U.S. Fish & Wildlife Service

Schoolyard Habitat Project Guide

Chapter 3

Wetland Habitat Project

Teacher Section

Step 1 Complete research

Step 2 Complete wetland site survey

Step 3 Complete wetland habitat survey, wildlife survey

Step 4 Determine growing conditions

Step 5 Determine number of plants

Step 6 Select plants

Step 7 Make a planting map

Step 8 Have plan reviewed

Step 9 Review planting day checklist

Step 10 Carry out management and maintenance

Introduction

Overview

Students will complete several steps that will lead to planting a wetland. All wetlands have three characteristics: water, saturated soil and plants adapted to wet conditions. Not all wetlands remain wet year-round. There are many different types of wetlands. They are usually classified by the amount and duration of water and by their plant community. Constructing a shallow marsh is the most popular type of school wetland project. Marshes are the wettest type of wetland and look like a large shallow puddle with plants, like cattails, growing out of the water. A school wetland can provide a fascinating outdoor laboratory for instruction across many disciplines.

How to begin

The starting point is different depending on the type of wetland project possible given the existing site conditions on the school grounds. The flow chart on page 50 gives examples of different existing school site conditions and should help you decide where you need to begin. *For any type of wetland project you should get advice from a wetland specialist before beginning.*

General types of wetland projects

Plant a wetland. Look for the following types of sites to plant a wetland:

• A pond. Possible project includes planting a marsh wetland in the shallow water area of the pond and planting an upland buffer next to the pond

• An area that is always wet and soggy. Possible area to plant a wet meadow, forested wetland or scrub/shrub wetland. A marsh can be built in these areas by digging out a shallow basin to hold more water.

• A stream that does not have an adjacent forested buffer. This is a good spot to plant a riparian or streamside wetland and plant an adjacent upland buffer.

Construct a wetland. Constructing a wetland will involve digging out a very shallow pond or building a small dam to trap water. The ideal site to construct a wetland has three characteristics:

1. A source of water:
   - A spring or seep
   - Rainwater from the school roof
   - Rainwater from the parking lot

- A spot that stays wet and muddy
- Ditches
- Stormdrains or grates
- Pipes carrying stormwater
- Stormwater management basins

2. Flat ground where a shallow pond can be dug out.

3. Clayey soil that will hold the water.

Estimated time for students to complete the project

Depending on the size and scope of the project, students will need eight to 16 hours to complete the steps that lead up to *planting the wetland*. At least one full day should be dedicated to the planting. It is best for students to begin planning in the fall or early winter and work toward a spring planting day. Allow six to 12 months to *plan and construct* a wetland. This can take longer depending on several factors.

Resource team role

To plan and construct a wetland, a team of teachers, community members and a wetland specialist should be assembled. The team should guide and advise students, and help with technical, administrative and logistical issues.

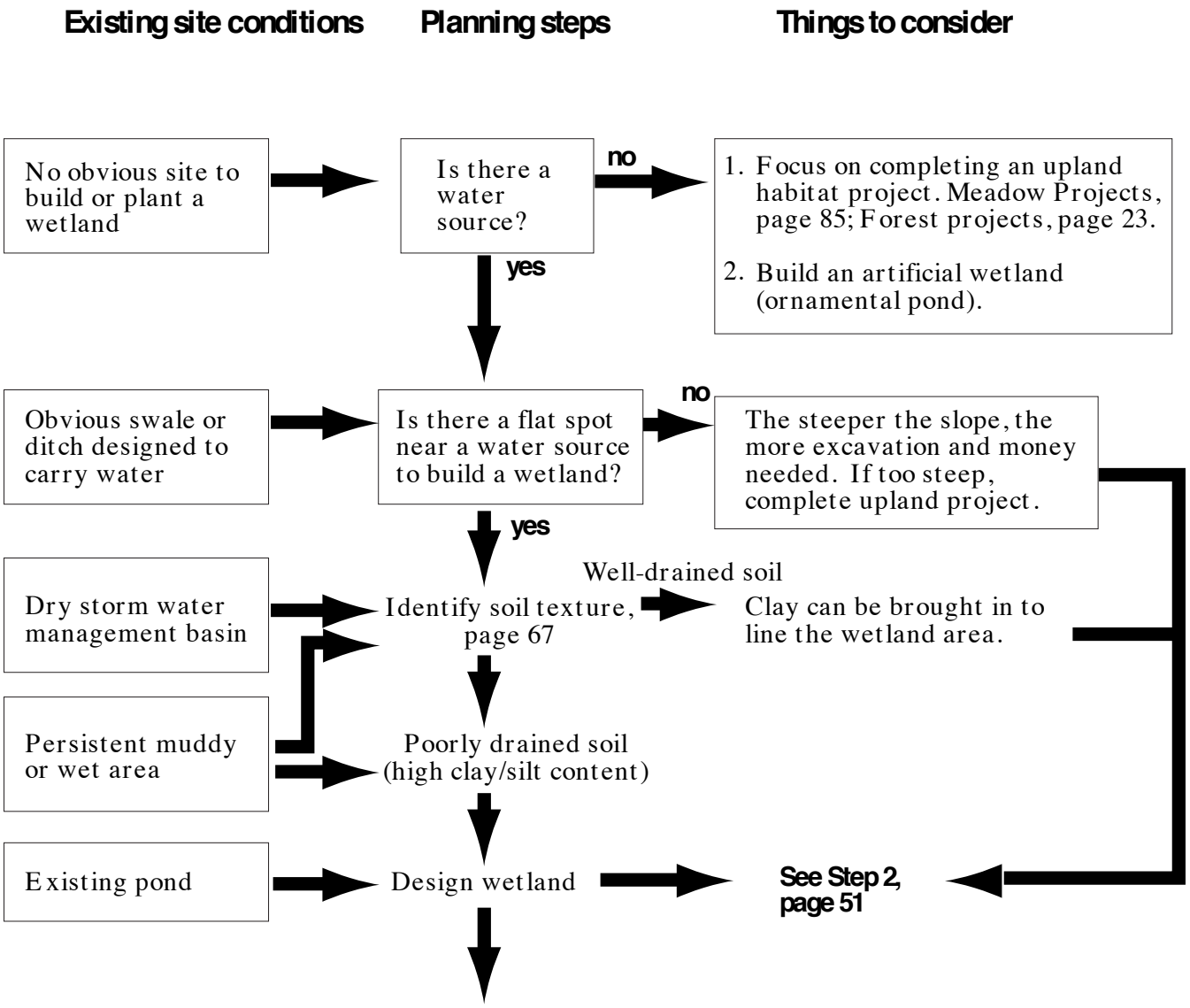
Sources of wetland expertise

- Natural Resource Conservation Service and Soil Conservation Districts: Federal and local employees who provide assistance to landowners. They have expertise in pond construction and expertise on soils.
- U.S. Fish and Wildlife Service: The federal agency that is involved with many wildlife and habitat issues. Most states have an office. They have expertise in wetland habitat design and construction.
- State natural resource agencies: Many state agencies have a wetland section.
- Wetland consulting firms. These businesses have expertise in wetland design and construction.
- Universities. Contact engineering or ecology professors
- Local public works departments
- Engineering firms

Additional project features

See pages 20-22 in the *Getting Started* section for additional project features.

Wetland Planning Chart



Students begin planning the wetland planting beginning with Step 4 on page 72.

Step 1
Complete background research

As the teachers and planning team are working on finding a site, obtaining administrative approval, and working on design and construction logistics, students can be researching and learning more about wetlands. There is a short introductory reading in the student section. Additional information about specific wetland types may be found in the back of the student section. If you have the time, it is very helpful for students to visit a nearby wetland to collect data and help them visualize what they will be planting or constructing.

Materials
copies of "What are Wetlands, Why Should We Care?" page 64

Step 2
Complete wetland site survey

Before students complete this task, ask a wetland expert to work with you and decide if and where you could plant or construct a wetland. If the specialist says it is not feasible, then there is no sense in having the students continue with the project. If it is feasible, then the students should complete this step. By completing this step, students will be involved from the very beginning and therefore will take ownership of the project.

After the students come up with their recommendations, explain that you have met with a wetland expert. Explain to them why the wetland expert picked a certain site for the project. Compare and contrast the expert's recommendations with the students' recommendations.

Caution. The most common mistake students make when looking for a site to construct or plant a wetland is to identify a natural stream or wetland. These natural areas are probably already good habitat. The main challenge is to find an area that is not a good habitat, such as a lawn or a pond without a wetland edge, and change these areas into better habitat. Students may be able to do minor habitat enhancements to natural wetlands. These would include putting up nesting boxes or building brush piles, trails and boardwalks.

Materials
shovels
water bottle (to moisten soil)
clipboards
copies of pages 65-68

Wetland design

Now you need to design the wetland. The design includes the size, shape, depth and slopes. Since each school site is unique and offers different opportunities and limitations, a wetland expert should be ultimately responsible for the design. Students can complete a concept design (sketch). Ask the wetland expert to design the biggest and best wetland, given the limitations of the site. Use the following information to provide guidance for working with an expert.

General information

The most important thing to communicate is that you want to build a wetland as opposed to a pond. Most wetlands are less than 2 feet deep. Pages 79-84 of the student resource section describes several different wetland types. A shallow marsh is the most common type of wetland that schools build. The diversity of plant and aquatic animal life found in marshes offers the greatest potential for instructional use. Some sites will allow more than one wetland type to be constructed in the same area.

