Resources Conservation Service office can provide maps and County Soil Surveys of a wetland. Consider how the community regards the wetland and remember that not all functions are values and not all values are functions.

Rank each characteristic from 1 – 5 (with 5 being the most important) to understand which functions and values are considered most important. Download a copy of the chart below from the AAS website and rank the functions and values of a wetland once per year. Values may change due to community perceptions and functions may differ as land use within the watershed is altered.

Wetland Functions and Values

Wetland Characteristic	Wetland Function	Community Value
Recreational Values ○ Hunting permitted? ○ Fishing for food or sport? ○ Nature trails or wildlife observation points?		
Fish, Wildlife, and Plant Habitat ○ Pathway for migratory birds? ○ Bird nesting in wetland? ○ Habitat for mammals, birds, fish, amphibians, and reptiles?		

Intrinsic ○ The only "natural" or green area in the community? ○ Site for scientific research? ○ Habitat for endangered or threatened species?		
Economics ○ Timber, fish, or shellfish production? ○ Tourist attraction? ○ Timber or vegetation harvests?		
Educational ○ Nature preserve or county park? ○ Nature center or interpretive trail which is easily accessible? ○ Historical artifacts in or around wetland?		
Flood Storage ○ Located at the headwaters of the watershed? ○ Downstream in watershed? ○ Is it a riverine wetland? ○ Is it large enough to store and diminish flood waters?		
Groundwater Recharge and Discharge ○ Recharge for community drinking water supply? ○ Does the community heavily rely on groundwater for water supply?		
Erosion Control: Channel and Shoreline ○ Does a prominent river or stream run through the community? ○ Wetland associated with rivers, coast, or lake?		
Water Purification: Surface and Groundwater ○ Filter runoff water and release clean water? ○ Trap polluted runoff or excess nutrients?		

VISUAL SURVEY FOR WETLANDS

Soil, Vegetation, and Hydrology

Vegetation, soil, and hydrology of wetlands characterize the transition from aquatic to upland habitats. Noting these factors can help delineate or define the border of a wetland. Use the visual data sheets to understand the current and changing conditions of a wetland. Completed data sheets help to assess the general characteristics of a wetland. The *Visual Survey* notes dominant vegetation cover, soil color and texture, and water depth and conditions. Note the wildlife sightings or signs of wildlife present.

To best understand an unfamiliar wetland, AAS recommends surveying it once a month. Monthly changes in habitat and hydrology may be drastic or barely noticeable. Once fully acquainted with a wetland, *Visual Survey* may be conducted quarterly (once every 3 months or once per season).

To ensure information is gathered consistently, create a transect along which vegetation, soil, and hydrological data will be collected. A transect always runs from an upland point to the water source (if it is associated with a body of water) or to an area of the wetland that contains all the wetland indicators (if it is palustrine). The length of the transect and the number of stations along it will vary depending on the monitoring group and time available to complete the survey. The transect should contain at least one upland station, one wetland station, and one transitional station. If the wetland is large or contains a variety of conditions that cannot be assessed along one transect, run several parallel transects to collect more information.

Wetland Delineation Transects

A wetland delineation transect is a linear sampling path used to map the exact boundary between a wetland and an upland area by measuring changes in vegetation, soil, and hydrology. Follow the steps below to set up a wetland delineation transect.

1. Place a stake on the upland side of a wetland for a starting point. Stakes may be metal, treated wood, or PVC pipe.
2. Use twine or measuring tape to run a straight line from the upland into the wetland. Use a compass to get a heading of the transect (example: north 20 degrees). Ensure that zones or sites representative of the wetland are included. Stop the transect at running or deep water, or once it reaches well into the wetland.
3. Measure the length of the transect.
4. Set up survey stations by dividing the transect length by the desired number of

stations *minus one* (don't forget the starting point!). The resulting quotient will be the length between stations.

Transect Stations Example

- Transect length is 60 feet
- Number of stations desired is 3
- 60 ft ÷ 2 = 30 ft
- A survey station will be placed every 30 feet along the transect
- Name the stations (1, 2, 3, etc.). This transect has three stations: staring point, ending point, and halfway in between.

At each station, measure an area of 5 ft radius using the point on the transect as the center. Take the soil, vegetation, and hydrology data from within this 5ft radius for each survey station. Use the information below for directions when filling out the data forms. Example data forms can be found within this manual following the blank data forms.

Vegetation Survey

Plants that have adapted to living in wetland soil are called hydrophytes or water-loving vegetation. Characteristics have developed over time to aid with moving oxygen throughout the plant parts that are underwater or within soil with little or no oxygen. Oxygen is needed for metabolic processes within plants. Examples of adaptions include aerenchyma tissue, water roots, and the ability to pump oxygen to the roots forming a rhizosphere. Aerenchyma tissue has air or pore spaces in plant roots and stems. This allows the diffusion of oxygen from aerial potions to the roots. Some hydrophytes may produce water roots, or roots formed above the soil line, growing in the water. These roots have greater contact with dissolved oxygen in the water column that roots in the soil. Root growth is facilitated by having an oxidized area around the tip called the rhizosphere.

