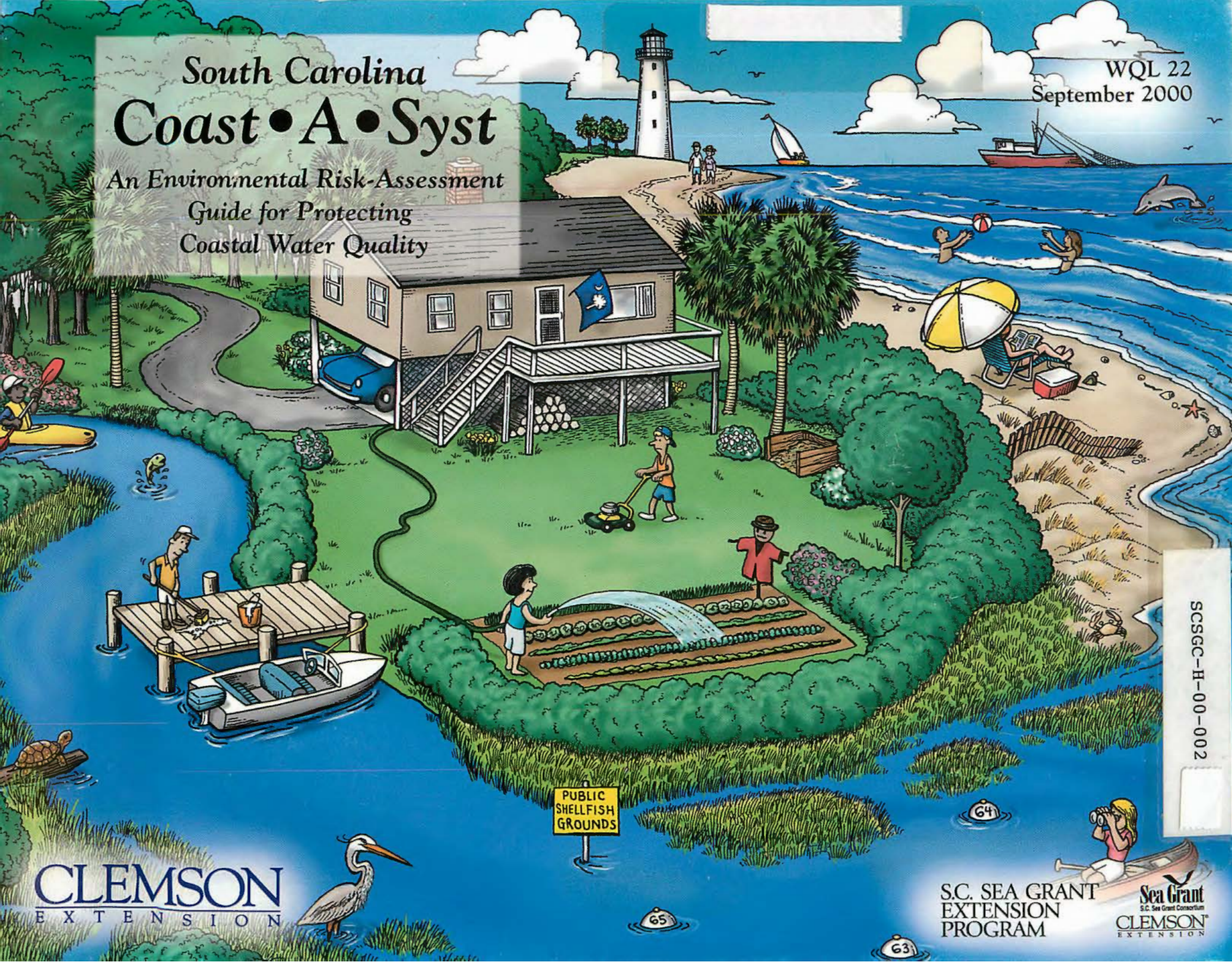
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About South Carolina Coast-A-Syst

South Carolina Coast-A-Syst was adapted from South Carolina Home-A-Syst and materials produced by the national Farm-A-Syst/Home-A-Syst program.

About National Home-A-Syst

Home-A-Syst is a companion project of the Farm Assessment System (Farm-A-Syst). Farm-A-Syst pioneered the system of self-assessments on which Home-A-Syst is based. Home-A-Syst and Farm-A-Syst are national programs supported by the U.S. Department of Agriculture (USDA) Cooperative State Research Education and Extension Service (CSREES), the USDA Natural Resources Conservation Service (NRCS), and the EPA. The national Farm-A-Syst/Home-A-Syst office provides guidelines and educational support to states. Each state and territory has a primary contact for the development and implementation of Farm-A-Syst/Home-A-Syst programs.

For information about the national Farm-A-Syst/Home-A-Syst programs or to find out about programs in other states, contact Farm-A-Syst/Home-A-Syst programs, 303 Hiram Smith Hall 1545 Observatory Drive Madison, WI 53706, telephone (608) 262-0024, homeasys@uwex.edu.

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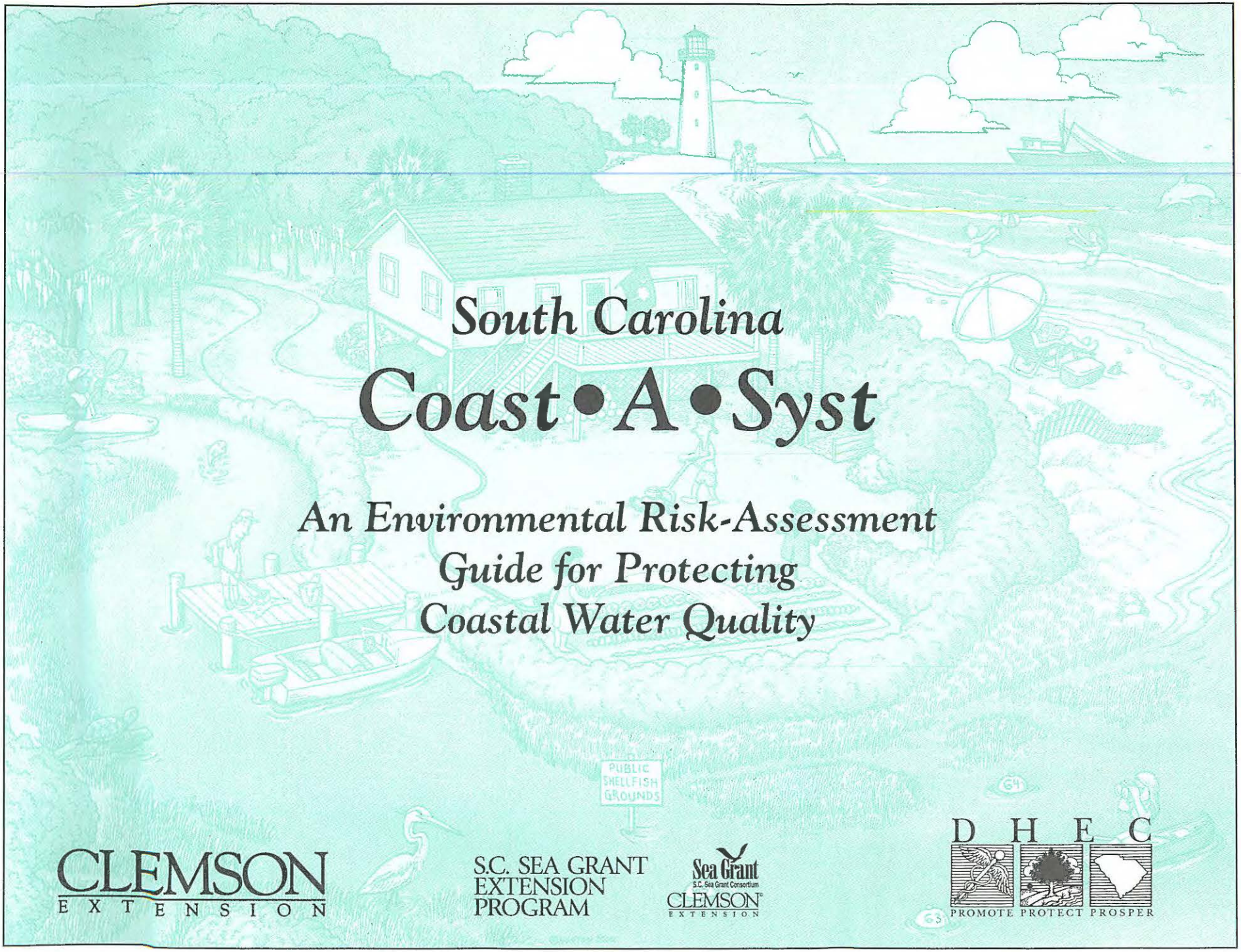

South Carolina
Coast•A•Syst

An Environmental Risk-Assessment Guide for Protecting Coastal Water Quality

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Introduction

What Is South Carolina Coast-A-Syst?

Coast-A-Syst, the Coastal Homestead Assessment System, is a program that helps you protect the quality of surface and ground water near your home and throughout your community. This booklet provides information to help you make the most effective use of the program. *South Carolina Coast-A-Syst* consists of information and a series of confidential self-assessments that will enable you to identify and correct pollution sources and health risks in your home and around your yard.

Coast-A-Syst is a spin-off of the highly successful South Carolina Home-A-Syst and the nationwide programs, Farm-A-Syst and Home-A-Syst. This program is being singled out and developed in recognition of the special significance of South Carolina's coastal water resources and the role they play in the state's economy, environmental health and overall quality of life.

Common practices in every home — large or small, new or old, rural or urban — can contaminate water and affect the health of your family, your community, or the environment.

Coast-A-Syst is particularly focused on what you can do to avoid polluting local water sources, such as reservoirs, neighborhood ponds, tidal creeks, rivers, estuaries, or private wells. Your drinking water may come from any of these sources. Simple changes in your household routine can reduce pollution and protect the health of your family and the environment.

The seven chapters in *South Carolina Coast-A-Syst* cover topics that are important for every resident and homeowner to understand. Each chapter contains information about a specified topic, and one or more assessment tables to guide you in identifying risky practices around your home. Since this book cannot answer all questions for all household situations, lists of additional references and contacts are provided at the end of each chapter.

South Carolina Coast-A-Syst has been written to conform with pertinent state laws and regulations relevant to the specific chapter topics. However, you will also need to comply with any local, county, or regional regulations. Check with your local officials and Cooperative Extension office to make sure that your home practices or planned changes comply with local laws.