Size

Building the largest wetland possible, given the limitations of the site, should be the goal. Too often schools build a small wetland in areas where a larger project is possible. A larger wetland will allow students more opportunities for investigation and discovery without standing on top of each other. A good size is 1,500 square feet or larger. However, space limitations will dictate the size of the project. Creating several smaller wetland pockets with upland between is a good option.

Shape

An irregular shape is best as it creates a more natural look with more nooks and crannies that provide good habitat. Irregularly shaped wetlands are more interesting for exploration. The bottom should be lumpy and uneven to create diversity. Hummocks, small islands that project out of the water, are an excellent feature to include. Different species of plants will spread and colonize different areas of the wetland based on small differences in water depth.

Depth

For shallow marshes, at least half of the wetland should have less than 6" of standing water depth. The saturated upland-wetland edge should be as wide as possible. A great diversity of wetland plants grow well in an area that remains saturated and only temporarily floods.

Slopes
For easy access and safety, the upland area leading down to the wetland and the bottom contour of the wetland should be very gradually sloped. A 5:1 slope or gentler is ideal.

Liners
If the soil in the proposed wetland area is well drained, 4" to 5" of clay soil can be used to line the site and create poorly drained soils. If clay is available, it is a much better to use clay than a rubber liner. Clay will not puncture or degrade like rubber, it is cheaper (if there is a nearby source), and it creates a much more natural wetland. If a rubber liner is the only option, 8" to 10" of soil should be placed on top of the liner. Wetland plants can then be planted directly into the soil. Soil is an integral part of any wetland system. Many aquatic invertebrates live in and on the soil substrate. Some amphibians and reptiles hibernate in the mud under wetlands.

Wetland construction
The person who designs the wetland or another specialist should be on hand to supervise construction. The construction supervisor will need to communicate very clearly with the equipment operator as many operators are more familiar with digging ponds than creating wetlands.

Conserving topsoil
Rototill or disc the footprint of the area being excavated for the wetland. Remove the top 4" to 6" of topsoil and set this aside. Complete the excavation, then spread the topsoil layer across the bottom of the wetland. Plants will grow much better in topsoil. Topsoil has important organic matter that provides the fuel for the small organisms at the base of the food chain. The reason for rototilling is that the sod would otherwise come up in large mats that will be nearly impossible to spread. The rototilling or discing can be done several days before the excavation.

Erosion control
Be sure to purchase silt fence and/or erosion control fabric before the construction day. The erosion control fabric should be used in spillways or swales where moving water could erode soil. Mats of sod can be scraped off the excavation site and used in place of erosion control fabric. Wetland vegetation should be planted for long-term erosion control.

Liners
If a clay liner is used, the clay should be kept moist so it is easy to spread and not allowed to dry out after construction. From six to 8 inches of topsoil or loamy soil should be spread on top of the clay. This will provide a good substrate for the roots of the wetland plants. You will need to adjust the depth of excavation to allow for the clay liner and soil on top of the liner.

Step 3
Complete wetland habitat survey, wildlife survey

Optional step depending on the existing conditions.

The *Wetland habitat survey* (pages 69-70) is used if you have a pond or degraded wetland you want to improve for better habitat. This survey will help students define existing habitat conditions and determine what kind of habitat improvements are possible. The student recommendations for habitat improvement should be primarily focused on native plants. If the site already has a diversity of native plants, then the opportunity for habitat improvement should focus on building nesting boxes, brush piles and other project features. A list of these can be found on pages 20-22.

An optional but important step is to have students complete a *Wildlife Survey*. This can be found on page 71.

Materials
copies of pages 69-71
clip boards

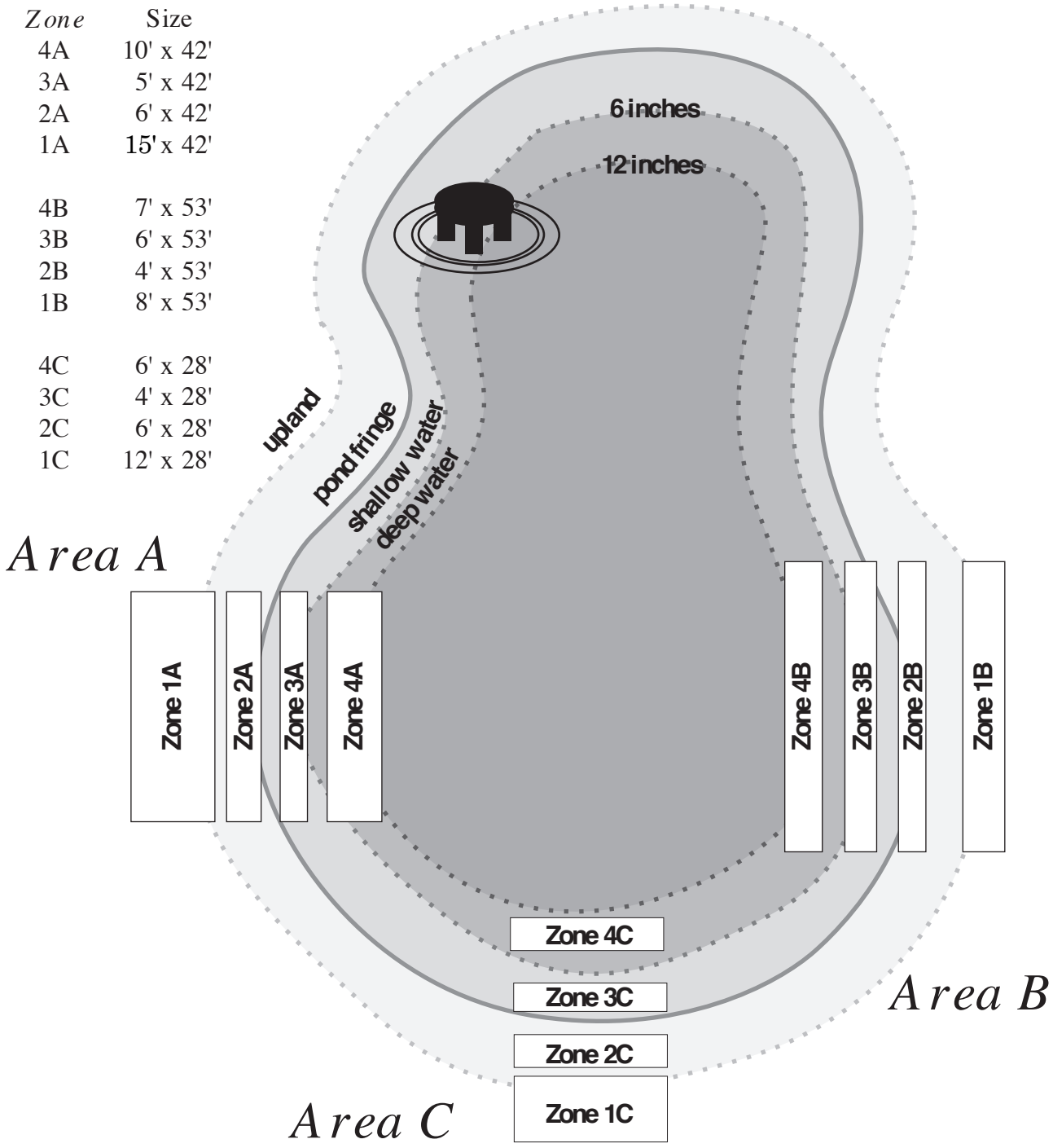
Order wetland nursery catalogs
optional for students
You will need to buy your plants from a native wetland plant nursery. A wetland expert, forester, member of a native plant society, or a biologist from a state natural resource agency or the U.S. Fish and Wildlife Service should be able to help locate a *native wetland plant nursery*. Call for a catalog or have students write letters requesting a catalog.

Make a design to help organize the planting
optional for students
Now you need to make a design similar to the example for Hollywood Elementary School on the next page. Doing this will help you organize the planting into manageable sections. Your wetland expert can help with this. Notice in the Hollywood example how each planting area is divided into four zones based on moisture. The design does not have to be as fancy as the Hollywood example as long as you have approximate sizes of the four planting zones. Not every wetland will have four planting zones. If your wetland is not constructed yet, use a scale drawing of the proposed wetland, draw in the planting zones, then measure the zones on the scale drawing. Now students should be divided up and assigned a zone or portion of a zone.

An optional task is to have students make an observational drawing of their zone or the entire project area.

Site:
Hollywood Elementary School
Wetland Planting Area

Zone	Size
4A	10' x 42'
3A	5' x 42'
2A	6' x 42'
1A	15' x 42'
4B	7' x 53'
3B	6' x 53'
2B	4' x 53'
1B	8' x 53'
4C	6' x 28'
3C	4' x 28'
2C	6' x 28'
1C	12' x 28'



		Moisture	Plant types
Zone 4	Deep wetland	flooded 6"to12"	herbaceous plants
Zone 3	Shallow wetland	flooded 0"to 6"	herbaceous plants
Zone 2	Wetland edge	wet to moist	shrubs & herbaceous plants
Zone 1	Upland	well drained	shrubs & small trees

Step 4
Determine growing conditions

Students need to be familiar with the light and moisture conditions of their zone so they can select appropriate plants. If the amount of sunlight is not obvious, students will need to set up a simple experiment to measure sunlight throughout the day. The moisture conditions were roughly figured out when the area was divided into different zones. The soil conditions were omitted since many native wetland plants grow in a wide range of soil conditions.

materials
copies of page 72

Step 5
Determine the number of plants

Divide the students into teams and assign each team to a planting zone. If there are more student teams than planting zones, divide the zones into smaller units, or have two teams work on the same area and combine the results.