Consider three general plant layers for the vegetation survey tally: trees, shrubs, and the herbaceous layer. Trees are woody perennials which usually have a main stem or trunk, while shrubs are woody perennials with several stems branching from the base. The herbaceous layer consists of all other vegetation including vines, grass, and soft-stemmed plants.

View these three layers within the radius created at each survey station. Identify the three most abundant species in each layer and estimate the percent dominance of each. Record the names of these plants and the % dominance on the data form.

Vegetation can also be classified by the frequency plant species within a wetland. These are obligate wetlands, facultative wetlands, facultative, or obligate upland.

Obligate Wetland – found in wetlands 99% of the time
- Ex: *Taxodium distichum* (baldcypress)

Facultative Wetland – occurs in wetlands 67% - 99% of the time
- Ex: *Fraxinus pennsylvanica* (green ah)

Facultative – equally likely to be found in wetland and non-wetland
- Ex: *Pinus palustris* (longleaf pine)

Obligate Upland – Found 99% of the time in upland
- Ex: *Quercus alba* (white oak)

Some plants only found in the uplands of one region may be found in wetlands in other regions of the country.

Use the list of Georgia plants and their wetland indicator status below. Common names may vary. For a complete list of wetland plants and their wetland indicators, use the National Wetland Plant List from the U.D. Fish & Wildlife Service.

Characteristic Plants for Salt Marshes

Common Name	Scientific Name	Wetland Indicator
Saltmarsh cordgrass	*Spartina alterniflora*	OBL
Saltmeadow cordgrass	*Spartina patens*	FACW
Blackgrass	*Juncus gerardii*	FACW +
Virginia glasswort	*Salicornia virginica*	OBL

Characteristic Plants for Freshwater Marshes

Common Name	Scientific Name	Wetland Indicator
Soft-stem bulrush	*Scirpus Validus*	OBL
Cattail	*Typha spp.*	OBL
Arrow-head	*Sagittaroria spp.*	OBL

Buttonbush	*Cephalanthus occidentalis*	OBL

Characteristic Plants for Wet Meadows		
Common Name	**Scientific Name**	**Wetland Indicator**
Wool grass	*Scirpus cyperinus*	OBL
Jewelweed / Touch-me-not	*Impatiens capensis*	FACW
Soft rush	*Juncus effusus*	FACW +
Sensitive fern	*Onoclea sensibilis*	FACW+

Characteristic Plants for Forested Wetlands		
Common Name	**Scientific Name**	**Wetland Indicator**
Red maple	*Acer rubrum*	FAC
Black willow	*Salix nigra*	OBL
Green ash	*Fraxinus pennsylvanica*	FACW
Spice bush	*Lindera benzoin*	FACW
Swamp azalea	*Rhododendron viscosum*	FACW+

Chinese privet[1]	*Ligustrum sinense*	FAC
Cinnamon fern	*Osmunda cinnamomea*	FACW+
Royal fern	*Osmunda regalis*	OBL

Characteristic Plants for Shrub Swamps

Common Name	Scientific Name	Wetland Indicator
Buttonbush	*Cephalanthus occidentalis*	OBL
Pepperbush	*Clethra alnifolia*	FACW
Common alder	*Alnus serrulate*	FACW+
Skunk cabbage	*Sumplocarpus foetidus*	OBL
Marsh fern	*Thelypteris thelypteroides*	FACW+

Characteristic Plants for Bogs and Fens

Common Name	Scientific Name	Wetland Indicator
Sphagnum moss	*Spagnum spp.*	OBL
Pitcher Plant	*Sarracenia spp.*	OBL

[1] Exotic or invasive plants which may be found in wetlands

Slash Pine	*Pinus elliottii*	FACW
Toothache grass	*Ctenium aromaticum*	FACQ

Wetland Plant Imagery

There are several excellent wetland plant identifications guides available at local bookstores or online. Here are a few photos from *A World in Our Backyard* to get acquainted.