Who Should Use Coast-A-Syst?

The Coast-A-Syst program can be used by residents of rural, urban, and suburban homes — whether you rent a room or own a house. It is a valuable reference for anyone who is concerned about their health and the environment and who is willing to make changes to improve how they manage their homes.

The information in *South Carolina Coast-A-Syst* can help you protect your investment in your home and your community by identifying pollution risks on your property before expensive problems occur.

How Do I Use Coast-A-Syst?

You can complete Coast-A-Syst topics one at a time or all together — it's up to you. Whichever method you choose, take the time to identify risks and plan your course of action to reduce those risks. Involve your entire family in completing Coast-A-Syst self-assessments — children and adults alike will benefit from learning what they can do to help.

To start your Coast-A-Syst program, read the introductory information in a selected chapter. This will provide important details about why and how certain activities and conditions around your home could affect your water quality. Then complete the self-assessment table(s) associated with that topic. Easy-to-follow instructions are included with each self-assessment.

After you have completed each self-assessment, refer back to the information preceding it to make plans for changes that will remedy any risks you detect. If you need additional information to use the Coast-A-Syst program, or want help after completing your self-assessment, contact your county Extension office or one of the other resources listed at the end of each chapter and the end of the book.

Coast-A-Syst will help you accomplish three important objectives:

- Identify environmental risks, concerns, or problems in and around your home.
- Learn how to manage your home and property better.
- Take preventive actions to safeguard your health and the health of the coastal environment.

Site Assessment: Protecting Coastal Water Quality Around Your Home

Chapter 1

Is your soil sandy or gravelly? Does it drain quickly? Does stormwater runoff from your property flow into a nearby lake or pond? Do you store hazardous chemicals on your homesite, and are they close to a well or next to a tidal creek, river or estuary?

This chapter will help you become familiar with your homesite and how you manage it so you can recognize risks to coastal water resources. Completing the chapter will provide background information you can use throughout this book. This chapter covers two areas:

1. *Identifying the Physical Characteristics of Your Homesite.* Examples of characteristics include soil type and depth; depth to the water table; and location of wetlands, rivers or other surface water.

2. *Making a Map of Your Homesite.* A map of your homesite showing buildings, roads and other constructed or natural features can help you identify potential sources of trouble.

This chapter also invites you to draw a simple "aerial view" map of your homesite. Your completed map will show the locations of important features and help you recognize the activities in and around your home that may pose risks to your health and the environment.

Why should you examine your homesite's physical characteristics?

What you do in and around your home can affect water quality — both below the ground and in nearby ponds, tidal creeks, rivers and estuaries. Identifying some important characteristics of your homesite — such as soil type, geology, depth to groundwater and nearness to surface water — will help you understand how the land around your home can aid — or complicate — your efforts to protect coastal water quality.

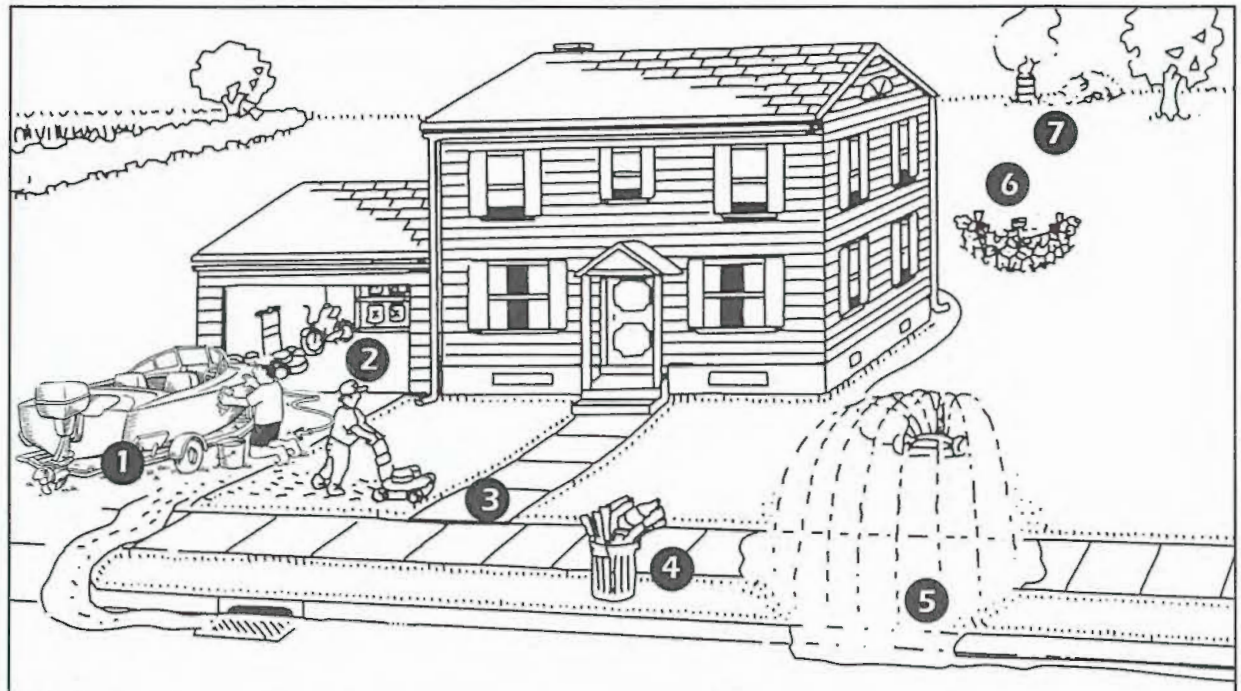


Figure 1.1. Many common household practices are harmful to the environment.

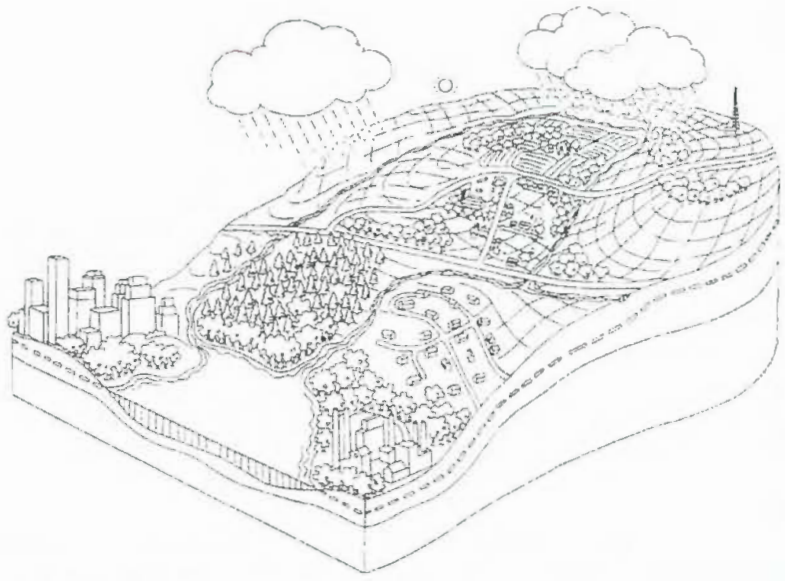


Figure 1.2. Activities in the watershed affect water quality.

Remember: This assessment is a starting point. It is meant to encourage you to complete some, or all, of the other *South Carolina Coast-A-Syst* chapters. Review Figure 1.1 for some examples of harmful practices, and think about how your habits and individual site conditions can threaten coastal water quality.

Why is the environmental health of the coast so important in South Carolina?

The natural features of the South Carolina coast are diverse and striking. The state contains 2,876 miles of tidal shoreline, 500,000 acres of tidal bottoms and 504,450 acres of salt marsh (representing 20 percent of the East Coast total). Five major estuaries drain water originating from as far away as western North Carolina. The great diversity of wildlife inhabiting the coastal region of the state includes notable populations of striped bass, sturgeon, bald eagles, ospreys, alligators and wood storks.

The South Carolina coastal economy has many traditional sectors that depend on healthy water resources. More than 2,000 commercial fishermen harvest an average 15.4 million pounds of seafood worth about $25 million. In addition, $14.4 billion was spent in 1997 for recreation and tourism in the state, with over 60 percent of that total expended along the coast.

Finally, more than 25 percent of the state's 3.5 million residents live in the state's eight coastal counties. While the population of South Carolina increased by more than 11.7 percent from 1987 to 1997, it grew by more than 22 percent along the coast. This pace of coastal growth is expected to increase over the next two decades. These facts point out the primary social, cultural, economic and environmental importance of South Carolina's coastal region and why the protection of its water resources is so essential.

What is a watershed?

The water from your tap and in nearby lakes, reservoirs or streams is part of a much larger water system. Not everyone lives next to a pond or stream, but we each live in a *watershed* — the land area that contributes water to a specific surface water body, such as a pond, lake, tidal creek, wetland, river or estuary (Figure 1.2). The landscape's slope and contours define the watershed, or "catchment area."

Not everyone lives next to the ocean or stream, but we each live in a *watershed*.

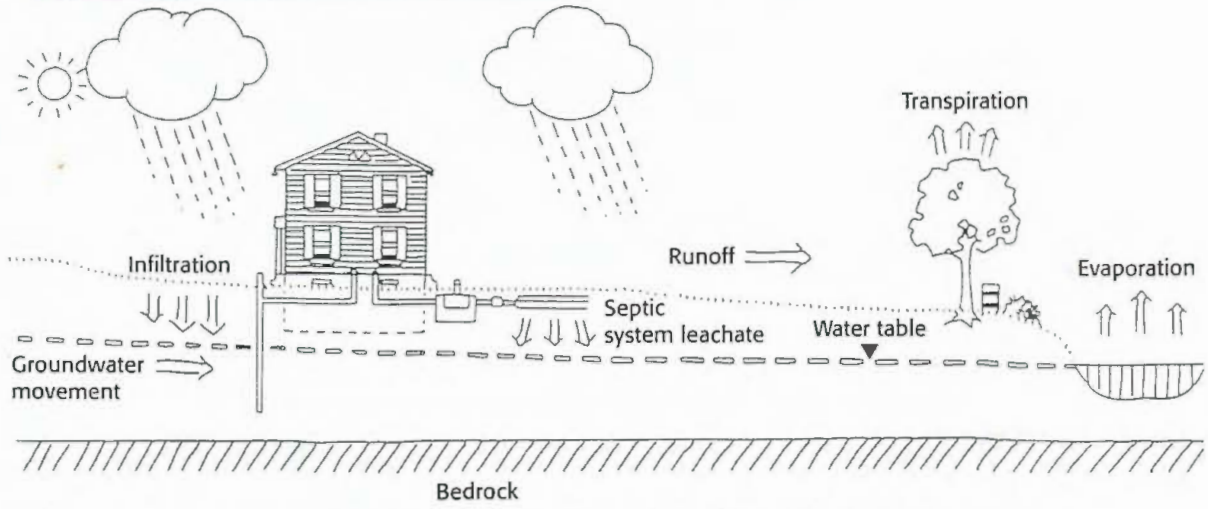


Figure 1.3. In the hydrologic cycle, water falls to earth as rainfall or snow. Water returns to the atmosphere through evaporation from wet surfaces and from plant leaves.