A fifth zone for water more than 12" deep may be added since several species of emergent wetland plants will grow in water more than 12" deep. Also, SAV (submerged aquatic vegetation) can be planted in deeper areas where permanent pools will remain.

Students should complete the calculation to figure out how many plants they need for their planting zone. Notice that different types of plants are used in different zones (see chart on page 73). The most confusing part here is that zone B uses both herbaceous plants and small trees and shrubs. Do the calculation using D= 2,' then add one shrub for each 20 to 25 herbaceous plants (refer to page 73 showing the calculation).

The number of plants that the students come up with is just a guideline for ordering plants. After doing the calculation, you may have too many herbaceous plants than you have the time to plant. Fifth graders can plant about 100 to 200 herbaceous plants and 20 to 30 shrubs in a school day assuming they will work in 45- to 60-minute shifts throughout a school day with different students in each shift. This is only a guideline and will change according to the amount of adult assistance, type of nursery stock ordered and the soil conditions. Planting in

hard clay soil will take much longer. Adjust the number of plants you order according to the budget and what you will be able to plant. Some of the herbaceous plants spread rapidly, therefore you won't need to order as many. It is better to order fewer plants, take your time and follow correct planting procedures.

materials
copies of page 73

Step 6 Select plants

Students can now choose the plants for their zone. *We strongly recommend using only plants native to your area.* Buying plants from a native plant wetland nursery is a good way to ensure native plants are used. An example of Steps 6 and 7 can be found on page 58.

materials
copies of pages 74, 75

Step 7 Make a planting map

Students can now make a planting diagram. The directions in the student section should be clear.

materials
copies of pages 58, 76, 77

Step 8 Have plan reviewed

Students need to write a letter and send their plant lists and planting map to a wetland expert for review. Have them review the instructions for writing a letter. Contact the wetland expert before sending the letters.

materials
copies of page 77

Order Plants

It is best to order plants several weeks before the planting day. Again, don't order more plants than the students will be able to plant.

Name Jenny Green **Team Number** 4 **Zone** 1C

Team name Slaphappy

Plant species	Water tolerance	Sun	Number of plants needed	Price each	Total	Notes
		○				Blooms all year
Blue Flag Iris	0-6 in.	◑	15 Blue Flag Irises	.85	$12.75	Near mid tide
Sweet Flag	0-2 ft.	◑	14 Sweet Flags	.65	$9.10	blooms all year
Lizard's Tail	1 ft.	◑	14 Lizard's Tails	.90	$2.60	Near mid tide
Spatterdock	1-3 ft.	◑	14 Spatterdocks	$1.50	$21.00	Spreads slowly
						Spreads rapidly
Duck Potato	0-2 ft.	◑	14 Duck Potatoes	.65	$9.10	blooms all year

Name Jenny Green

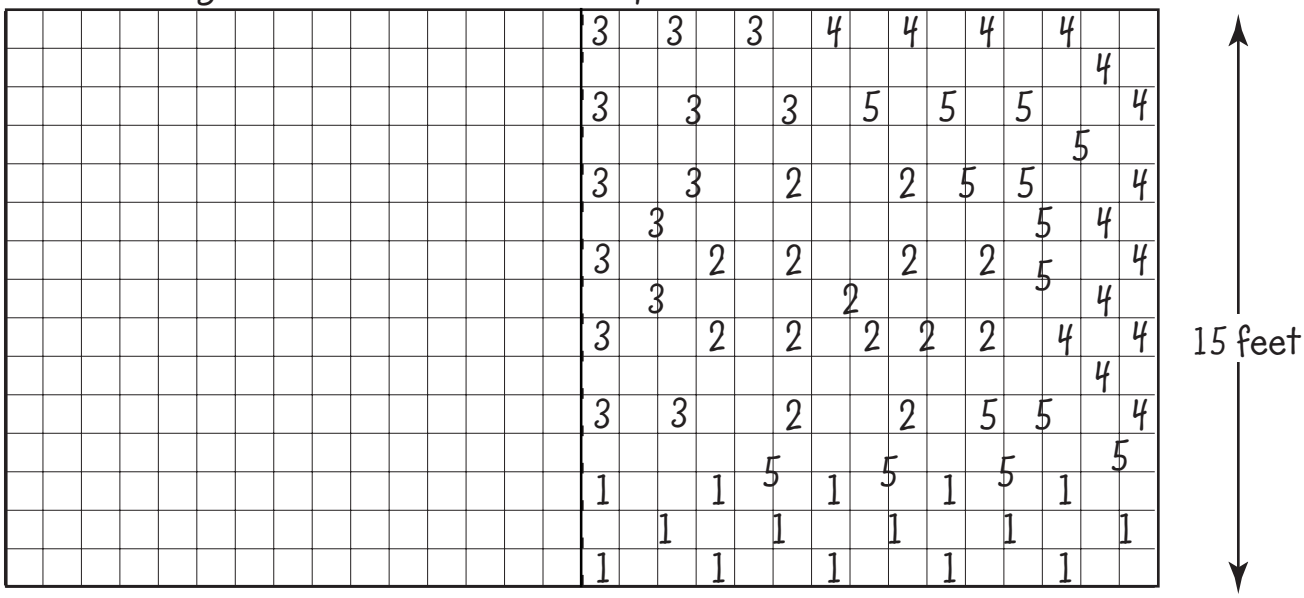
Team Number 4

Team Name Slaphappy

Zone 1C = greater than 6 inches deep

Key

1 = Blue Flag Iris
2 = Sweet Flag
3 = Lizard's Tail
4 = Spatterdock
5 = Duck Potato



Step 9
Review planting day checklist

General

- ☐ Water in the wetland needs to by drawn down below the level where students will be planting. *This is very important!*
- ☐ If necessary, remove all domestic or Canada geese. *They will* pull out herbaceous wetland plants. Contact a wildlife agency for assistance.
- ☐ Invite members of the community.
- ☐ Invite the local newspaper or TV station. See pages 105-106 for information on writing news releases.
- ☐ Find at least one person to take photographs. Slides work best for archiving and for giving presentations.

Plants

- ☐ Order plants several weeks before planting day and arrange for pick up or delivery.
- ☐ Have a shady, safe place to store the plants until planting day.
- ☐ Keep plants watered.

Materials

- ☐ Shovels, rakes, pick axes, hand trowels
- ☐ A method to water plants immediately after planting: hoses, buckets, empty milk jugs for watering
- ☐ Wheelbarrows
- ☐ Mulch
- ☐ Compost

Step 10
Carry out management and maintenance

Monitoring and observing changes over time is the key to making management decisions. It is very helpful to work with a wetland expert or botanist to provide guidance. The following are some general maintenance guidelines.

Removing invasive exotic species

This is your number one concern. Remove invasive exotic species as soon as they are identified. A wetland expert, botanist or naturalist should visit your site one to two times a year to help identify and provide advice on managing invasive exotic plants. For more information about invasive exotic plants, see pages 132-133.

Colonization by other plants

Other plants will colonize the site. This is a natural process that will add to the diversity of your habitat. Some may compete with your plants. If the colonizing plants are not invasive, it is best to leave them alone.

Adding more plants

Some wetland plants spread rapidly; therefore, it may not be necessary to add plants. If you need to add plants, wait until late in the spring after dormant plants have come up so you don't step on and crush the dormant plants.

Water

Upland plants need to be watered at least during the first summer after planting. Refer to page 31 of the Forest section for additional maintenance tips for upland plants.

Coordination with maintenance staff

It is essential to let the maintenance staff know where to mow and where not to mow. Unmowed areas should be marked with stakes and/or a diagram. The single biggest frustration for school habitat projects occurs when new plants are accidently mowed.

Water fluctuation

Many plants are adapted to natural fluctuations in water levels. However, if the water floods too deep or too often, or dries out too much, then certain plants may not survive. Therefore, it is important to keep track of which species survive better than others. More often than not, too much water is the cause of plants not surviving. There are other reasons for plants dying, such as poor planting technique or poor nursery stock, but water levels play a major role in plant survival.

Siltation

Depending on several factors, the depth of the wetland may become more shallow over time through siltation. This is a natural process and can be accelerated by poor land use in the drainage area. The plant community may change as the depth of water changes. Eventually, you may need to remove silt or let the wetland progress to a shallower basin.

Adding animal species

One of the most common questions about wetland projects is "Should I add fish, frogs or turtles?" There is no need to add your own frogs or turtles (unless your site is in an enclosed area) as they will find their way to your wetland if it meets their habitat needs. Many amphibian species only use wetlands to lay eggs so you may not see the adults. Other species are more water dependent and will stay around longer. Adding fish is a little different since it is unlikely fish will colonize your site unless it is connected to a stream or river system. Since fish eat tadpoles, many species of amphibians will only lay their eggs in wetlands that do not have fish. Fish require deeper water to survive winter freezes and summer heat. Since there is a worldwide decline in many amphibian species, it is usually recommended not to add fish unless it meets a specific educational goal.