Figure 5: Burreeds

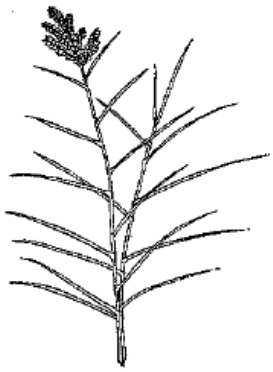


Figure 6: Spike grass



Figure 1: Alder



Figure 4: Woolgrass



Figure 3: Arrowhead



Figure 2: Buttonbush

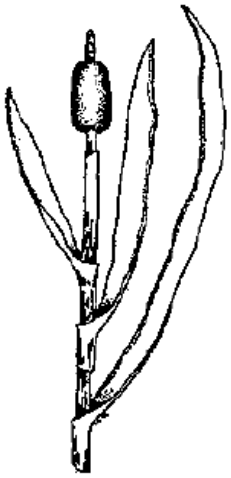


Figure 9: Broad-leaved cattail



Figure 8: Red Maple



Figure 7: Smooth cordgrass



Figure 12: Jewelweed

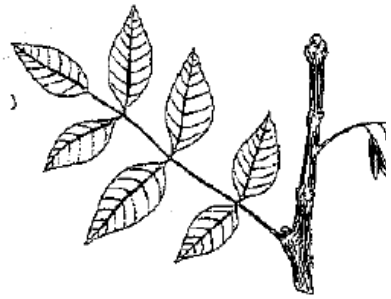


Figure 10: Green ash



Figure 11: Spice bush

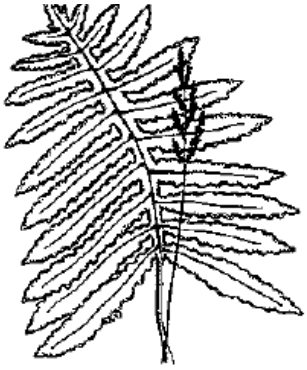


Figure 13: Sensitive Fern

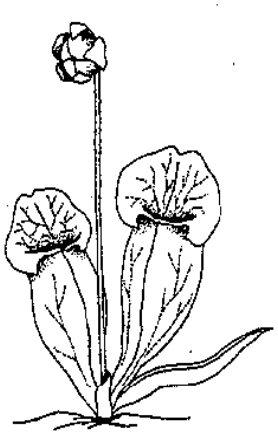


Figure 15: Pitcher plant

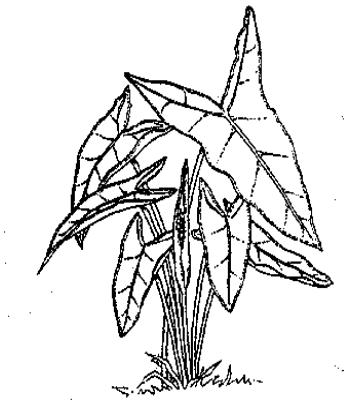


Figure 14: Arrow arum



Figure 16: Leatherleaf

Soil Survey

Wetland Soils

Soils have a distinctive look when they are regularly flooded with water, even for only a short period. Hydric soils are soils characterized by and show the effects of water present. One characteristic is the color of the soil. Even if soil is not wet at the time of sampling, if it has been flooded long enough for the oxygen to be used by microbes and wetland plants (anaerobic soil), the color will have changed. To recognize the difference between upland and hydric soils, take samples at upland, wetland, and transitional stations. Use the instructions below to obtain a soil sample.

- Dig a hole about 18 inches deep using a sharp shooter or small shovel.
- Make a smooth, clean surface along the inside of the hole to note the soil changes from the surface to the bottom.
- Use the soil chart provided below to identify soil colors
- Use the texture to determine if soil is sticky and smooth like clay, gritty like sand, or somewhere in between. Some wetland soils ribbon or stick together and may ooze between finger when squeezed in a ribbonlike strand.
- Does the soil smell like rotten eggs? Sulfur gas and methane are sometimes formed in anaerobic atmospheres and emit this distinctive smell. Also note the degree of wetness.
- Does water drip from the soil when it is squeezed? Is there water standing in the hole? Is the soil organic or mineral?

Note this information on the data sheets provided.

If there is standing water on the soil, gently bring the spade to the surface with the soil sample resting on the blade to observe.

Wetland Soil Classification		
Major Wetland Soil Types	**Description**	**Characteristics**
Organic Soil	Soils contain more than 10% of partially decomposed plants within at least 1.5 feet of the ground's surface	Black muck or black to dark brown peat
Mineral Soil	Soils that contain little or no organic material	**Gleyed** – neutral gray, greenish, or bluish gray **Mottled** – soil has splotches of brown, orange, red, or yellow

Wetland Soil Color Chart

Hydric soil may appear dark brown or black if there is a buildup of organic matter. Often they have a grayish background and mottled (speckled) with red, orange, and yellow from iron in the soil OR black from manganese in the soil. The color of the soil and its location help to identify the boundaries of a wetland.

Use the chart below to determine the soil present. Notice the letters and numbers indicated in the parentheses beneath each color name. This information relates to the color information in the Munsell Color Chart, which professionals use to identify hydric soils. Dominant hues for soil are red, yellow – red and yellow (R, YR, Y). The first number before the "/" refers to the degree of darkness of the soil color, ranging from 0 (black) to 10 (white). The second number refers to the strength of the color, beginning with 0 (neutral gray) and increasing to 8.