A watershed is like a bathtub. The watershed outlet — the mouth of a pond, lake, river or reservoir — is the tub's drain. The watershed boundary is the tub's rim. The watershed's drainage system consists of a network of rivers, streams, constructed channels and storm drains, wetlands, and the underlying groundwater.

Common activities — like disposing of household cleaning products or fertilizing your lawn and garden — can affect water quality, even when you do these things far from any shore. By paying careful attention to how you manage activities in and around your home, you can protect your watershed and the water you drink.

Do you know where your water comes from?

List the source of your home drinking water (e.g., well, municipal pipe) in the space below.

_____

What influences the quality of your water?

Understanding the site characteristics of your residence and identifying the locations of potential contamination sources are important first steps in protecting your water. In the hydrologic cycle, water moves through the air, over land and through the soil (Figure 1.3).

Physical characteristics — such as soil type, depth to groundwater and distance to surface water — may speed up or delay a contaminant's effect on water quality.

Activities that affect water quality include drinking-water well construction, boat and automobile maintenance, pesticide and fertilizer use and storage, septic system maintenance, waste disposal methods, and soil erosion.

Animal and pet wastes are another threat to water quality, particularly if large amounts from horses, dogs or other animals are allowed to accumulate on your property. Household pets and livestock are not the only animal threats to water quality, however; wildlife that congregates along lakeshores, such as geese and other waterfowl, can contribute pollution as well. To protect your water, all of these factors need to be considered.

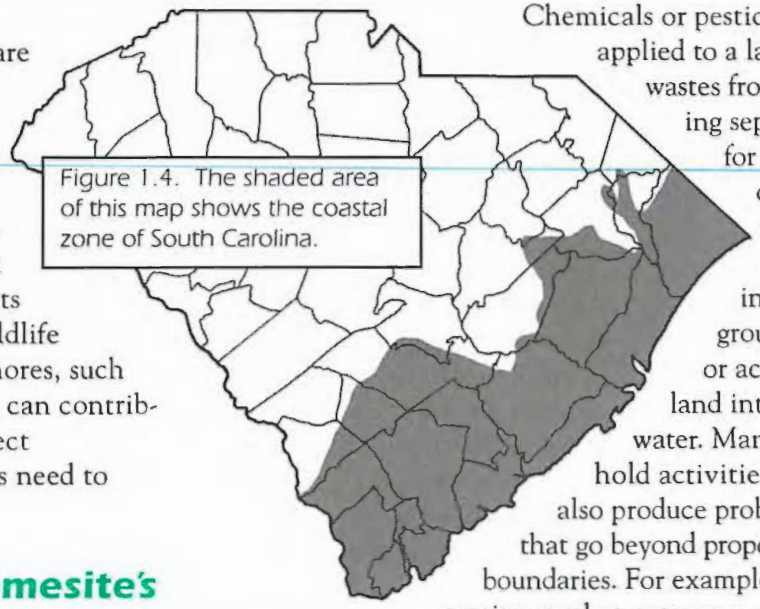


Figure 1.4. The shaded area of this map shows the coastal zone of South Carolina.

Part 1.1 Your Homesite's Physical Characteristics

Every home comes with its own unique set of physical site conditions. You cannot change these conditions, but once you are aware of them, you can better understand risks that may result from activities you are able to change. Assessment 1.1 on page 6 can help you determine your potential risks. The information below will help you answer the questions in the table.

How can soil type affect water quality?

Soil plays an important role in determining where contaminants go and how water moves. Nearly all soils are permeable, which means water and other fluids can infiltrate, or seep, through them. Different soils have different properties that permit water and contaminants to soak through the soil or run off at variable rates.

Chemicals or pesticides applied to a lawn and wastes from a leaking septic tank, for instance, can flow down vertically into groundwater or across the land into surface water. Many household activities can also produce problems that go beyond property boundaries. For example, contaminants that enter groundwater through a neighbor's abandoned well may flow underground until they reach your well.

What is your soil type?

Soil is grouped into three basic types based on particle size: clay, which has small particles; silt/loam, which has medium particles; and sand/gravel, which has large particles. You can get a good idea about your soil type by rubbing a moistened sample between two fingers. Is it sticky like clay, gritty and crumbly like sand, or somewhere in between like loam? Consult the soil survey for your county, which you can obtain from your local soil and water conservation district office, or contact your local Cooperative Extension agent.

Soil Types Along the Coast of South Carolina

The South Carolina coast is composed of two distinctive landform regions, each with its own topography and soil types. The type of rocks from which these soils were formed and the topography have a great influence on water quality.

The coastal zone consists of the Upper Coastal Plains soils (14 percent of the state) and the Lower Coastal Plains or Atlantic Coast Flatwoods soils (38 percent of the state). These soils have a sandy texture with subsurface clay. In the Upper Coastal Plains soils, the subsoil clay is closer to the surface than it is in the Lower Coastal Plains soils. Some of the Lower Coastal Plains soils have a large amount of organic matter due to poor drainage and negligible erosion. Some of the Lower Coastal Plains soils also have no appreciable clay throughout their depth.

Within these landform regions exist dozens of specific soil types. Each county will have identifiable soil profiles and distribution patterns that can be determined from a soil map. In Beaufort County alone there are over 20 different designations ranging from Seabrook Fine Sand in the southern portion to large tracts of Coosaw Loamy Fine Sand in the northern sections. Once again, consult the soil survey for your county or contact your local Cooperative Extension agent.

Eroding soil, or sediment, is considered a water pollutant.

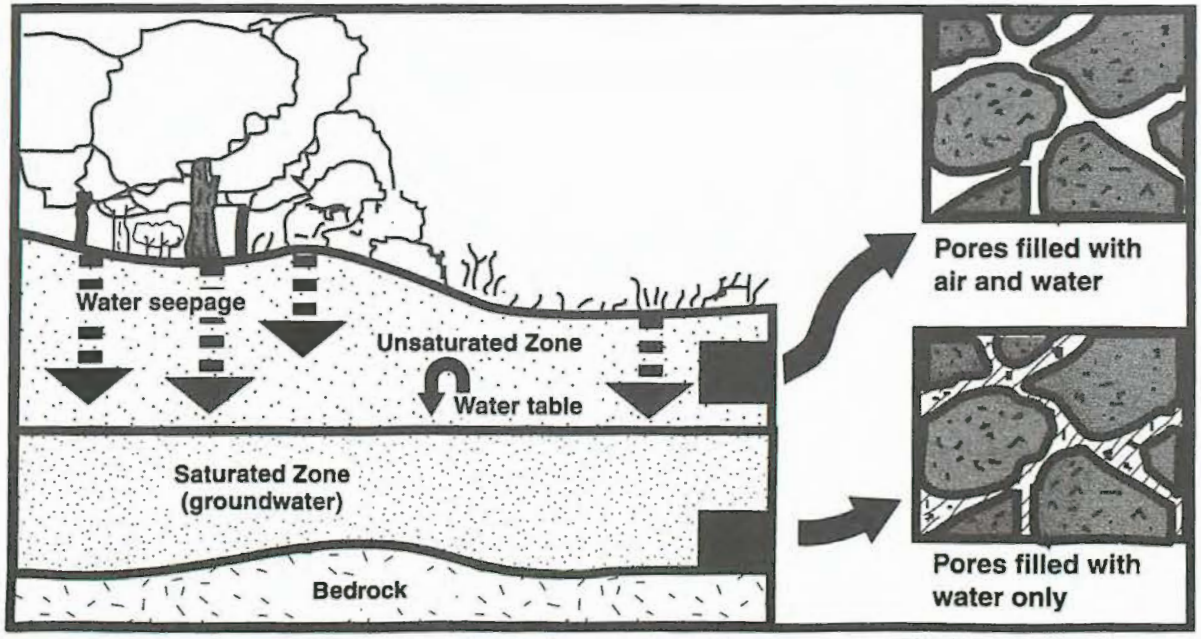


Figure 1.5. The water table is the boundary between saturated and unsaturated soil.

How does soil type affect groundwater in the coastal zone?

Groundwater is the water below the surface of the earth that, from the water table down, saturates the spaces between soil particles or fills cracks in underlying bedrock. Soil particle size influences which pollutants are able to reach groundwater. Some soils are better at trapping pollutants than others.

Clay soils, which are made of tiny particles, slow the downward movement of water and in some cases can impede water movement completely. Sandy soils allow for rapid water movement, and silty soils occupy the middle range. Soils made of large particles pose the greatest risk, because water seeps downward through them readily without filtering out or decomposing pollutants. Since many soils in the coastal zone of South Carolina have little to no appreciable clay layer, its capacity to filter pollution can be very limited. Wells and other sources of untreated potable water should be tested periodically for contamination.

The ideal soil for protecting groundwater quality is a mix of midsize particles to allow infiltration and tiny particles, like clay or organic matter, to slow water movement and filter pollutants.

What are the risks to surface water?

Soil type can also affect surface water contamination. Although runoff occurs from all soil types, clay soils — which are least permeable — are more likely to cause surface water runoff.

During a storm or flood, or even when you water your lawn, this runoff can wash contaminants from the land's surface into nearby surface waters. Eroding soil is also considered a water pollutant. Bare soil, especially on sloping land, can run off into streams, rivers, lakes or estuaries. Runoff in cities goes into storm drains and then discharges into surface water bodies.

Soil type affects the potential for erosion. Although soil erosion is greatest in the Blue Ridge and Piedmont regions, where rainstorms wash soil from the hilly terrain into local streams and reservoirs, residential and commercial construction along the coast is a significant contributor of sediment to area surface waters. Eroded sediment can smother aquatic habitat, carry pollutants, and reduce water clarity. While some amount of erosion is normal, heavily altered landscapes accelerate this natural rate.