Wetland Habitat Project

Student Instructions

Your class has decided to do a wetland habitat project. There are many steps in this project. All of the steps will lead to your class activity of planting a wetland. Building and planting a shallow marsh is the most popular type of school wetland project. When the project is completed, it should look like a very shallow pond with many kinds of wetland plants growing in and around it. The plants will provide food, shelter and space for wildlife.

What Are Wetlands, Why Should We Care?

Step 1 Complete background research

Wetlands are basically wet lands. Wetlands include swamps, bogs and marshes. All wetlands have three things in common: water, water-logged soil and plants adapted to a wet environment. Most wetlands are covered with shallow water at least part of the year. Some wetlands rarely have standing water.

Wetlands are very important. They are home to many different species of wildlife. Wetlands and wetland plants provide wildlife with food, water, shelter and hiding places. They prevent floods by slowing down rainwater running off the land. They also filter pollutants including toxins, excess nutrients and sediment (soil in the runoff water).

Unfortunately, we have only recently begun to understand the importance of wetlands. In the past 50 years, the Chesapeake Bay watershed has lost many acres of valuable wetlands. At least 50 percent of the land that was once wetlands has disappeared. Most of the wetlands have been lost to the development of homes, roads, farms, stores and other buildings. New laws are helping to protect wetlands. Creating wetlands and planting wetland plants can help replace some of the wetlands that have disappeared.

Step 2
Complete wetland site survey

In this step, your task is to:

- Walk around your schoolyard and identify two possible sites to *plant or construct a wetland*. The best spot to plant or construct a wetland is in an area that is not already a good habitat. This means you would not want to cut down trees or dam up a natural stream to build a wetland. Use the checklists to keep track of what you find.
- Write the information about the two sites on the Wetland Site Evaluation Chart, page 68.
- Make your decision about which site would be best.

Checklist to plant a wetland

Place a check in the box if you find one of the following types of areas:

☐ A pond. Possible project includes planting a marsh wetland in the shallow water area of the pond and an upland buffer of shrubs and small trees next to the pond.

☐ An area that is always wet and soggy. Possible area to plant a wet meadow, forested wetland or scrub/shrub wetland. A marsh can be built in these areas by digging out a shallow basin to hold more water.

☐ A stream that does not have a forested buffer next to it. This is a good spot to plant a streamside or riparian wetland and plant an adjacent upland forested buffer.

Note: If you found a site to plant a wetland, then refer to planting instructions. If you want to construct a wetland, continue:

Checklist to construct a wetland

Constructing a wetland will involve digging out a very shallow pond or building a small dam to trap water. First you need to find a good area to do this. Three features are necessary to construct a wetland. Your task is to find an area on your schoolyard that has these three features.

- A *water* source
- Flat *ground* near the water source where a shallow pond can be dug out
- Clayey *soil* that will hold the water.

Factors for contructing a wetland

When you go outside to look:

First —
Find a water source. Use the checklist to keep track of the water sources you found.

Second —
Look for flat ground near the water sources. Circle the water sources that also have flat ground nearby.

Third —
Pick the two best water sources with flat ground and examine the soil. You will be examining the soil texture. Soil texture refers to the amount of sand, silt and clay particles that make up the soil. Soils with more clay and silt drain slowly and are good for building wetlands. Sandy soils drain quicker and are not good for building wetlands. Dig a hole at least one foot deep and take a small handful of soil. Carefully follow the directions on the Soil Texture Chart (page 67) and decide what type of soil you have.

Water sources

- ☐ A spring or water seeping out of the ground
- ☐ Rain water from the school roof
- ☐ A spot that stays wet and muddy
- ☐ Ditches or gullies
- ☐ Pipes under roads or parking lots
- ☐ Stormwater management basins
- ☐ Other
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Slope of ground

Good

slope of ground

Fair

slope of ground

Poor

slope of ground

Type of soil

Suitable for building wetlands

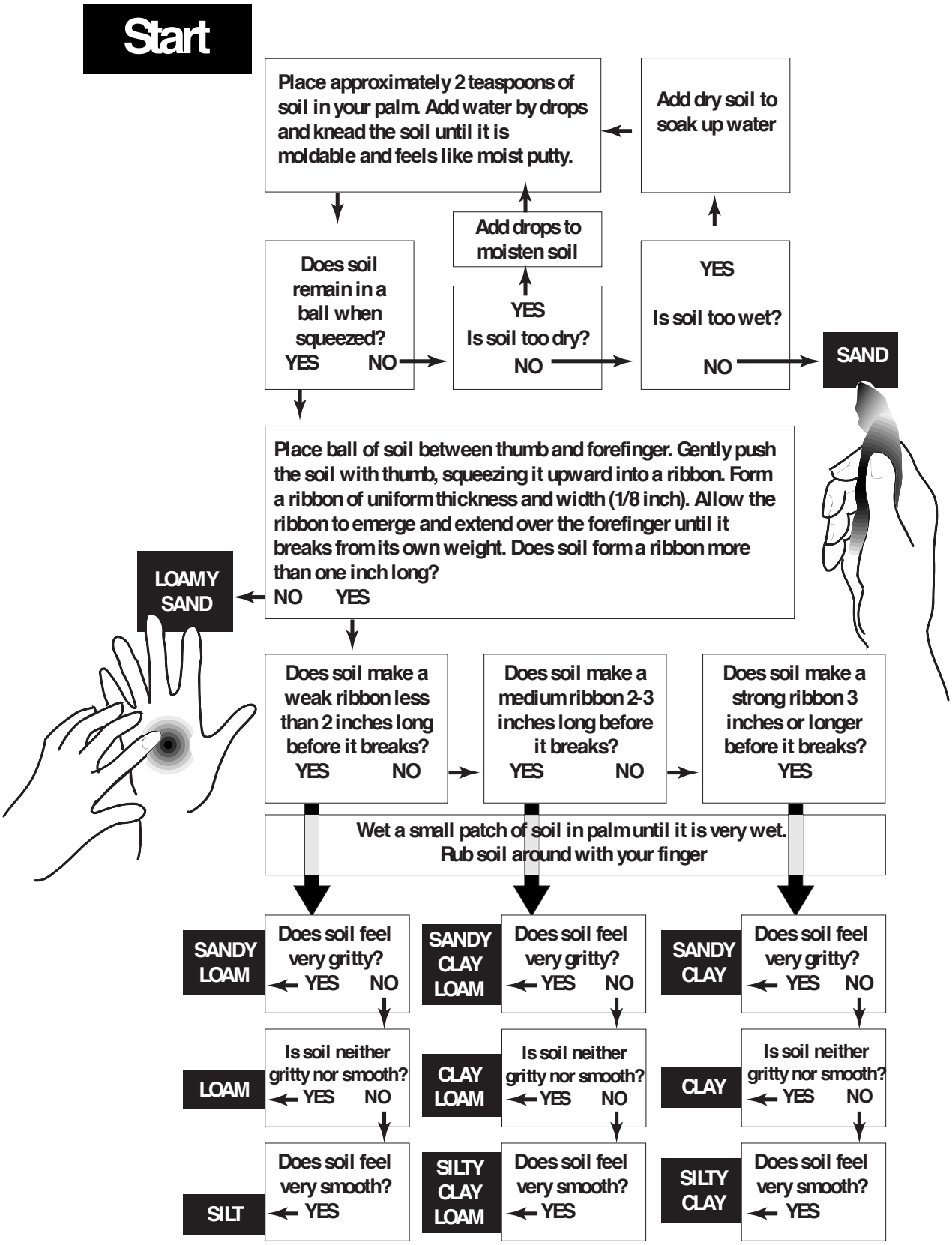
- ☐ Sandy clay loam
- ☐ Clay loam
- ☐ Silty clay loam
- ☐ Sandy clay
- ☐ Silty clay
- ☐ Clay

Unsuitable for building wetlands

- ☐ Sand
- ☐ Loamy Sand
- ☐ Sandy loam
- ☐ Loam
- ☐ Silt loam

Note: If your soil is not good for building a wetland do not be discouraged. The site can be lined with 4" to 5" of clayey soil. The clay liner will prevent water from seeping, thereby creating a wetland.

Soil Texture Chart



Adapted with permission from Environmental Concerns, Inc.

Wetland Site Evaluation Chart

Your teacher will invite a wetland expert to review your decision. The expert will help you understand which site would be the best to construct a wetland.

Use the information you gathered from your wetland field checklist, page 66, to complete the chart. The chart will help you evaluate which site is the best for your wetland project.

In the first column, describe site A and site B.
In columns two through four (Wetland site features), place a check in the box if the feature is good for building a wetland.

In the last column describe the type of plants that are growing on the site.

	Wetland site features			
Wetland site	**Water source**	**Slope**	**Soil texture**	**Existing plants**
A.				
B.				

Write down which site you think would be better for building a wetland and list three reasons why.

1.

2.

3

Step 3 Complete wetland habitat survey, wildlife survey

Your task is to examine the existing habitat in your wetland area. Go outside to the wetland area. Read through the survey and score each question. Estimate a score for the parts that are difficult.