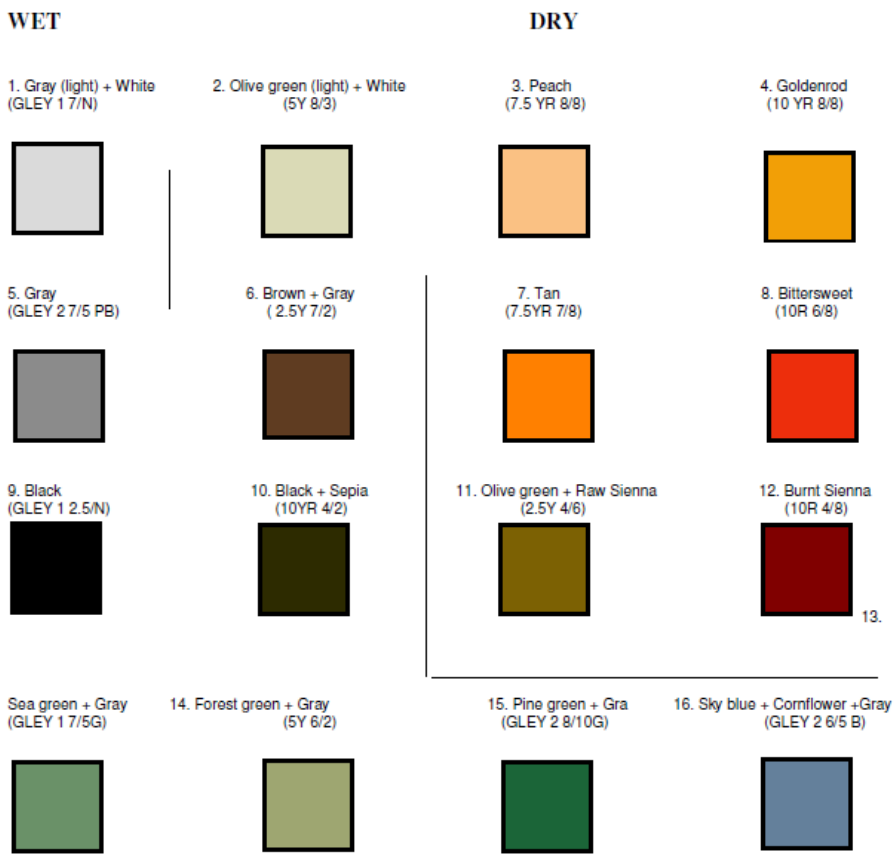


Table 2: With permission, from Wonders of Wetlands

Considering the Hydrology

Hydrology is the study of the behavior of water in the atmosphere, on the earth's surface, and underground. The hydroperiod in a wetland is the seasonal and cyclical pattern of water in a wetland. It also helps designate into which wetlands classification an area will be placed (lacustrine, palustrine, etc.). Landscape position and hydrology determine water depth, flow patterns, and the duration / frequency of flooding or saturation in a wetland. Topography, proximity to other water bodies, and depth to the water table are all factors that influence wetland hydrology.

The frequency, depth, and duration of flooding in a wetland are defining factors in the area's characteristics of vegetation, soils, and wildlife. A wetland with deep, slow-moving,

or stagnant waters will have markedly different vegetation and habitat from a wetland with shallow, fast-moving water.

Water can enter a wetland in several ways, including the following:

- Direct precipitation
- Surface water runoff
  - From brooks, streams, and rivers
- Springs or seeps
  - Places where the water table intersects with the land surface
- Flood water
  - From upstream and adjacent surface water bodies
- Tidal flow and storm surges
  - In coastal areas
- Underground water sources like groundwater or springs
  - In low-lying areas, groundwater may lie just below the soil surface (high water table), keeping soil saturated from below

Complete the hydrology survey form by measuring the depth of the water at each station. If water is not present, note the hydrologic indicators. DO NOT WADE INTO DEEP OR FAST-MOVING WATER. If a transect survey station is at the edge of deep water, take depth measurement there.

When is water present at the site (all four seasons or just in spring)? How long is the water present? What is the likely source? These questions help in understanding the ecology of a wetland.

Drawing Conclusions

Since wetlands are so diverse in appearance and quality, draw conclusion about a wetland's overall health based on its wetland classification type. For example, saltwater intrusion in an estuarine wetland may not be considered poot quality, as this is typical for some marshes at high tide. On the other hand, saltwater intrusion into a freshwater marsh following a storm event may change the wetland's original quality, as vegetation which is not adapted to brackish water dies. If this change results in a severe loss of habitat or erosion, it may be considered lower in quality. However, not all changes are negative. Some are natural and expected fluctuations in wetland characteristics. Most decreases in wetland quality will be the result of manmade disturbances such as road building, dredging, or filling.

Using information from this manual and resources listed in the Appendix, continue to learn about a wetland.

After a Wetland Survey

Send Results

As data is collected, make copies to give to local partners, Regional Training Centers, local governments, and Georgia Adopt-A-Stream. Enter the data collected into the Adopt-A-Stream database. Many people will be interested in the education and information collected about the wetland. Be sure to upload the survey data each quarter to the Adopt-A-Stream database.

Litter Collection

Although wetlands are not easily accessible to people who aren't trying to get there, trash and debris from nearby communities can litter the area. Removing this litter is an easy way to instantly make a difference in the wetland quality and aesthetics.

Note the amount of litter present and, if needed, bring trash bags for the next quarterly visual survey. Be sure to register the site with Rivers Alive to conduct an official cleanup event. Resources, manuals, and information on waterway cleanups are available on the Rivers Alive website.