Did You Know...
Residential and commercial construction along the coast is a significant contributor of sediment to area surface waters.

What is your soil depth?

The depth of soil influences risks to groundwater. Usually, the greater your soil depth, the farther water must seep down before reaching groundwater. Deep soils offer a better chance of filtering or breaking down pollutants before they reach groundwater. Generally, soils that are less than 3 feet deep present the highest risks for groundwater contamination.

Along many parts of the South Carolina coast, the water table is shallow and very near the land surface. The proximity of the groundwater in the coastal zone makes it very susceptible to pollution. Fertilizers, pesticides and even the soap you use to wash your car can have a significant effect on the condition of groundwater quality.

How far down does bedrock lie?

Bedrock depth varies; it can be at the land's surface, just below the surface or hundreds of feet down. The type of bedrock influences pollution risks. Shale, granites and other impermeable types of rock make effective barriers that block the downward movement of water and contaminants. Other rocks such as limestone, which is very common throughout coastal South Carolina, can be highly permeable, allowing water to move freely into groundwater. When bedrock is split or fractured, water can move through it unpredictably, spreading pollutants rapidly over long distances.

How deep is the water table?

If you dig a hole, you will eventually reach soil saturated with water (Figure 1.5). This water table marks the boundary between the unsaturated soil (where pore spaces between soil or rock contain air, roots, soil organisms and some water) and the saturated soil, or groundwater (where water fills all pore spaces). In a wetland, the water table is at or just below the surface.

Your local water table fluctuates throughout the year but is usually highest in the wet months of spring and in late fall. In general, the closer the water table is to the land's surface, the more the groundwater is susceptible to contamination. Usually, a water table that is less than 10 feet from the surface presents a higher risk for groundwater contamination.

Groundwater and surface water are interconnected. Groundwater generally flows downhill, following the same path as surface water, and eventually discharges into rivers, lakes, springs, wetlands, bays or estuaries. If you keep impurities out of surface water but do not protect groundwater — or vice versa — contaminated waters may occur where you least expect.

What is underground at your site?

There are several ways to find out about soil depth, bedrock type, and other features below the ground. If you have a well, check your well-drilling records, ask a neighbor who has a well, call a local well-drilling company, talk to your county Extension agent, or call the local government office that gives permits for drilling wells. The Natural Resources Conservation Service maintains county soil surveys. You may also contact the South Carolina Geological Survey, the U.S. Geological Survey or your local soil and water conservation district (see page 118).

The closer the water table is to the land's surface, the more the groundwater is susceptible to contamination.

Risk Assessment 1.1 Physical Characteristics of Your Homesite

Record the characteristics of your homesite on the chart below. For each characteristic, three choices are given. These choices describe situations or activities that could lead to high, medium and low risks to human or environmental health. Mark your risk level in the right hand column.

Do the best you can. For some questions, your well-drilling records or local well drillers may be able to help. Some choices may not be exactly like your situation, so choose the response that best fits. Refer to Part 1.1 above if you need more information to complete the table. If no choice is applicable, leave that line blank.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Soil type and risks to lakes, rivers, wetlands or other surface water from runoff	Sand / gravel (large particles)	Silt/loam (midsize particles)	Clay (very tiny particles)	❑ Low ❑ Medium ❑ High
Soil type and risks to groundwater from infiltration	Clay (very tiny particles)	Silt/loam (midsize particles)	Sand / gravel (large particles)	❑ Low ❑ Medium ❑ High
Soil depth	Deep (over 12 feet)	Moderately deep (3-12 feet)	Shallow (less than 3 feet)	❑ Low ❑ Medium ❑ High
Bedrock	Solid, not permeable or fractured	Solid limestone or sandstone	Fractured bedrock — any kind	❑ Low ❑ Medium ❑ High
Depth to water table	Over 20 feet	10-20 feet	Less than 10 feet	❑ Low ❑ Medium ❑ High
Nearness to surface water	Over 100 feet	25-100 feet	Less than 25 feet	❑ Low ❑ Medium ❑ High

Responding to Risks

You can't depend solely on the physical characteristics of your soil, bedrock or other site features to protect water quality. You must take informed steps to prevent pollution. Although you can't change your soil type or the depth to groundwater, you can take these factors into account when choosing home management practices that are better for preventing environmental problems. Note especially the medium and high risks you identified. Keep them in mind as you complete your homesite map and work on other *South Carolina Coast-A-Syst* chapters.

Coastal Natural Hazards

While you are taking the time to inspect your property, consider also looking over your home's structure. In coastal South Carolina, high winds from hurricanes or other storms are a common cause of damage to homes. If your house is in an unobstructed area or within 1500 feet of open water, it is at greater risk for damage from these winds.

Generally, **the most vulnerable parts of a house are the roof, windows and doors.** If a window, door or roof is punctured, wind uplift forces inside your home can more than double, leading to further damage.

Check your roof: Do the shingles look old, cracked or worn? Have you noticed dark spots in the attic indicating water damage? If so, it may be time to replace your roof covering. When you do, follow the newest building code recommendations for high wind areas, available from your local building official. If you do not have "hurricane straps" (metal connectors attaching the roof to the walls), think about adding them.

It is also wise to use window coverings — commercial or plywood shutters — on your windows and doors. Designs for plywood shutters are available free from the Engineered Wood Association (APA) website at www.apawood.org, or for $1 by mail. You can reach the APA by telephone at (206) 565-6600. Local hardware stores may also give demonstration classes on installing shutters.

Unless your garage door is designed to withstand strong storms, wind forces can push it out of the roller track, especially if the track is lightweight or some of the anchor bolts are not in place. You can reinforce the door with a commercially available retrofit kit.

For more information about strengthening your home, contact the Institute for Business and Home Safety at www.ibhs.org, or 175 Federal Street, Suite 500, Boston, MA 02110-2222, telephone: (617) 292-2003. Recommendations for re-roofing are available from Clemson University's civil engineering department. To request the publication *What Homeowners Can Do to Make Their Homes Stronger Against High Winds,* contact S.C. Sea Grant Extension Program Coastal Hazards Specialist Beth Judge by telephone at (843) 727-6497 or by fax at (843) 727-0191, or see www.clemson.edu/special/hugo/.

Part 1.2 Making a Map of Your Homesite

Why make a map?

Drawing a map of your homesite will help you to better understand your pollution risks. Although your property has physical features you cannot change, there are many things that you can do to minimize the threats to water quality. Your map will identify areas where you can focus your efforts. You'll add to your map in other *South Carolina Coast-A-Syst* chapters. If you involve your children as you make your map and conduct the assessment, you can help teach them the importance of having clean water.

The materials you need to make your map are readily available: a measuring tape, a clipboard, a pencil and the grid provided on page 11. The map you create will be an aerial view — the way your property would look if you took a photo of it from the air. A sample map is provided in Figure 1.6 on page 8.

Don't leave out things you cannot see.

Learn about previous or current industrial or agricultural activities in the area. Check with your town or city hall for information. Old landfills and buried fuel tanks are just a few examples of what you might find. Find out if any underground fuel tanks exist on neighboring properties. If there are tanks, septic systems or other potential sources of contamination upgradient (that is, uphill) from your well, they could affect the quality of your groundwater. These issues will be discussed in-depth in subsequent chapters.

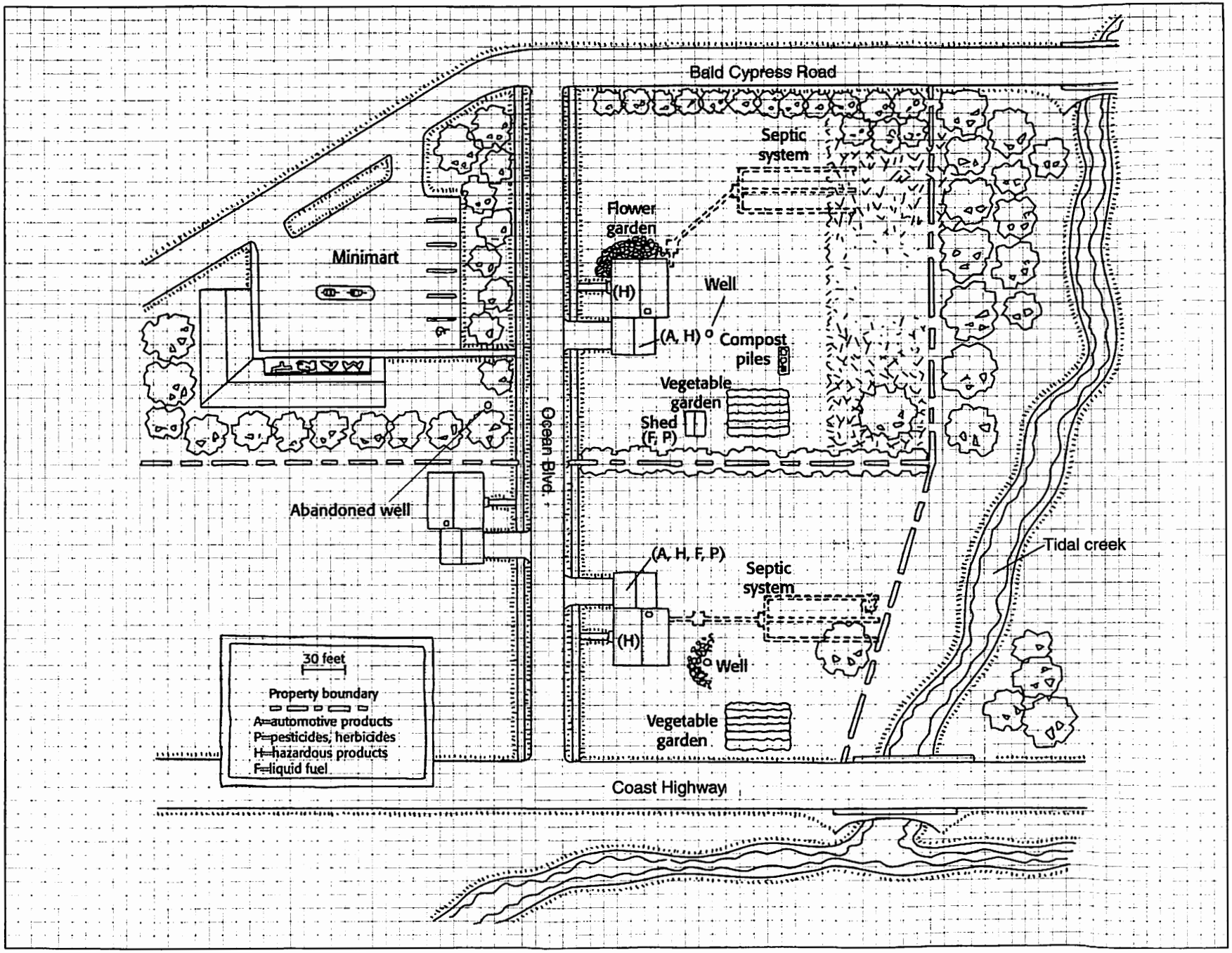


Figure 1.6. An Example of a Homesite Map

State Critical Areas

In addition, throughout the coastal zone are designated land and water resources called critical areas. By law, the critical areas in South Carolina are the coastal waters, tidelands and beach/dune systems that are located in each of the eight coastal counties. In these areas the S.C. Office of Ocean and Coastal Resource Management (OCRM) has direct jurisdiction over any alteration, however small. If your property is located on a tidal creek, salt marsh wetland or directly on the beachfront, there are certain activities that are illegal in front of the designated critical line. If you have a critical area on your property, please make sure to indicate the line on your site map and be aware of the limitations outlined by the state.