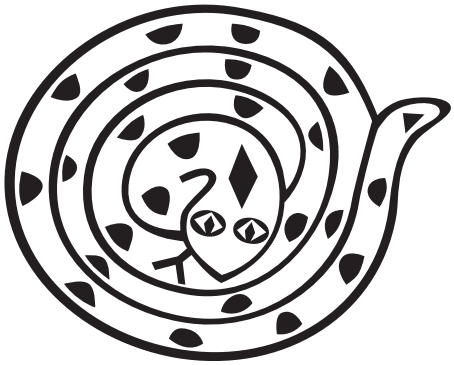
Points possible	Points scored	
		Water
		Water is important. Many plants and animals live in water. Animals that live on land need water to drink. Some land animals like many frogs and salamanders lay their eggs in water.
8 to 10	_____	Is there water present all year?
1 to 7	_____	Is there water present only part of the year?
0	_____	Does water remain for only a few days?
		Shelter/Space
		All types of wildlife need a space to live and shelter from weather and predators. Plants provide most of the shelter and space in an animal's habitat. Other habitat features that provide shelter/space include brush piles, dead trees, rotting logs and nesting boxes.
		The shallow part of the wetland that is less then 2' deep is very important for growing wetland plants. In this part you will decide on a habitat score for this shallow water area.
0 to 20	_____	• Decide on a score between 0 and 20 –Score 20 points if wetland plants cover all of this area –Score 0 points is there are no wetland plants
		Upland or dry land around wetlands provides important habitat for animals that may visit your wetland. Measure 30' out from the wetland and put in a stake. In this part you will survey all the area within 30 feet of the wetland.
0 to 20	_____	• Decide on a score between 0 and 20 –Score 20 points if natural vegetation (trees, shrubs, tall grass and wildflowers) cover all this area –Score 0 points if there is no natural vegetation in this space (mowed lawn is not natural vegetation)
0 to 2 each		
_____	_____ _____	**Plant Food**
_____	_____ _____	Plants provide shelter, space and food, including seeds, nuts, berries and nectar for wildlife.
_____	_____ _____	
_____	_____ _____	
_____	_____ _____	
		–Score 2 points (up to 30) for each different type of seed, nut, berry or nectar flower found.
	_____	**Total points**

Summary of your survey

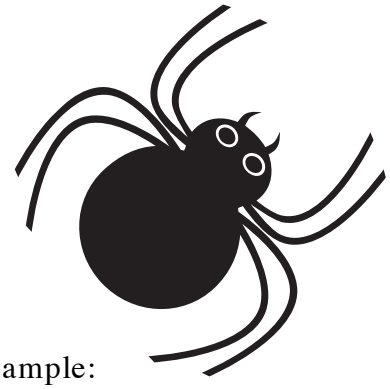
1. How many points would a wetland with excellent habitat score? List three habitat features that would make a wetland habitat score high.

2. How many points did your wetland score?

3. What could you do to improve the habitat score of the wetland?



Wildlife Survey



Go to the area where you will do your habitat project. Your task is to count the number of different wildlife species that use the area. Counting wildlife can be difficult since many wildlife species are secretive and hide when people are around. Others only come out at night. It is sometimes easier to find evidence of wildlife such as feathers, scat (droppings) or burrows. Do not be discouraged if you don't find many types of wildlife. If you know the names of different species list them. For each one seen or heard, make a mark, then add the marks.

Sample:

	Total
Number of different birds seen or heard: (list names if you know them)	| | | 3

1.
Number of different insects and spiders seen
(list names if you know them)

2.
Number of different birds seen or heard
(list names if you know them)

3.
Number of different reptiles or amphibians seen or heard
(list names if you know them)

4.
Number of mammals seen
(list names if you know them)

5.
Number of different types of wildlife you see evidence of, including tracks, fur, feathers, scat (droppings), nests and chewed food.
(list names if you know them)

Step 4
Determine growing conditions

In this step your task is to decide on the growing conditions in your planting zone. Sunlight and water tolerance are the two growing conditions you will investigate. Read the information about sunlight and water tolerance.

Sunlight and Wetland Plants

Plants vary in the amount of sunlight they prefer. Some plants require full sun to produce a flower. In less sunlight, these plants may still grow, although they may produce fewer flowers or no flowers at all. Other plants cannot tolerate full sun and may only grow in shade. Place an X in the box that best describes the sunlight in your zone.

- ☐ *Full sun* means the site is in direct sunlight for at least six hours a day.
- ☐ *Partial sun* means the site receives three to six hours of sunlight.
- ☐ *Shade* means the site receives less than three hours of direct sunlight.

Water Tolerance and Wetland Plants

Wetland plants are called hydro-phytic vegetation. This means water-loving plants. Wetland plants are specially adapted to wet soil conditions. When soil stays wet for a long time, the oxygen is forced out of the tiny spaces between soil particles. This presents a problem for plants since all plant roots need oxygen. Wetland plants have different ways to supply their roots with oxygen. Some wetland plants have hollow stems that allow oxygen to get to the roots. Some plants have special cells in their roots that store oxygen.

Wetland plants vary in the amount of water they can grow in. Some plants can grow in as much as 4' of water. Some plants can grow in 1' of water, while others can only grow in 1" of water. Many wetland plants grow better if the soil surface dries out for part of the year.

Step 5
Determine the number of plants

In this step, your task is to figure out how many plants you need. Use Equation 1 to find the area in square feet. Use Equation 2 to find the number of plants you need.

1. Finding the area: **Area= Length (L) x Width (W)**

Length (L) = ☐ **in feet**

Width(W) = ☐ **in feet**

Length ☐ **x Width** ☐ **=** ☐ **Area in square feet**

2. Finding the number of plants:

N = $A \div D^2$

N = **number of plants**

A = **area in square feet**

D^2 = **spacing between plants squared. For reforestation projects, use D = 10 ft.**

See chart below to get correct spacing.

A ☐ **÷ D^2** ☐ **= N** ☐

Place an X in the box that best describes the water in your planting zone.

Zone		Water Depth	Plant type	Plant spacing
☐	Zone 5: Flooded	>12”	Submerged aquatic vegetation	2’
☐	Zone 4: Deep wetland	6” to 12”	Herbaceous emergent plants	2’
☐	Zone 3: Shallow wetland	0” to 6”	Herbaceous emergent plants	2’
☐	Zone 2: Wetland edge	Wet and soggy	Herbaceous emergent plants & shrubs	*2’
☐	Zone 1: Upland	No water	Shrubs & small trees	7’

*Select one shrub for every 20 to 25 herbaceous plants.

Step 6
Select plants

Choose several different species of native plants for your zone. Refer to the chart and diagram on the previous page that indicates the type of plants for each zone. Use nursery catalogs and other references to choose plants. Write your selections on the plant chart. Be sure to fill in the plant name, water tolerance, light, cost and number. In the notes column, explain why you selected the plant.

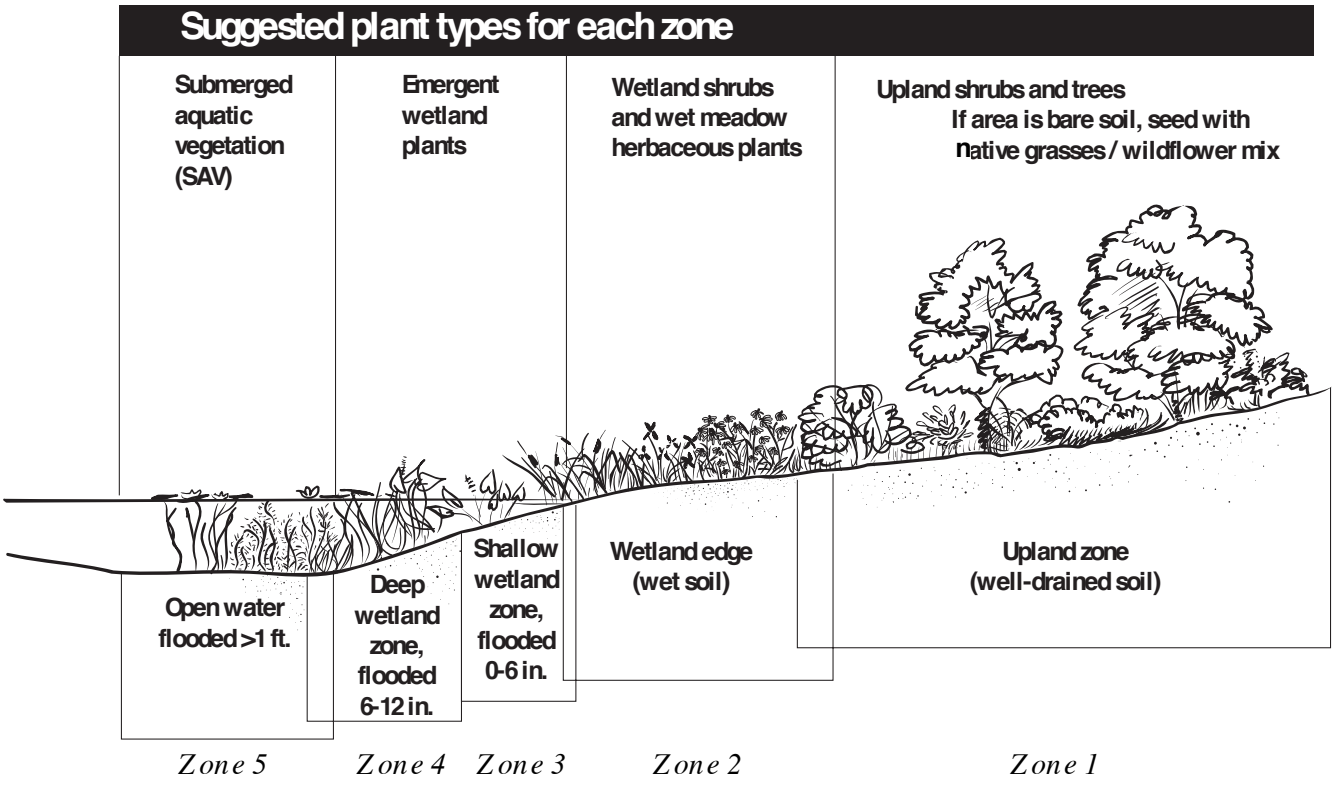
Keep the following in mind when selecting plants:

- Use only native plants.
- Select between four to seven species for your zone.
- Choose plants for a variety of wildlife benefits.
- Select plants for the sunlight and water tolerance in your zone.
- Notice that some wetland plants spread rapidly; therefore you do not need to order as many.
- Refer to nursery catalogs while selecting plants so that you choose plants that are available.
- Consider unique features of the plants that interest you.