Public Outreach

Promote the wetland to the local community to educate them on how to protect and preserve its resources. Conduct at least one presentation during the project. Contact local reporters and incite them to join during a visual survey or upload a video to social media. Write articles for school newspapers or newsletters and keep a scrapbook of activities to show off at environmental fairs. Many groups from canoe clubs to civic organizations have newsletters and are interested in water stewardship. Keep track of each presentation or article to send to staff at Adopt-A-Stream to be featured in our quarterly newsletter.

WETLAND SURVEY DATA FORMS

Wetland Monitoring Data Form

Use this form to record important information about vegetation, soils, and hydrology in the chosen wetland. Keep accurate and consistent records of visual observations to document current conditions and changes in wetland characteristics.

Wetland Name _____ **Group Name** _____

AAS-S- _____ **Site Number** _____ **Members Present**

Date _____ **County** _____

Weather Conditions:

☐ Clear ☐ Cloudy ☐ Rain ☐ Rain within last 24 to 48 hours?

Visual Survey

Water Source:

☐ Precipitation ☐ Groundwater ☐ Stream, River, or Lake ☐ Coastal

Other _____

Name of associated river/stream/lake _____

Name General Wetland Classification _____

Type of system ☐ Open System ☐ Closed System

Surface Water Appearance:

☐ Clear	☐ Milky / Gray	☐ None	☐ Rotten Eggs
☐ Muddy	☐ Green	☐ Natural	☐ Sewage
☐ Oily	☐ Brown	☐ Gasoline or Oil	☐ Chemical
☐ Foamy	☐ Black	☐ Chlorine	☐ Other_____
☐ Scum	☐ Other: _____		

Odor:

Wetland Buffer: (within 25 ft. from wetland)	**Excellent**	**Good**	**Fair**	**Poor**
Natural Vegetative Cover	☐	☐	☐	☐
Bank Stable - no erosion	☐	☐	☐	☐
Undisturbed land	☐	☐	☐	☐

Impacts to Wetland:

☐	Artificial Water Control (dam, dyke, etc.	☐	Dumping of sand, dirt, gravel
☐	Eroded Banks	☐	Trash
☐	Dredging	☐	Clearing of Vegetation
☐	Algal Blooms (indicates nutrients)	☐	Other:

Transect Locations

Location of transect upland point _____

Length of transect _____ ft.

Compass bearing along transect _____(degrees)

Number of stations along transect _____

Location of transect wetland point _____

Vegetation Survey

At each sampling station, look at the area within a 5 foot radius from the point along the transect. Identify the 3 dominant species in each layer. Record the species name (cypress, red maple, lizard tail, cattail, etc.) and wetland indicator status (obligate, FacWet, Fac, Upland) if known.

Vegetation Survey			
Station Number	Dominant Species Layer		
	Tree	Shrub	Herbaceous Layer
Station 1			
Station 2			
Station 3			
Station 4			
Station 5			
Station 6			

How many plant communities (obvious changes in vegetation) are along the transect?

Soil Survey

To collect a soil sample, use a spade or small shovel to dig an 18 inch-deep hole at each transect station. Using the soil color chart, determine the representative color of the soil at each transect (including upland areas). Fill in observations in the following table:

Soil Survey				
Station Number	**Soil Characteristic**			
	Color (from Color Chart)	**Smell**	**Degree of Wetness** (wet, damp, dry)	**Texture** (clay, sandy, sticky)
Station 1				
Station 2				
Station 3				
Station 4				
Station 5				
Station 6				

Observations of wetland soil:

Are there any defined layers to the wetland soil? If so, describe.

Is there mottling (concentrated areas of red or yellow soil)?

How deep do the plant roots go? _____ (Inches)

Is there standing water in the hole? _____ How many inches to the surface? _____

What organisms are living in the soil?

Hydrology Survey

Answer the following questions. Depending on the time of year, precipitation amounts, and other factors, a wetland may appear dry.

Hydrology Survey				
Station Number	**Hydrology Characteristics**			
	Depth of Surface Water	**If there is no surface water, is water filling the hole?**	**Surface Water Movement** (slow, fast, none)	**If there is no water, name hydrology indicators** (water marks, drift lines, sediment deposits, water stained leaves, drainage patterns)
Station 1				
Station 2				
Station 3				
Station 4				
Station 5				
Station 6				

Wetland Monitoring Sample Forms

Wetland Monitoring

Use this form to record important information about vegetation, soils and hydrology in your wetland. By keeping accurate and consistent records of your visual observations, you can document current conditions and changes in wetland characteristics.

Clayton County Wetland — **Wetland Name:**

Clayton Critter Watch AAS-G-100 — **Group Name:**

AAS-S-222 — **Site Number:**

Harold Harbert and Kim Morris-Zarneke — **Members Present:**

6/26/01 — **Date:**

Clayton — **County:**

Weather Conditions:

[x] Clear [ ] Cloudy [ ] Rain [ ] Rain within last 24 to 48 hours?