Potential Sources of Contaminants

Several home management practices and home site characteristics could have major effects on water quality. As you survey your property to make your map, be especially watchful for ...

- Improperly located or poorly maintained septic system.
- Underground or aboveground storage tank containing fuel oil, gasoline or other petroleum products.
- Improperly constructed or abandoned well.
- Stockpiled animal waste or animal pens, corrals or kennels close to a well or surface water body.
- Improper storage, use or disposal of yard and garden chemicals and other hazardous products like paints and solvents.
- Machine maintenance workshop near well.
- Abandoned automobiles and boats which contain fuel, lubricating oil or other petroleum products.

Although your property has physical features you cannot change, there are many things that you can do to minimize the threats to water quality.

Instructions for Your Homesite Map

You should include the following homesite features in your map:

- Property boundaries
- House and garage
- Outbuildings, sheds
- Septic system and drainfield
- Nearest surface water (wetlands, tidal creeks)
- Active wells
- Dry or abandoned wells
- Heating oil or other fuel storage tanks
- Building perimeter drains (french drains and others)
- Lawn areas
- Vegetable and flower gardens
- Other cultivated areas
- Animal waste storage areas
- Roads, driveways
- Drainage ditches
- Beach dunes
- Impervious surfaces (patios and sidewalks)

Location Codes

On your map, note the areas where you store and use chemicals and other potential hazards by using letter codes. Also, make note of any OCRM critical areas so they can be singled out for increased attention. Make up your own code letters or symbols as needed. Examples are:

F = Fuel tanks for gasoline or heating oil
A = Automotive products (motor oil, gasoline, antifreeze)
P = Pesticides (herbicides, insecticides fungicides)
H = Hazardous products (solvents, acids, paints, thinners)
C = Critical areas (dunes, salt marsh tidal creeks)

Other Map-making Ideas

For larger-view maps, add landscape features such as hills, rivers and ponds and human-built features such as runoff pathways, roads and bridges. Note potential sources of contamination beyond the boundaries of your property such as farm fields, dumps and gas stations. Indicate seasonal changes at your homesite. For example, are there wet areas in the spring? Such areas might indicate a high water table.

Putting It All Together and Taking Action

The final step is to put both pieces of your assessment together — the results from Assessment 1.1 on page 6 and your homesite map. This will allow you to identify potential problem areas on your property. If you have rated any of the items in the table as medium or high risks and have identified potential contamination sources, then you should be concerned.

For example, you may have identified an underground heating oil tank or realized that you apply lawn or garden chemicals within 25 feet of a lake or stream. Perhaps your soil is sandy and your septic system is close to your

drinking water well. Is your compost pile located too close to a tidal creek or river? To protect your family's health and the environment, and to safeguard your financial investment, you will want to take steps to correct these problems.

How Coast-A-Syst Can Help

If you recognize potentially hazardous or unsafe situations, what should you do? Each *South Carolina Coast-A-Syst* chapter addresses specific concerns. These chapters will help you identify problems and develop an action plan for protecting your family's health and the local environment.

For more information about topics covered in the Coast-A-Syst program, or for information about laws and regulations specific to your community, contact your local Cooperative Extension office.

For More Information

Publications

Call the South Carolina Department of Health and Environmental Control (DHEC) at (803) 898-4187 to request a copy of these useful tools:

- *Turning the Tide: A Citizen's Guide to Reducing Nonpoint Source Pollution*, a 24-page brochure providing information on reducing nonpoint source pollution

- *What Is a Watershed?* This publication describes what a watershed is and how you can protect yours.

Understanding our Coastal Environment. This booklet documents the coastal landscape of South Carolina from marshes to tidal inlets and talks about the importance of each area. Request a copy by contacting the OCRM at (843) 744-5838.

Educational Resources for Schools

South Carolina Maps and Aerial Photographic Systems, 1996. (P.W. Cain, J.R. Wagner, J.B. Berry, III) is available from:
Steve Bates
South Carolina Department of Natural Resources
P.O. Box 167
1000 Assembly Street
Columbia, SC 29202
(803) 734-3885

Soil Testing

Agricultural Service Laboratory
171 Old Cherry Road
Clemson, SC 29634
(Contact your local Cooperative Extension office to learn more about this service.)

Services offered by the soil-testing lab are described in the brochure, *The Agricultural Service Laboratory at Clemson University* (IL 28), available from:
Clemson University Cooperative Extension
Bulletin Room
82 Poole Agricultural Center
Clemson, SC 29634-0129
(864) 656-3261

This material was adapted for South Carolina Coast-A-Syst by Cal Sawyer, S.C. Sea Grant Extension Program. The section on site assessment chapter was originally written by Alyson McCann, Water Quality Program Coordinator, University of Rhode Island Cooperative Extension, and adapted for South Carolina Home-A-Syst by Barbara Speziale, Clemson University Cooperative Extension. Natural hazard information provided by Beth Judge, S.C. Sea Grant Extension Program.

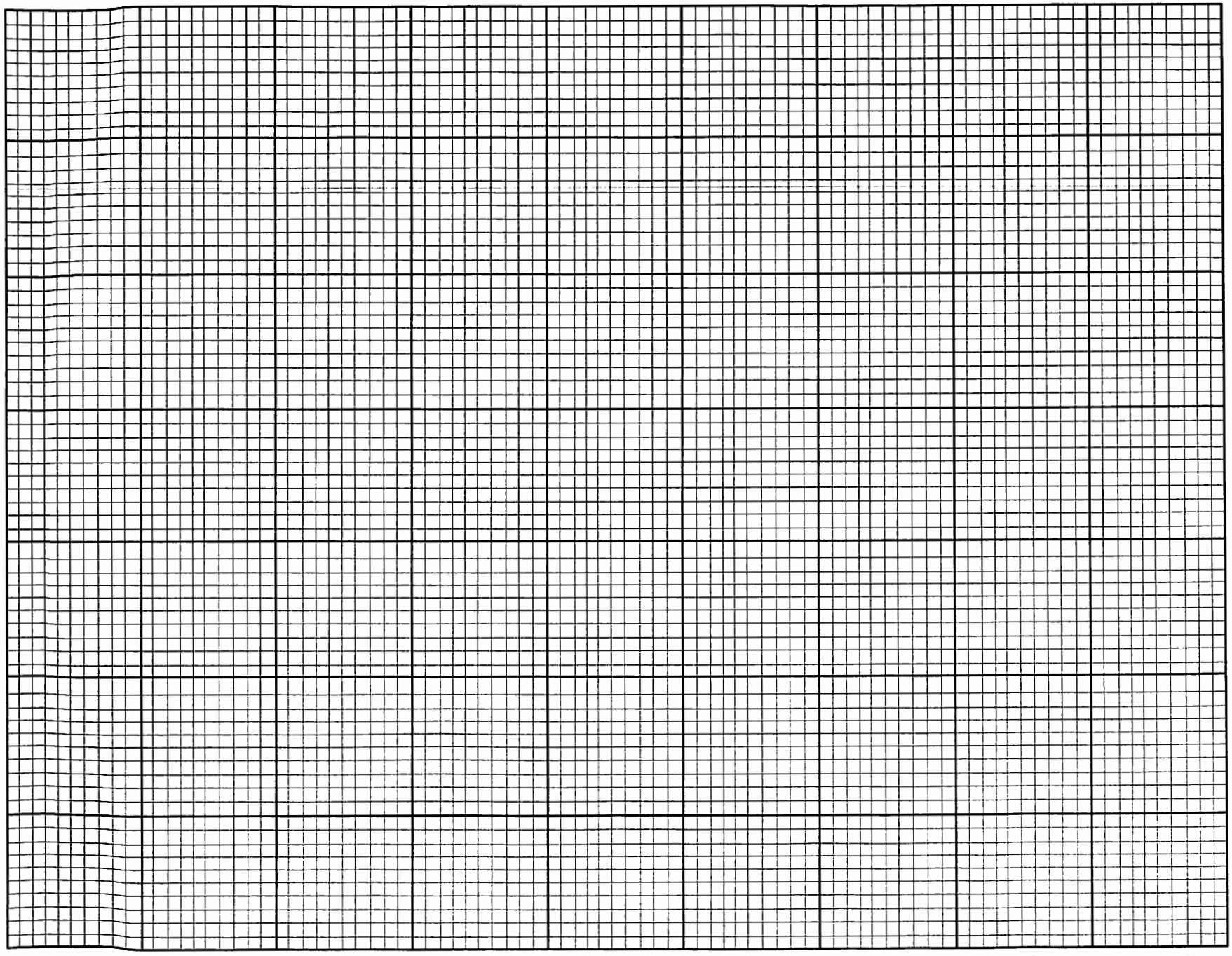


Figure 1.6. Blank Graph Paper for Your Homesite Map

Graph Paper for Homesite Map
(one block = 1/10 inch = 10 feet)

The Clear Choice: Managing Stormwater On Your Property

Chapter 2

This chapter examines potential risks to the coastal environment and your health from the adverse affects of stormwater runoff. Two areas are covered:

1. *Reducing Pollutants in Runoff.* Pollutants can include pesticides and chemicals, automotive wastes, grass clippings and yard waste, and pet and animal wastes.

2. *Landscaping and Site Management to Control Runoff.* Some ways to help control runoff are preventing soil erosion, landscaping, providing proper roof drainage and minimizing paved surfaces.