C A U T I O N

Some plants are invasive. This means they grow rapidly, and can take over a natural wetland. Do not plant the following invasive species.

Phragmites
Purple loosestrife
Cattail
Some willow species
Red maple (in some areas)



Plant Chart

Team name_____

Zone_____Date_____

School name _____

Plant Species - Common name	*Plant Species - Scientific name*	*water tolerance*	*sun*	*# of plants*	*cost of each*	*total cost*	*notes*

Planting Map

Name_____

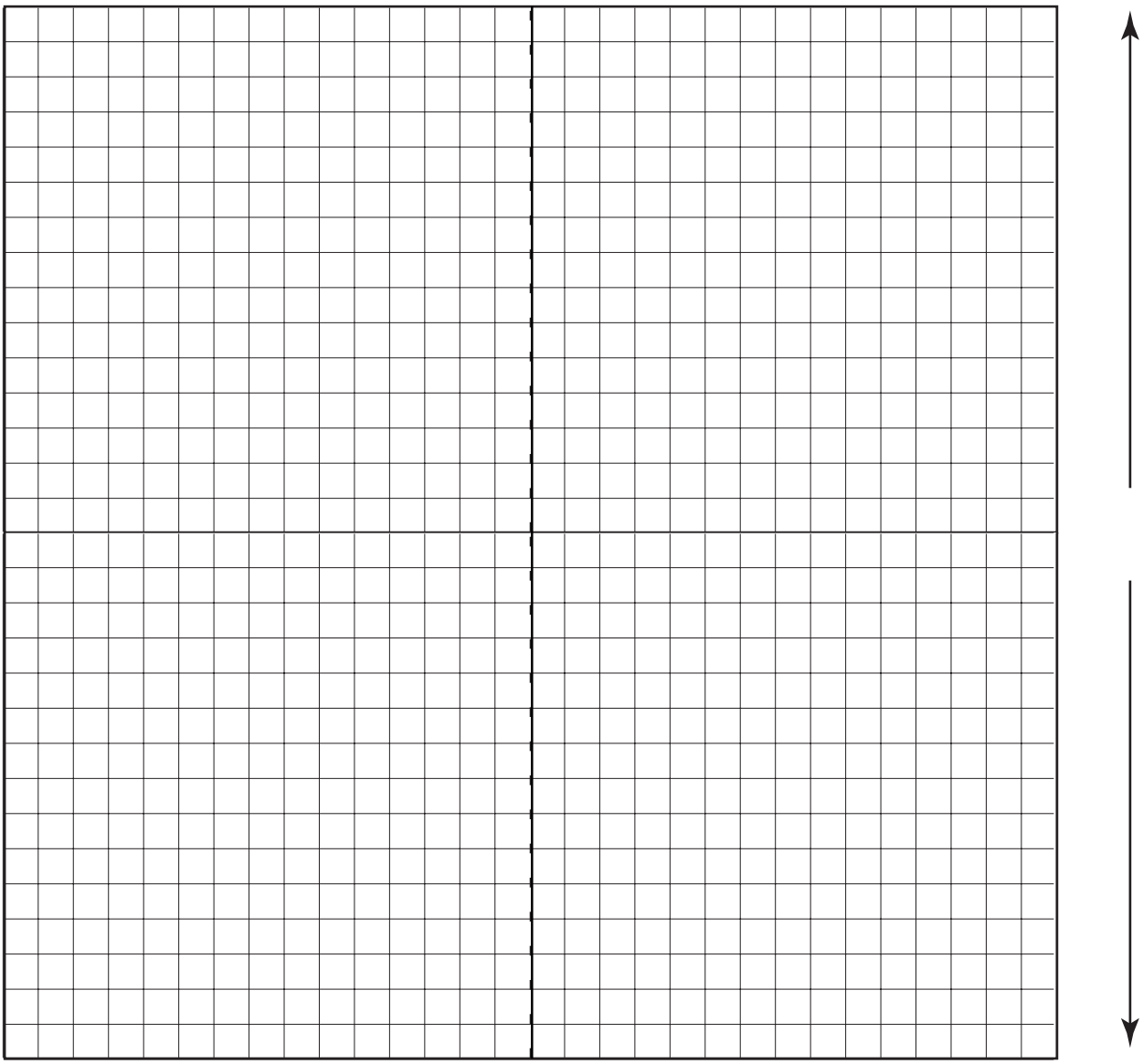
Team Number_____

Team Name_____

Zone_____

Key

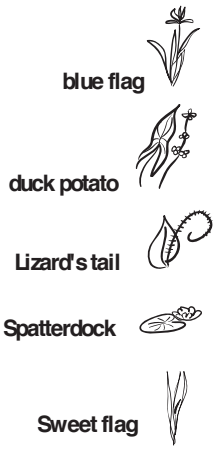
1 =
2 =
3 =
4 =
5 =
6 =
7 =
8 =
9 =
10 =

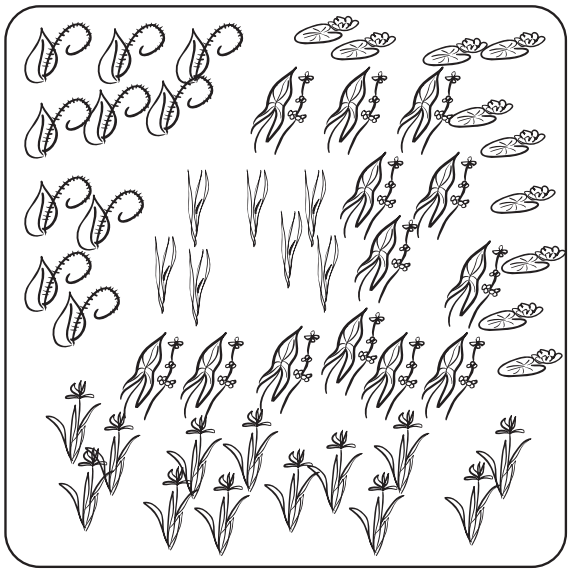


Step 7
Make a planting map

Your task in this step is to make a map that shows where each of your plants will be planted. Make a key for each species and show where each will be planted. Look at the diagram below to help you. Another type of planting map is on page 45. Notice how similar species are loosely grouped together.

Natural Plant Arrangement





Step 8
Have plan reviewed

Your task in this step is to write a letter to a wetland expert asking them to review your work. All habitat specialists have their work review by their peers. Use the guidelines below to help write your letter.

Writing a Letter

Your group has developed a plan for planting wetland plants for your zone. The plant choices you made were based on water tolerance, sunlight needs, wildlife value and other reasons. You have also made a map of your zone showing where the plants will be planted. It is very important to get advice from an expert before you order the plants. Write a group letter to the wetland specialist.

Before you begin to write, think about the plants you selected, the reasons you selected them and any questions you may have about the plants. Remember to thank the wetland expert for their review of your plan.

Writing prompt: Topic

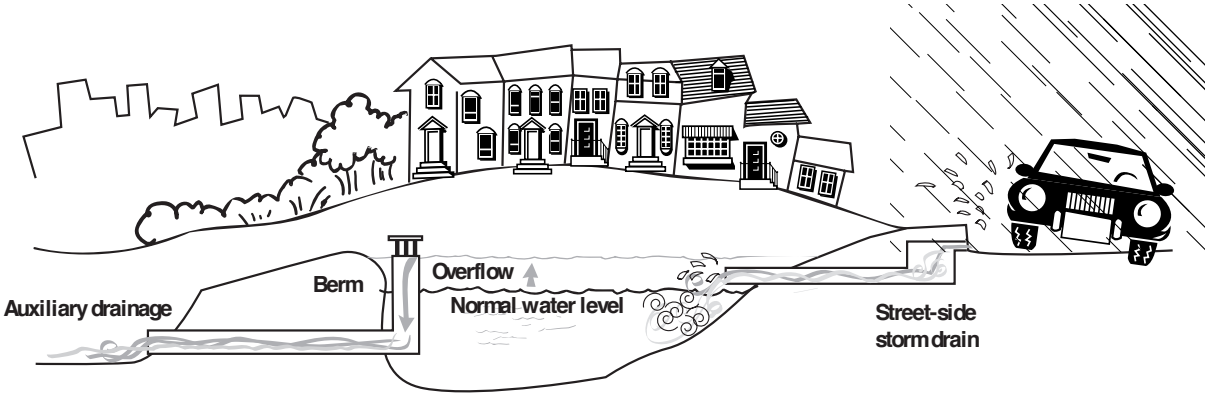
Audience

Purpose

Form

What Are Stormwater Management Ponds?