Visual Survey

Water Source: [x] Precipitation [ ] Groundwater [x] Stream/river /lake [ ] Coastal Other _____

Name of associated river/stream/lake: Pate's Creek

Name General Wetland Classification:	Riverine	Circle type of system	Open System	Close System

Surface Water Appearance:

[ ] clear	[ ] milky / gray	[x] none	[ ] rotten eggs
[ ] muddy	[ ] green	[x] natural	[ ] sewage
[ ] oily	[x] brown	[ ] gasoline or oil	[ ] chemical
[ ] foamy	[ ] black	[ ] chlorine	[ ] other: _____
[ ] scum	[ ] other: _____		

Odor:

Wetland Buffer: (within 25 ft. from wetland)	**Excellent**	**Good**	**Fair**	**Poor**
Natural Vegetative Cover	[x]	[ ]	[ ]	[ ]
Bank Stable- no erosion	[x]	[ ]	[ ]	[ ]
Undisturbed land	[ ]	[x]	[ ]	[ ]

Impacts To Wetland:

[x] Artificial water control	(dam, dyke, etc.)	[ ] Dumping of sand, dirt, gravel	
[ ] Eroded banks		[ ] Trash	
[ ] Dredging		[ ] Clearing of vegetation	
[ ] Algal blooms	(indicates nutrients)	[ ] Other:	

Transect Locations

Location of transect upland point Hill Behind Turtle Cove, Tied to Small Tulip Poplar

Length of transect 82 ft.

Compass bearing along transect 130 (degrees)

Numbers of stations along transect 3

Location of transect wetland point At cane and rush transition, to the right of the red maple

Vegetation Survey

At each sampling station, look at the area within a 5 foot radius from the point along your transect. Identify the 3 dominant species in each layer. Record species name (cypress, red maple, lizard tail, cattail, etc.) and wetland indicator (obligate, FacWet, Fac, Upland) if known.

Layers	Station 1	Station 2	Station 3
Tree	Tulip Poplar (FacW) White Oak (FacU) Loblolly Pine (Fac)	Tulip Poplar (FacW) Basswood (FacU)	Red Maple (Fac)
Shrub	none	Chinese Privet (Fac) Sweet Gum (Fac+) River Cane (FacW)	Blackberry (Fac)
Herbaceous Layer	Chickweed (FacU) Virginia Creeper (Fac) Dog Grass (unknown)	Dog Grass (unknown)	Dog Grass Soft Rush (FacW+) Sedge (FacW) Honey Suckle (Fac)

How many plant communities (obvious changes in vegetation) do you see along your transect? Three

Soil Survey

To collect your soil sample, use a spade or small shovel to dig an 18-inch hole at each transect station. Using the soil color chart, determine the representative color of the soil at each transect (including upland areas). Fill in your observations in the following table:

	Station 1	Station 2	Station 3
Color (from Color Chart)	Burnt Sienna	Burnt Sienna	Black / Sepia mixed with Burnt Sienna
Smell	none	none	sulphur
Degree of wetness (wet, damp, dry)	damp	damp	Squishy wet
Texture (clay, sandy, sticky)	clay	clay	Clay, ribbons when squeezed

Soil Survey

To collect your soil sample, use a spade or small shovel to dig an 18-inch hole at each transect station. Using the soil color chart, determine the representative color of the soil at each transect (including upland areas). Fill in your observations in the following table:

	Station 1	Station 2	Station 3
Color (from Color Chart)	Burnt Sienna	Burnt Sienna	Black / Sepia mixed with Burnt Sienna
Smell	none	none	sulphur
Degree of wetness (wet, damp, dry)	damp	damp	Squishy wet
Texture (clay, sandy, sticky)	clay	clay	Clay, ribbons when squeezed

APPENDIX

Wetland Resources

Army Corps of Engineers, Wetland Information

Corps of Engineers Wetlands Delineation Manual

DNR Coastal Resources Division

Georgia Environmental Protection Division

National Service Center for Environmental Publications – Landowners Guide to Wetlands and Watersheds

National Water Summary – Wetland Resources

National Wetland Plant List

Natural Resources Conservation Service - Wetlands

NRCS – A Guide for Identifying and Delineating Hydric Soils

The Jones Center at Ichauway

U.S. EPA Wetland Hotline: 1 (800) 832 – 7828

U.S. EPA Wetlands Protection and Restoration

U.S. Fish & Wildlife Service National Wetlands Inventory

U.S. Fish & Wildlife Service Wetlands Mapper

UGA Cooperative Extension Service

USDA NRCS Soil Surveys by State

USDA Web Soil Survey

Educator Resources and Programs

A Day in a Forested Wetland

Created for K-6 students, this picture book takes readers through a forested wetland habitat. This book provides readers with a rhythmic, scientifically-sound look into a typical day for organisms living in a swamp habitat.

An Introduction to Wetland Classification

Developed by the U.S. Fish & Wildlife Service, this interactive StoryMap covers wetland classification using the Cowardin Classification System. This map teaches about how wetlands are mapped and classified within the United States.