Completing this chapter will help you evaluate how stormwater affects the environmental quality of your property as well as properties "downstream." You will also learn ways to reduce pollution risks.

What is stormwater, and why should you be concerned?

Stormwater is water from rain — or melting snow — that does not quickly soak into the ground. Stormwater flows from rooftops, over paved areas and bare soil, and through sloped lawns and fields. As it flows, this runoff collects and transports soil, pet waste, pesticides, fertilizer, oil and grease, leaves, litter, and other potential pollutants. You don't need a heavy rainstorm to send pollutants rushing toward streams, wetlands, lakes and oceans. A single garden hose can supply enough water.

Even houses that are not beside a creek or lake can contribute to problems. Storm drains and sewers are designed to move runoff from your neighborhood to the nearest body of water. Contrary to popular belief, storm sewers do not carry stormwater to wastewater treatment plants (Figure 2.1).

You don't need a heavy rainstorm to send pollutants rushing toward streams, wetlands, lakes and oceans. A single garden hose can supply enough water.

The bottom line is that polluted stormwater degrades South Carolina's coastal environment. Sediment clouds water and smothers habitats for fish and plants. Nutrients like phosphates and nitrates can promote excessive algae growth. Toxic substances such as antifreeze and oil from leaking cars, carelessly applied pesticides, and zinc from galvanized metal gutters and downspouts may threaten the health of fish and other aquatic life. Bacteria, viruses and parasites from animal waste may make nearby lakes, rivers and beaches unsuitable for wading, swimming, or shellfish harvesting after storms.

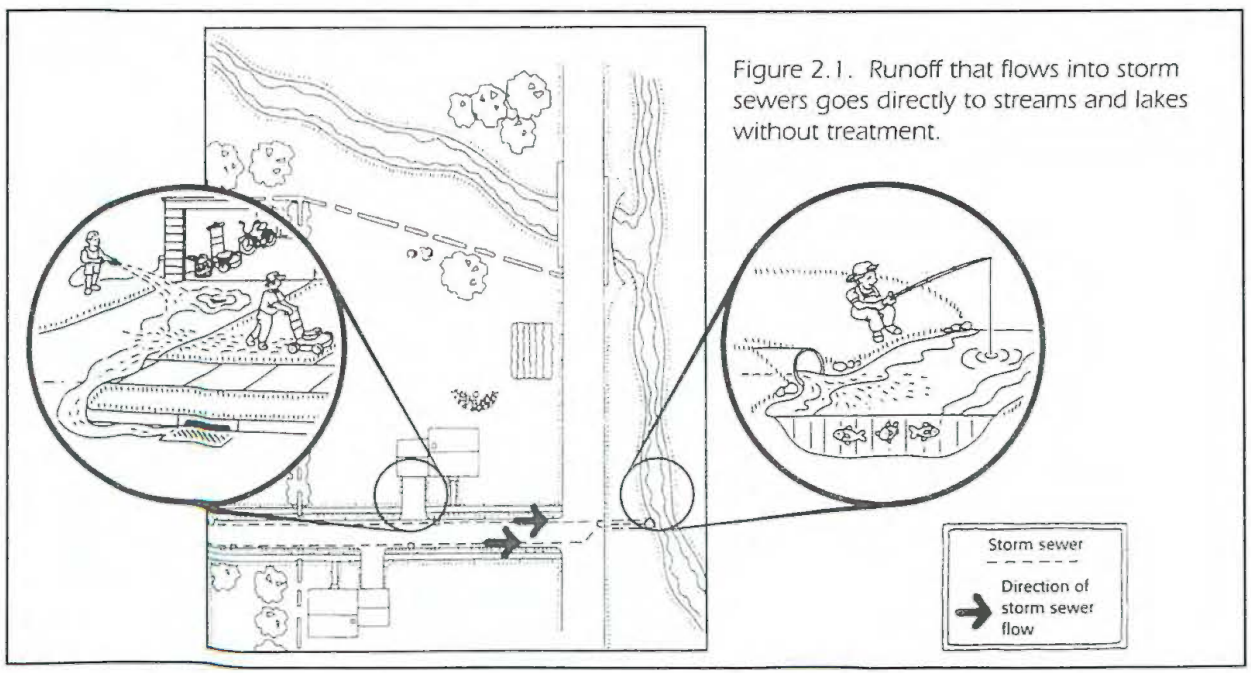


Figure 2.1. Runoff that flows into storm sewers goes directly to streams and lakes without treatment.

As many people have discovered, stormwater can be a problem closer to home. Although runoff is natural, changing the landscape increases the amount of runoff by limiting infiltration. For highly developed, gentle sloping, low-lying areas of the coast, runoff causes chronic (and sometimes severe) flooding problems. Stormwater can also flow down poorly sealed well shafts contaminating drinking water.

Public officials are shifting their pollution control efforts from wastewater discharges to stormwater management, especially in those coastal areas experiencing rapid population growth. Stormwater pollution cannot be treated in the same way as water pollution from discharge pipes. Runoff pollution originates from multiple sources (see Table 2.1). ***Every street, parking lot, sidewalk, driveway, yard and garden can potentially contribute to the problem.*** The issue can only be solved with everyone's help.

Part 2.1 Reducing Pollutants in Runoff

Stormwater in the coastal zone is unavoidable, but its effects can be reduced by keeping harmful substances out of the runoff. This section reviews potential sources of contamination and offers ways to minimize them. At the end of the section, fill out the assessment table to help identify stormwater risks on your property.

Where does stormwater go?

The next time you're home during a storm, and it's safe to go outside, take your boots and umbrella and watch where the rainwater goes. On a sketch of your property, draw arrows showing the direction that stormwater flows off driveways, rooftops, sidewalks and your yard. A sample map is provided in Figure 2.2. (Instructions for making a homesite sketch can be found in Chapter 1 beginning on page 7.)

Table 2.1. Common Sources of Stormwater Pollutants

Pollutant	Common Sources	Reasons for Concern
Sediment	Construction sites; bare spots in lawns and gardens; wastewater from washing cars and boats on driveways or parking lots; unprotected and eroding stream banks	Loss or destruction of habitat for fish and plants. Potential navigation hindrances.
Pathogens	Animal and pet wastes, malfunctioning septic systems, sewer overflows	Serious risk to human health. Closure of shellfish beds and beaches.
Nutrients	Overused or spilled fertilizers; pet waste; grass clippings and leaves left on streets and sidewalks; leaves burned in ditches	Increased potential for nuisance or toxic algal blooms. Lower levels of dissolved oxygen in surface water.
Toxic Contaminants	Car and truck exhaust; metallic debris from brake pads, leaks and spills of oil and gas; improperly applied pesticides	Serious risk to aquatic life and human health.
Debris/Litter	Improperly discarded plastic, fishing line, six-pack rings, styrofoam, cigarette butts, grocery store bags, etc.	Potential risk to human health and aquatic life. Unpleasant to see along the side of a road or the bank of a river. Expensive to clean up and discard properly.
Thermal Stress	Runoff from large impervious areas such as parking lots or roads	Reduces opportunity for valued native aquatic species. Increases risk of invasive, non-native nuisance species.

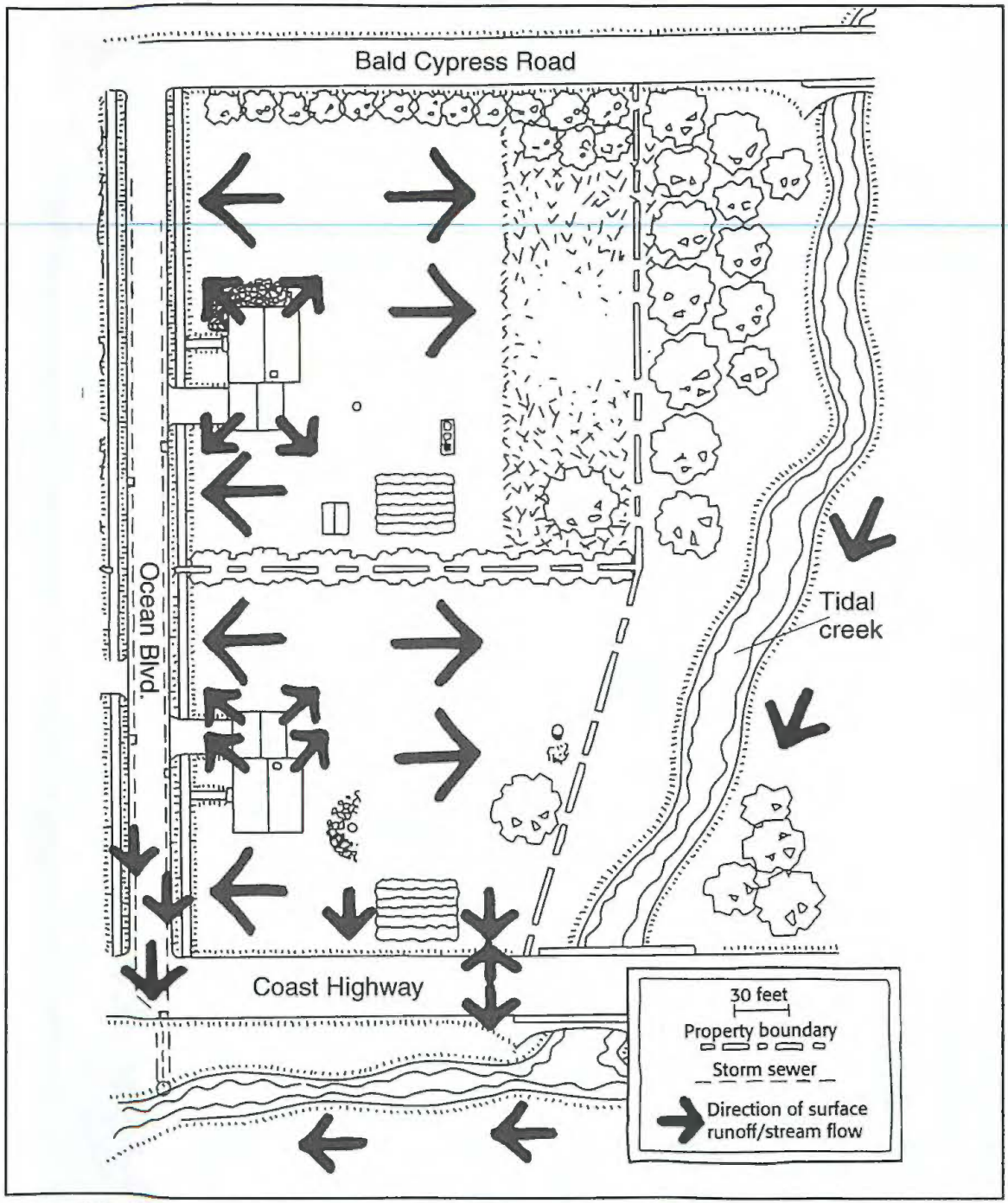


Figure 2.2. A homesite map with arrows showing the directions of surface runoff and stream flow.