The human population keeps growing and growing. As the population grows, land that had been meadows, forests and wetlands is developed into houses, schools, roads, shopping centers and other buildings. This creates a problem. When it rains on land that has vegetation (plants) growing on it, the vegetation helps slow down and absorb the rainwater. The water can soak into the soil. This is a good thing since the soil filters and cleans the water before it slowly seeps into a nearby stream. When rainwater falls on land covered with concrete or buildings, the rain cannot soak into the ground. Instead, the water runs across the paved surface and usually into a stormdrain (these are the grates next to the curb). Since there is nothing to slow the water, it rushes down the stormdrain into a nearby stream. Once in the stream, the rushing water carves away soil from the stream bank and makes the water muddy. Muddy water causes harm to aquatic life. As rainwater flows across roads and parking lots, it can pick up many harmful pollutants. The combination of muddy water and pollutants from streets and parking lots harms fish and other life in the stream.

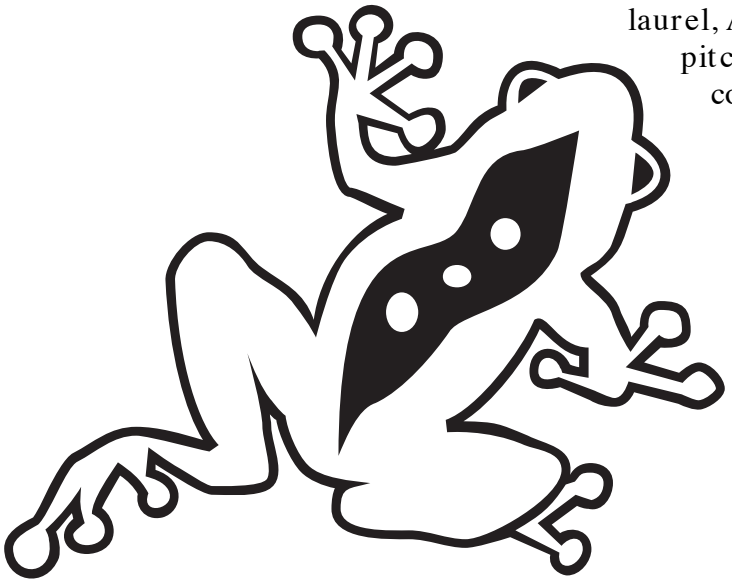


Structures called stormwater management ponds are often built to help reduce the problems caused by stormwater. These ponds catch the water before it enters a stream. The water is then slowly released into a stream. Slower moving water will not erode the banks of streams like fast moving water. Also, some stormwater management ponds hold the water for many days or even all year. In these types of ponds, wetland plants, bacteria and other natural processes help break down pollutants into less harmful substances. Wetland plants also cause sediment to settle out of the water column. While most stormwater management ponds reduce the effects of erosion and pollution, they are not usually designed to provide a natural habitat that is beneficial to wildlife.

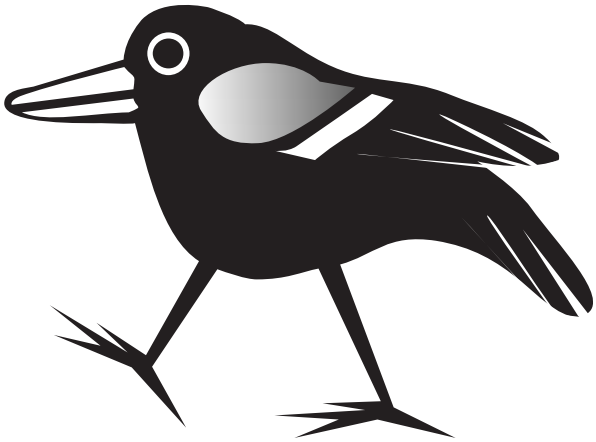
Bogs

Bogs are isolated wetlands with no obvious streams or channels flowing into them. They are likely to be covered with sphagnum moss and are very soggy because of high levels of water in the ground. They are usually found in basins that were carved out of the ground by glaciers in the last Ice Age. Bogs get most of their water and nutrients from rain and groundwater. They have very low levels of nutrients. Plants need nutrients to grow. Bog plants have adapted to scarce nutrients. Some plants do not require high levels of nutrients. Other plants trap and consume insects for nutrients. Still others have special bacteria that changes nitrogen gas into a mineral form the plants can use. Bogs function to control flooding, protect against storm damage and provide a stable wildlife habitat.

Typical plants found in mid-Atlantic bogs include Atlantic white cedar, red maple, black spruce, leatherleaf, sheep laurel, American cranberry, sphagnum moss, pitcher plant, sundew, rose pogonia and cottongrass.



Some animals that use bogs as habitat include whitetail deer, black bear, rabbits, mice, voles, shrews, ruffed grouse, black-capped chickadees, parula warblers, barred owls, northern water snakes, eastern ribbon snakes, green frogs, bull frogs, spring peepers, moths, butterflies and bees.



Freshwater Marsh

Freshwater marshes are formed in depressions that hold water long enough to support water-loving plants. Depressions are lined with soft organic muck or clay that helps to hold water. This is an open system where streams bring in water and let it out. Water also comes from runoff, precipitation and groundwater. Water depth varies from several inches to several feet. Shallow freshwater marshes have mainly emergent plants, those with their roots and lower stems in water and upper parts out of water, like cattails, sedges and rushes. Deeper marshes tend to have some water all year and support floating plants, like water lilies, while emergent plants are found along the outer edges of the wetland. The organic muck on the bottom of marshes provides nutrients for plants and energy for the microscopic animals in the food chain.

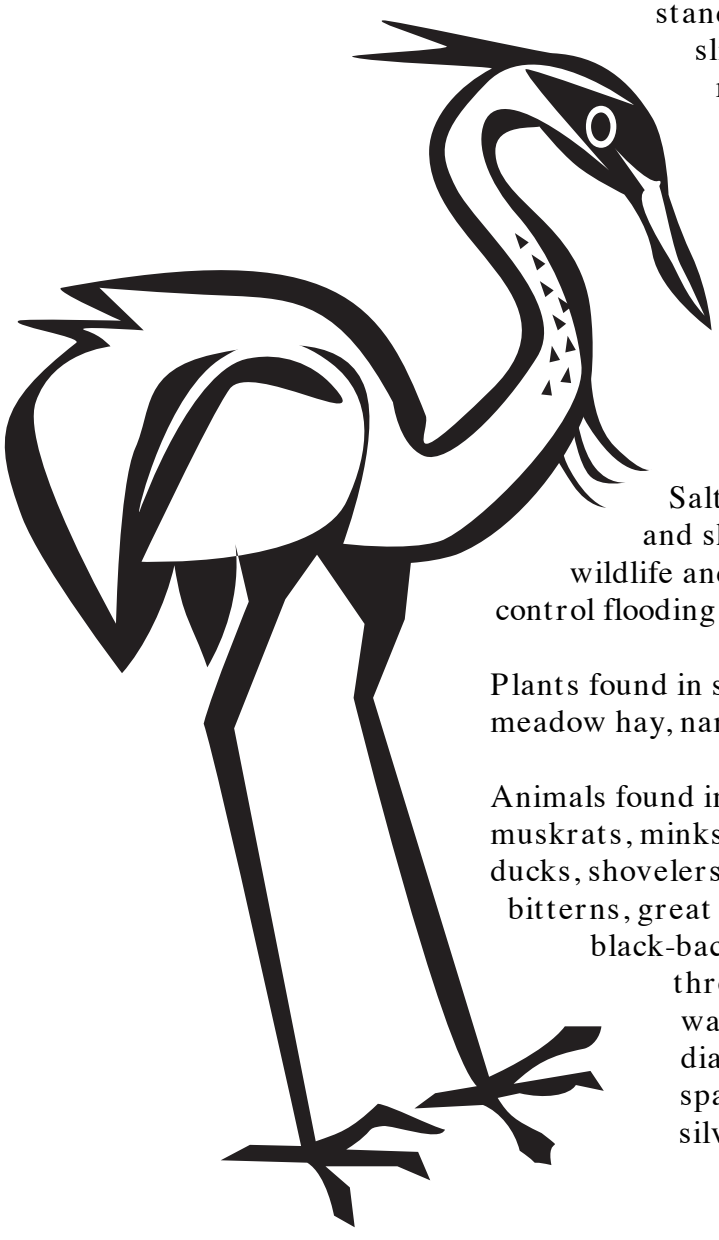
In addition to being excellent habitats, freshwater marshes also supply water, filter pollutants out of water, catch and temporarily hold water to reduce flooding and provide habitat for wildlife.

Typical plants found in freshwater marshes include buttonbush, leatherleaf, common cattail, narrow-leaved cattail, arrowhead, pickerel weed, arrow arum, tussock sedge, soft stem bulrush, spike rush, three square sedge, wild rice, marsh hibiscus, skunk cabbage and sweet flag.

Animals that commonly use freshwater wetlands include deer, muskrat, bitterns, herons, songbirds, mallards, wood ducks, red-winged black birds, freshwater clams and mussels.