A World in Our Backyard, A Wetlands Education & Stewardship Program

Developed by the New England Interstate Water Pollution Commission with funding provided by the U.S. EPA – Region 1. This resource material is focused mainly on wetlands in New England for educators. It suggests ways of studying wetland characteristics, why wetlands are important, and how students and teachers can help to protect a local wetland resource. This guide encourages students to become familiar with a local wetland and advocate its protection through stewardship activities.

Wetlands Activity Guide

Developed by the National Environmental Education Foundation, the Wetlands Activity Guide provides information and projects to teach about wetlands. It includes hands on activities for students to discover wetlands and their functions.

Wetlands Education for Students and Teachers

A U.S. EPA webpage that provides activities, teaching guides and materials, education programs, videos, and additional resources surrounding wetlands for students of all ages.

WETMAP: Wetland Education Through Maps and Aerial Photography

An introduction for educators and students to wetland habitats' functions and values, wetland mapping, digital databases, and GIS technology. This program assists educators with integrating wetland issues into their existing curricula, promotes public awareness of wetland loss issues, and provides an understanding of the causes and effects of wetland changes.

WOW! The Wonders of Wetlands, An Educator's Guide

Produces by Environmental Concern, Inc. and The Watercourse, this book is a resource book with background material for teachers and wetland related activities for grades K-12. Each activity includes curriculum planning information. The activities are hands-on and are a good model for learning wetland ecology, values, and functions.

GLOSSARY

Aerenchyma tissue – special tissue with pore spaces a plant has in its roots and stems to allow for the diffusion of oxygen.

Algae – simple plants which do not grow true roots, stems, or leaves and which live mainly in water, providing a base for the food chain.

Algal bloom – a heavy growth of algae in and on a body of water as a result of high nitrate and phosphate concentrations from farm fertilizers and detergents.

Alkalinity – a measure of the negative ions available to react and neutralize free hydrogen ions. Some of most common of these include hydroxide (OH), sulfate (SO_4), phosphate (PO_4), bicarbonate (HCO_3) and carbonate (CO_3)

Anaerobic – living, active or occurring in the absence of oxygen.

Assemblage – the set of related organisms that represent a portion of a biological community (e.g., benthic macroinvertebrates).

Benthic – pertaining to the bottom (bed) of a water body.

Bog – a wetland characterized by waterlogged soils and dominated by spongy mosses.

Brackish water – water that contains a mix of fresh and salt water.

Carolina Bay – wetlands found on the east cost of the US fed by rainwater and ground water.

Closed system wetland - is a wetland where there is little exchange of water, sediment, nutrients, pollution, organisms and energy with surrounding systems.

Community – a group of plants and animals inhabiting a given area.

Cypress swamp – a wetland environment common throughout the SE US in which cypress trees are a dominant species.

Delineate – to decide where something begins and ends.

Designated uses – state-established desirable uses that waters should support, such as fishing, swimming, and aquatic life. Listed in state water quality standards.

Dissolved oxygen (DO) – oxygen dissolved in water and available for living organisms to use for respiration.

Downstream – the direction the water is flowing

Dredge – to remove sediments from the streambed to deepen or widen the channel.

Ecoregion – geographic areas that are distinguished from others by ecological characteristics such as climate, soils, geology, and vegetation.

Effluent – an out-flowing branch of a main stream or lake; waste material (i.e. liquid industrial refuse, sewage) discharged into the environment.

Emergent plants – plants rooted underwater, but with their tops extending above the water.

Endangered species – a life form that faces extinction

Erosion – the wearing away of land by wind or water.

Erosion Control – is the preventing of the wearying away or loss of material.

Estuarine – an area associated with an estuary

Estuary – the lower course of a river where the current is met by the ocean tides.

Eutrophication – the natural and artificial addition of nutrients to a water body, which may lead to depleted oxygen concentrations. Eutrophication is a natural process that is frequently accelerated and intensified by human activities.

Fen – low, flat swampy land. Also called a bog or marsh.

Fish kill – the sudden death of fish due to the introduction of pollutants or the reduction of dissolved oxygen concentration in a water body.

Floating plants – plants that grow free-floating, rather than being attached to the streambed.

Floodplain – a low area of land surrounding streams or rivers that holds the overflow of water during a flood.

Flow – the direction of movement of a stream or river.

Groundwater – a supply of fresh water under the earth's surface that forms a natural reservoir.

Groundwater Discharge – the outflow of water from the groundwater source.

Groundwater Recharge – the addition of water to the groundwater supply by natural

filtration that tends to raise the water table.

Headwaters – the origins of a stream.

Herbaceous Layer – this layer consists of all vegetation except trees and shrubs. Examples of plants found in the herbaceous layer include vines, grasses, and soft-stemmed plants.

Hydric Soil – soil characterized by the presence of water.

Hydrology – the study of the behavior of water in the atmosphere, on the earth's surface and underground.

Hydrophytes – water loving vegetation

Hypoxia – depletion of dissolved oxygen in an aquatic system.