Does water soak into the ground quickly, or does it puddle in places and flow off lawns and driveways? Your soil type affects water infiltration (soaking into the ground). As you might expect, water infiltrates sandy soil quickly but has a hard time seeping into fine-grained silt or clay soils.

During your walk, note how far it is to the nearest storm sewer, ditch, wetland, stream or surface water. Note whether runoff flows onto your land from adjacent streets, lands or stormwater systems. If you live at or near the bottom of a hill, you may have special problems. Try to go out during more than one rain shower to get a good understanding of runoff flow during small and large storms.

Does your car or truck leak?

Oil stains on your driveway and spills of antifreeze, brake fluid or other automotive fluids are easily carried away by a rainstorm. If the runoff from your driveway has an oily sheen, that's a sure sign that you need to be more careful.

Pans, carpet scraps, and matting can catch drips. Routine maintenance can prevent your car from leaking and help identify potential leaks. If you change your own oil, be careful to avoid spills and collect waste oil for recycling. Store oily car parts and fluid containers where rain and runoff cannot reach them. Never dump used oil, antifreeze or gasoline down a storm drain, in a ditch or on the ground. These wastes will end up in a nearby lake or stream, or they may pollute your drinking water.

Washing your car in the driveway creates runoff without the help of a rainstorm — your hose provides the water. The dirty, soapy runoff drains directly into storm sewers, picking

Using more pesticides or fertilizers than recommended invites pollution problems and is unnecessarily costly.

up oil and other pollutants as it goes. Try washing your car on the lawn or, better yet, take it to a commercial car wash or spray booth that sends its dirty water to a wastewater treatment plant.

Are household products stored outside the reach of stormwater?

Many households store lawn and garden products such as weed killers, insect killers and fertilizers. If stormwater or floodwater reaches these products, it can transport them into surface water and possibly your well. Pool chemicals, salt for water softeners and a wide variety of other chemical products can also cause trouble if they are washed away. See Chapter 5 for more information on selection, safe storage and disposal of household hazardous products.

Do you use and handle chemicals safely?

Safe storage is only the first step in preventing contaminated runoff. When mixing chemicals, try to do it within a washtub so spills will be contained. If you spill chemicals, act quickly to contain and clean up the spill. This is particularly important on paved surfaces. Carefully read and follow all application instructions. Using more pesticides or fertilizers than recommended invites pollution problems and is unnecessarily costly. Timing of applications is also important. DO NOT apply pesticides and chemicals if rain is expected within 24 hours.

Coastal Natural Hazards

Severe flooding not only affects water quality, it can also substantially damage your home and its contents. Elevated water levels in Horry County caused by Hurricane Floyd in 1999 damaged close to 2000 South Carolina homes. Many of the affected families did not realize that standard homeowner's insurance policies do not cover flood damage.

Flood insurance is provided by the Federal Insurance Administration (FIA) and administered through the National Flood Insurance Program (NFIP). The Federal Emergency Management Agency (FEMA) conducts scientific studies to determine flood hazard areas and issues Flood Insurance Rate Maps (FIRMs) showing the locations of these areas. Rates are set by the FIA, so whether you buy your flood policy directly from the FIA or through a private insurer, you should be quoted the same rate.

If you live in a flood zone — or if you want to guard against uninsured flood damage from unusual events — consider purchasing a flood insurance policy. The average premium cost is $300 for $108,000 worth of coverage. You can reduce your premium costs by electing higher deductibles or elevating your home from one to four feet above the 100-year base flood level. In addition, if your community has been recognized by the Community Rating System for taking steps exceeding the minimum NFIP guidelines, you could be eligible for discounts up to 45 percent.

For more information about the NFIP, call the S.C. Department of Natural Resources at (803) 734-9103, the Federal Emergency Management Agency at (770) 220-5400, or your local permit office. Your local building inspector should have copies of the FIRMs for your property.

See Chapter 6 for information on the proper use and handling of yard and garden products.

How can you keep animal wastes from becoming a pollution problem?

Droppings from dogs and cats and other commonly kept animals such as horses, exotic birds, rabbits, goats and chickens can be troublesome in two ways. First, animal wastes contain nutrients that can promote the growth of algae and aquatic plants if they enter streams and lakes. More important, animal droppings are also a source of disease organisms (dog waste, for example, can contain *Salmonella* and *Giardia*, pathogens that can affect human health). The risk of stormwater contamination increases if animal wastes are allowed to accumulate in pen areas or left on sidewalks, streets or driveways where runoff can carry them to storm sewers.

The job of cleaning up after your pet can be as simple as taking a plastic bag or pooper scooper along on your next walk. Don't just stand there and pretend you don't see what your dog is doing when he squats over — carry a bag and PICK IT UP!

No solution is perfect, but here are three ways to handle pet waste:

1. Flush it down the toilet: The water from your toilet goes to either a sewage treatment plant or a septic system that removes the pollutants before the water reaches a lake or river.
2. Bury it in the yard: Dig a hole or trench that is about 5 inches deep, at least 100 feet away from gardens, wells or surface water bodies. Microorganisms in the top layer of soil will break down the waste and release the nutrients to nearby plants. Do not add any pet waste to gardens or compost piles.
3. Put it in the trash: Check local ordinances first. Putting pet waste in the trash is against the law in some communities. Even if it's legal and easy, it's not the best solution. Waste taken to a landfill or incinerator can still cause pollution problems.

"Don't Dump! Flows To River"

This important message is being stenciled onto nearby storm drains as part of a statewide Paint the Drain Campaign. Volunteers are painting the "Don't Dump" messages to alert passers-by that nothing but rainwater belongs in these drains.

Every year antifreeze, motor oil, cigarette butts, paint, plastic and yard wastes travel through storm drains into coastal creeks and rivers, spoiling them for people and marine life.

Stenciling lets people know that these wastes flow directly into local creeks and streams without ever visiting a treatment plant. Storm drains, in effect, are pollution gateways from the street to the ocean.

For information about this project, contact Cal Sawyer, Coastal Environmental Quality Specialist, S.C. Sea Grant Extension Program, (843) 722-5940.

Are yard and garden wastes kept out of stormwater?

If left on sidewalks, driveways or roads, grass clippings and other yard wastes will wash away with the next storm. Although leaves and other plant debris accumulate naturally in streams and lakes, homesites can contribute excess amounts of plant matter, especially in areas with concentrated development. As the plant materials decompose, they release nutrients into the water. These nutrients can then stimulate growth of algae and aquatic plants.

Burning yard waste is not an environmentally friendly alternative (in some areas or times of the year, it is illegal). Hydrocarbons and nutrients released by burning leaves contribute to water pollution as well as air pollution. Rainfall washes smoke particles out of the air, and runoff picks up dust and ashes left on pavement or in ditches. You can easily avoid the problem by sweeping clippings back onto the grass, and composting leaves and garden wastes on your property to recycle nutrients.

Droppings from dogs and cats and other commonly kept animals such as horses, exotic birds, rabbits, goats and chickens can be troublesome.

Risk Assessment 2.1 Reducing Pollutants in Runoff

Use the following assessment table to rate your stormwater pollution risks. For each question, check your risk level in the right-hand column. If the choices do not exactly describe your situation, choose the response that fits best. Refer to Part 2.1 above if you need more information.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Automotive wastes	Oil drips and fluid spills are cleaned up. Dirty car parts and other vehicle wastes are kept out of reach of stormwater runoff.	Drips and spills are not cleaned up. Car parts and other vehicle wastes are left on unpaved areas outside.	Used oil, antifreeze and other wastes are dumped down the storm sewer, in a ditch or on the ground.	❑ Low ❑ Medium ❑ High
Car washing	Cars and trucks are taken to a commercial car wash or spray booth.	Cars, trucks or other items are washed on a lawn or gravel driveway.	Cars, trucks or other items are washed on a driveway, street or other paved area.	❑ Low ❑ Medium ❑ High
Storage of harmful chemicals	Chemicals are stored in waterproof containers in a garage, shed or other area that is protected from stormwater.	Chemicals are stored in waterproof containers but within reach of stormwater.	Chemicals are stored in non-waterproof containers outdoors or within reach of stormwater.	❑ Low ❑ Medium ❑ High
Handling and use of outdoor chemicals	Spills are cleaned up immediately, particularly on paved surfaces. Minimum amounts of chemicals are applied according to label instructions. Applications are delayed to avoid rain.	Applications are not delayed to avoid rain.	Spills are not cleaned up. Products are used in higher amounts than what is recommended on the label.	❑ Low ❑ Medium ❑ High
Pet and animal wastes	Animal and pet wastes are flushed down the toilet; buried away from gardens, wells, ditches or areas where children play; or wrapped and placed in the garbage for disposal.*	Animal wastes are left to decompose on grass or soil. Wastes are scattered over a wide area.	Animal wastes are left on paved surfaces, concentrated (in pen or yard areas), or dumped down a storm drain or in a ditch.	❑ Low ❑ Medium ❑ High
Yard waste	Grass clippings, leaves and other yard wastes are swept off paved surfaces and onto lawns away from water flow routes. Leaves and other yard wastes are composted.	Leaves and other yard wastes are piled on the lawn next to the street for collection.	Grass clippings, leaves and other yard wastes are left on driveways, streets and other paved areas to be carried off by stormwater. Yard waste is burned on-site.	❑ Low ❑ Medium ❑ High

*Be sure to check local regulations regarding burying or landfilling pet and animal wastes.

Responding to Risks

Your goal is to lower your risks. Turn to the Action Checklist on page 22 to record medium- and high-risk practices. Use the recommendations in Part 2.1 to help you make plans to reduce your risks.

Part 2.2 Landscaping and Site Management to Control Runoff

You can control some stormwater risks by making changes to buildings, paved surfaces, the landscape and soil surfaces. This section reviews some easily addressed problems, as well as major landscape alterations you might want to consider. More specific information on home landscape practices is covered in Chapter 6.

Are there areas of bare soil around your home?