Salt Marsh

Salt marshes are open wetlands where water moves in and out with the tide. They fill in with sediment brought in with the tides. They form in lagoons, bays and behind barrier islands where the water is shallow and land is flat, allowing sediment to build up. Salt marshes have very muddy bottoms formed from decaying plants. The plants that grow here tolerate high levels of salt that concentrate through evaporation of surface water.



Salt marshes have distinct zones based on the depth of water. Closest to the water is salt marsh cordgrass that can stand the twice daily flooding. Behind this, in a slightly a higher and drier area, grows salt meadow hay, which is less tolerant of flooding. At the highest and driest edge of the salt marsh, other plants like seaside goldenrod and marsh elder grow. These wetlands are very productive systems with three main food producers; marsh grasses, algae in the mud and phytoplankton in the water. Salt marshes sometimes give off an odor similar to the smell of rotten eggs. This is from gases given off by bacteria in the salt marsh.

Salt marshes are a nursery ground for young fish and shellfish, making them very important to wildlife and people. They also protect shellfish and fish, control flooding and lessen damage to shorelines by storms.

Plants found in salt marshes include salt marsh cordgrass, salt meadow hay, narrow-leaved cattail and marsh elder.

Animals found in salt marshes include whitetail deer, muskrats, minks, shrews, mice, Canada geese, mallards, black ducks, shovelers, clapper rails, black skimmers, American bitterns, great blue herons, cattle egrets, willets, great black-backed and herring gulls, common yellow throats, seaside sparrows, goldfinches, northern water snakes, eastern garter snakes, diamondback terrapins, American toads, spadefoot toads, sheepshead minnows, Atlantic silversides, shellfish, bees, moths and flies.

Wet Meadow

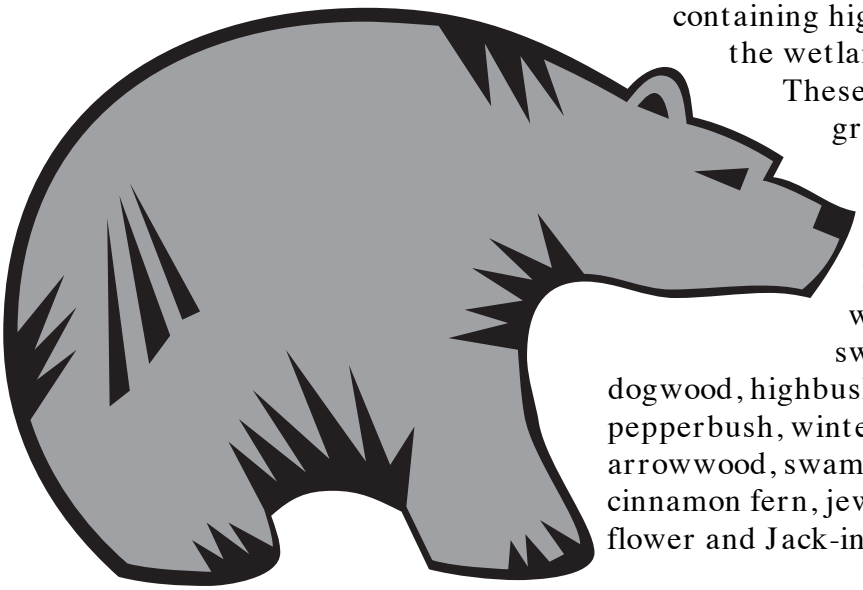
From far away, wet meadows may look like a field. They are full of herbaceous (soft-stemmed) plants and the surface is usually dry in summer. Wet meadows are an open system, getting water from springs, high groundwater and runoff. The water is at or near the surface only during a portion of the growing season. The soils are drier than other types of wetlands and the oxygen levels are higher. Because of the changing conditions throughout the growing season, wet meadows support a variety of wildflowers, grasses, rushes, sedges and shrubs. Left alone, trees and shrubs will eventually grow in wet meadows turning them into forested wetlands. Like other types of wetlands, wet meadows can provide a source of recharge for water supplies, control flooding, filter pollutants and provide habitat for wildlife.

Common plants found in wet meadows include buttonbush, highbush blueberry, sensitive fern, blue flag, Joe-pye weed, boneset, soft rush, tussock sedge and wild rice.

Animals likely to be found here include whitetail deer, rabbits, fox, chipmunks, mice, moles, voles, raccoons, ruffed grouse, wild turkeys, field sparrows, spring peepers, pickerel frogs, leopard frogs, box turtles, wood turtles, moths, bees and butterflies.

Shrub Wetland

As the name implies, the vegetation in shrub wetlands is mostly shrubs in addition to small trees (saplings) and herbaceous (soft-stemmed) plants. Shrub wetlands are considered a transition between wet meadows and tree swamps. They often start in wet meadows, along the edge of streams and rivers or along the edges of shallow marshes. These are open systems with water from runoff and streams or rivers moving in and out. The ground water is usually near the surface to 1 inch deep. Shrub wetlands are generally drier than wet meadow or marshes, due to the buildup of soil created by the decomposition of plants over the years. The small trees and shrubs generally grow on high spots in the swamp, known as hummocks. Their roots cannot tolerate the wetter, lower spots. The soils are rich and fertile, containing high levels of nutrients brought into the wetland by water and decomposition. These wetlands function to recharge groundwater, filter pollutants, reduce flooding and provide excellent wildlife habitat.

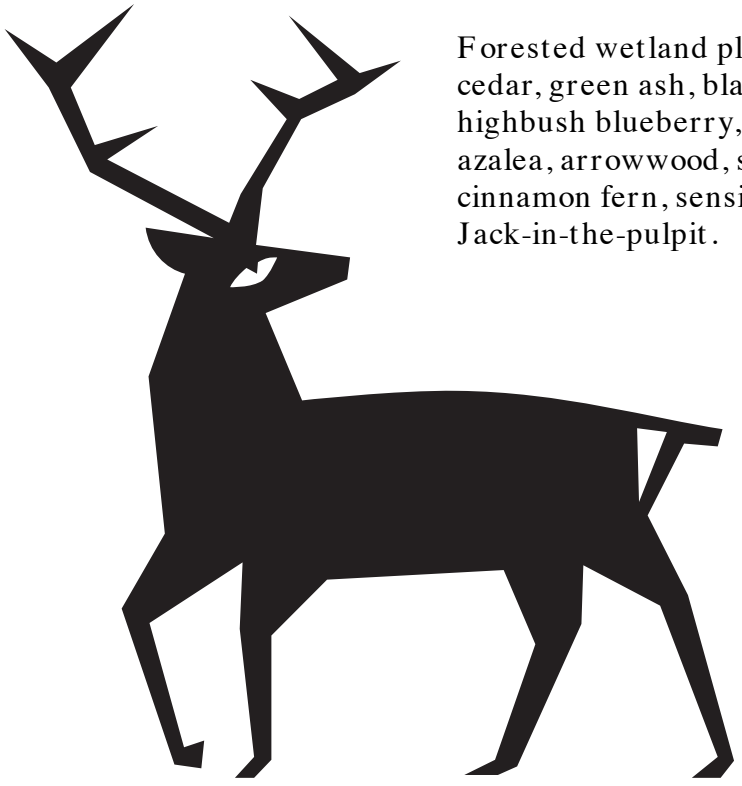


Plants commonly found in shrub wetlands include red maple, swamp azalea, buttonbush, silky dogwood, highbush blueberry, spicebush, sweet pepperbush, winterberry, common elderberry, arrowwood, swamp rose, swamp milkweed, cinnamon fern, jewelweed, sensitive fern, cardinal flower and Jack-in-the-pulpit.

Animals likely to be found here include whitetail deer, mice, black bears, skunks, fox, raccoons, squirrels, chipmunks, ruffed grouse, wood thrushes, veerys, red-eyed vireos, hooded warblers, brown thrashers, box turtles, water and ribbon snakes, garter snakes, bullfrogs, green frogs, leopard frogs, dusky salamanders, moths, bees and butterflies.

Tree Swamp

Tree swamps generally are found in poorly-drained, low areas. They have wet and mucky soils and are subject to flooding in the spring. These are open systems with high ground water that ranges from just below the surface to 1 inch above the surface for a good part of the growing season. Tree swamps are often found neighboring or adjacent to streams, rivers and lakes and are important in supplying water to them. The hummocky or "bumpy" nature of the forest floor creates temporary pools of water in the spring (vernal pools) that are breeding grounds for many reptiles and amphibians. Although trees are the dominant vegetation, shrubs and smaller herbaceous (soft-stemmed plants) do exist where sunlight can reach them. Tree swamps are extremely important for recharging groundwater, filtering pollutants, controlling flooding and providing wildlife habitat.



Forested wetland plants include red maple, Atlantic white cedar, green ash, black gum, hemlock, ironwood, pin oak, highbush blueberry, sweet pepperbush, spicebush, swamp azalea, arrowwood, shad bush, poison ivy, jewelweed, cinnamon fern, sensitive fern, skunk cabbage and Jack-in-the-pulpit.

Animals inhabiting forested wetlands include whitetail deer, raccoons, rabbits, fox, squirrels, beavers, river otters, mice, shrews, warblers, herons, wood ducks, mallards, barred owls, painted turtles, brown water snakes, bullfrogs, green frogs, spring peepers, American toads, spotted salamanders, sunfish, killifish, chain pickerel, crayfish, butterflies and moths.