Impoundment – a body of water contained by a barrier, such as a dam.

Lacustrine – having to do with lakes.

Land uses – activities that take place on the land, such as construction, farming, or tree clearing.

Leaching – the process in which material in the soil (such as nutrients, pesticides, chemicals) are washed into lower layers of soil or are dissolved and carried away by water.

Macroinvertebrate – organisms that lack a backbone and can be seen with the naked eye.

Marsh – a wetland characterized by soft, wet, low-lying land marked by herbaceous vegetation.

Nonpoint source pollution – pollution that cannot be traced to a specific point, but rather from many individual places (e.g., urban and agricultural runoff).

Nutrient – substance that is necessary for growth of all living things (i.e. phosphorous, nitrogen and carbon).

Open system wetland – is a wetland where the exchange of water, sediment, nutrients, pollution, organisms and energy with surrounding systems occurs naturally/easily.

Organic Waste - wastes derived from living organisms.

Palustrine – having to do with small non-tidal wetlands dominated by trees, shrubs, persistent emergent or emergent mosses and lichens.

Permeable – porous; having openings through which liquid or gaseous substances can penetrate.

Pesticide – a chemical that kills insects and rodents. Pesticides can poison aquatic life when they reach surface waters through runoff.

pH – a numerical measure of the hydrogen ion concentration used to indicate the alkalinity or acidity of a substance. Measured on a scale of 1.0 (acidic) to 14.0 (basic); 7.0 is neutral.

Phosphorus – a nutrient that is essential for plants and animals.

Photosynthesis – the chemical reaction in plants that utilizes light energy from the sun to convert water and carbon dioxide into simple sugars. This reaction is facilitated by chlorophyll.

Point source pollution – a type of pollution that can be tracked down to a specific source such as a factory discharge pipe.

Pollutant – something that makes land, water or air dirty and unhealthful.

Reagent – a substance or chemical used to indicate the presence of a chemical or to induce a chemical reaction to determine the chemical characteristics of a solution.

Rhizosphere – a zone of increased microbial growth and activity that surrounds the roots of a plant.

Riparian – of or pertaining to the banks of a body of water.

Riparian Wetland – a wetland that typically occurs or grows along the banks of rivers and streams.

Riparian zone – the vegetated area on each bank of a body of water.

Riverine – associated with rivers, streams and their floodplains.

Runoff – water, including rain and snow, which is not absorbed into the ground but instead flows across the land and eventually runs into streams and rivers. Runoff can pick up pollutants from the air and land, carrying Them into the stream.

Salt Water Intrusion – the movement of salt water into a wetland that is predominately fresh water.

Saturated – inundated; filled to the point of capacity or beyond.

Sediment – soil, sand, and materials washed from land into waterways. Other pollutants may attach to sediment and be carried into the stream.

Sedimentation – when soil particles (sediment) settle to the bottom of a waterway.

Septic tank – a domestic wastewater treatment system into which wastes are piped directly from the home; bacteria decompose the organic waste, sludge settles to the bottom

of the tank, and the treated effluent flows out into the ground through drainage pipes.

Submergent plants – plants that live and grow fully submerged under the water.

Substrate – refers to a surface. This includes the material comprising the streambed or the surfaces to which plants or animals may attach or upon which they live.

Surface water – precipitation which does not soak into the ground or return to the atmosphere by evaporation or transpiration and is stored in streams, lakes, wetlands, and reservoirs.

Swamp – a saturated lowland or seasonally flooded bottomland characterized by trees and wood vegetation.

Taxon (plural taxa) – a level of classification within a scientific system that categorizes living organisms based on their physical characteristics.

Taxonomic key – a quick reference guide used to identify organisms. They are available in varying degrees of complexity and detail.

Threatened Species – a life form that is still abundant in the wild but is likely to become an endangered due to threats it faces in it wild.

Tolerance – the ability to withstand a particular condition, e.g., pollution tolerant indicates the ability to live in polluted waters.

Topography – surveying the physical features of a region often to create topographical maps that note elevation across a given landscape.

Toxic substances – poisonous matter (either chemical or natural) which causes sickness, disease and/or death to plants or animals.

Transect – marked line along which scientific sampling or surveying is done.

Tributaries – a body of water that drains into another, typically larger, body of water.

Turbidity – murkiness or cloudiness of water, indicating the presence of some suspended sediments, dissolved solids, natural or man-made chemicals, algae, etc.

Upstream – opposite direction of the water flow.

Water cycle – the cycle of the earth's water supply from the atmosphere to the earth and back which includes precipitation, transpiration, evaporation, runoff, infiltration, and storage in water bodies and groundwater.

Water Purification – filtering of water to trap pollution and excess nutrients

Water roots – roots that that are produced above the above the soil line that grown down into the water.

Water table – the upper level of groundwater.

Watershed – land area from which water drains to a particular water body.

Waterway – a natural or man-made route for water to run through (such as a river, stream, creek, or channel).

Wetland – an area of land that is regularly wet or flooded, such as a marsh or swamp.