Areas of bare soil often exist in vegetable and flower gardens, on newly seeded lawns and around construction projects. Even on the shallow sloping Coastal Plain, water from runoff can remove large amounts of soil and carry it to estuarine wetlands, rivers and lakes. Planting grass or other ground cover, such as vegetated buffer, is a good way to stop erosion. Putting straw, wood chip mulch or a biodegradable geotextile over gardens or newly seeded areas will slow erosion and promote plant growth. Properly placed straw bales, diversion ditches and commercially available silt fences around construction sites can help slow runoff and trap sediment on-site. If you are working with a contractor, insist that precautions be taken to control runoff and erosion during construction. Likewise, if you are undertaking construction on your own, look into some of these options.

Can you eliminate paved surfaces or install alternatives?

Paved roads, driveways and walkways prevent rainwater from soaking into the ground. When you have the choice, consider alternative materials such as gravel or wood chips for walkways. Avoid paving areas such as patios. Where you need a more solid surface, consider using a "porous pavement" made from bricks, interlocking cement blocks or rubber mats that allow spaces for rainwater to seep into the ground. If you must pour concrete, keep the paved area as short and narrow as possible.

Does your roof water flow onto pavement or grass?

Roofs, like any other hard surface, shed water. If gutters empty onto grassy areas, the water will have a chance to soak into the ground. Aim downspouts away from foundations and paved surfaces (Figure 2.3). For roofs without gutters, plant grass, spread mulch or use gravel under the drip line to prevent soil erosion and increase the ground's capacity to absorb water. Consider using cisterns or rain barrels to catch rainwater for watering lawns and gardens in dry weather. Keep these containers closed to avoid providing a breeding site for mosquitoes.

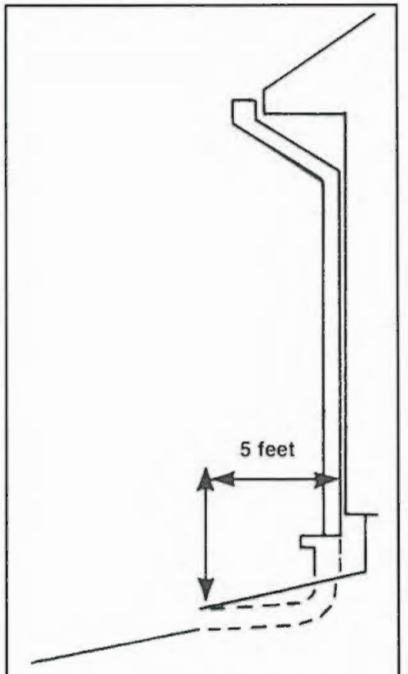


Figure 2.3. Roof drainage should be directed to the lawn at least 5 feet away from the foundation or paved surfaces.

Can you change the layout of your landscape to reduce runoff?

An essential part of coastal stormwater management is keeping water from leaving your property, or at least slowing its flow as much as possible. Many lawns are sloped to encourage water to run off onto neighboring properties or streets. Instead, landscape low areas with shrubs and flowers to encourage water to soak into the ground. If your yard is hilly, terrace slopes to slow the flow of runoff and make mowing and gardening easier. If you have a large lot, "naturalizing" areas with native woodland or wetland plants will improve aesthetics and minimize runoff impact. Good sources for ideas are your local Cooperative Extension agents, Master Gardeners, Natural Resources Conservation Service, or Soil and Water Conservation District offices.

The Need for Riparian Buffers in South Carolina

Rapid population growth and suburban sprawl in South Carolina are resulting in pollution problems all along the coast. Increased paved or hard surfaces, primarily in the form of rooftops, parking lots, and roads, has reduced infiltration and increased runoff. Among the results are greater pollutant loading, accelerated erosion and increased flooding. Establishing riparian buffers, areas of vegetation along tidal creeks and rivers, can provide numerous benefits for overall watershed and stream health, while also protecting water quality.

In its natural state, the land next to a river, tidal creek, or estuary has native plants growing on it such as trees, shrubs or tall, coarse grasses, depending on the

climate. Vegetated buffers can provide a natural filter to remove pollutants and sediments contained in surface water runoff. The effectiveness of any given vegetated buffer for removing pollutants depends on a variety of site-specific conditions, such as slope, soil type, type of vegetation and permeability. A vegetated buffer is typically found between an inland area (pollutant source) and an adjacent waterway. As runoff moves through the vegetated buffer, sediment and pollutants attached to sediment are filtered out as the buffer slows flow velocity, allowing sediment and pollutants to settle out. In general, the greater the width of vegetated buffer the surface runoff must travel through, the more sediment and pollutants it can remove.

A vegetated buffer provides these benefits:

- Filters pollutants out of stormwater runoff from land surfaces.
- Decreases and filters ground and surface water runoff.
- Retains nutrients such as nitrogen and phosphates. Excessive amounts of these two nutrients can lead to algae blooms which can cause depleted oxygen levels and reduced light penetration.
- Transforms toxic substances such as ammonia to nontoxic substances.
- Provides an energy source and organic food for a productive aquatic food chain.
- Provides shading that helps regulate water temperatures and keep waters from getting too hot for aquatic and plant life.

Additional information on vegetated buffers and suggestions for types of plants to use are outlined in Chapter 6.

The S.C. Office of Ocean and Coastal Resource Management (OCRM) has also developed an excellent brochure on vegetated buffers. Details on obtaining a copy can be found at the end of this chapter, on page 23.

Establishing riparian buffers — areas of vegetation along tidal creeks and rivers — can provide numerous benefits for overall watershed and stream health, while also protecting water quality.

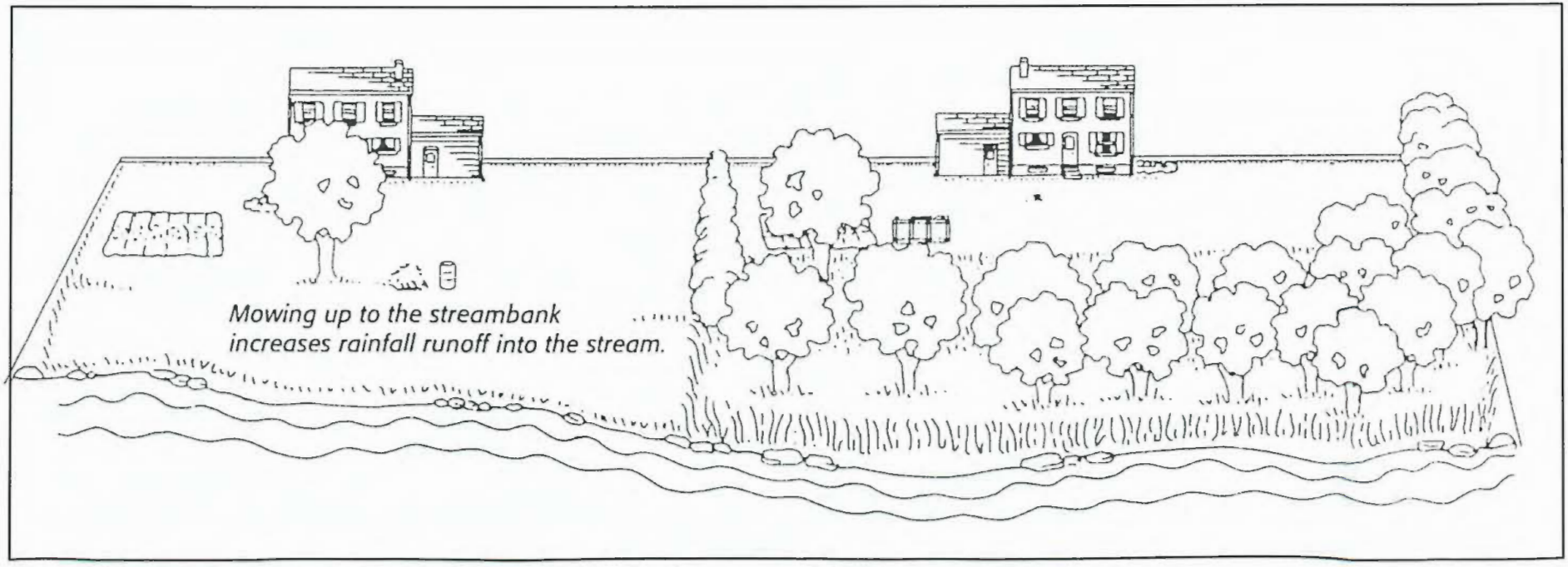


Figure 2.4. To help prevent erosion, leave a buffer strip of thick vegetation along coastal creeks, rivers and estuaries.

Risk Assessment 2.2 Landscaping and Site Management to Control Runoff

For each question in Assessment 2.2, check your risk level in the right-hand column. Select the answer that best matches your situation. Refer to Part 2.2 above if you need more information to complete the table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Bare soil in lawns and gardens	Bare spots in the lawn are promptly seeded and topped with a layer of straw or mulch. Bare soil in gardens is covered with mulch.	Grass or other groundcover is spotty, particularly on slopes.	Spots in the lawn or garden are left (exposed) without mulch or vegetation for long periods.	❑ Low ❑ Medium ❑ High
Bare soil during construction	Bare soil is seeded and mulched as soon as possible (before construction is completed). Sediment barriers are used until grass covers soil.	Soil is left bare until construction is completed. Sediment barriers are installed and maintained to detain muddy runoff until grass covers soil.	Soil is left bare and no sediment barriers are used.	❑ Low ❑ Medium ❑ High
Paved surfaces	Paved surfaces are minimized. Alternatives such as wood chips or paving blocks are used for walkways, patios and other areas.	Some small areas are paved for patios or basketball.	Paved surfaces are used extensively.	❑ Low ❑ Medium ❑ High
Roof drainage	Downspouts and drip lines direct roof drainage onto a lawn or garden where water soaks into the ground.	Some downspouts and drip lines discharge water onto paved surfaces or grassy areas where water runs off.	Most or all drip lines or downspouts discharge onto paved surfaces, or downspouts are connected directly to storm drains.	❑ Low ❑ Medium ❑ High
Landscaping and buffer strips	Yard is landscaped to slow the flow of stormwater and provide areas where water soaks into the ground. Unmowed buffer strips of thick vegetation are left along streams or lakeshores.	No areas are landscaped to encourage water to soak in, but yard is relatively flat and little runoff occurs. Mowed grass or spotty vegetation exists adjacent to a stream or lake.	There is no landscaping to slow the flow of storm-water, especially on hilly, erodible properties. Stream banks or lakeshores are eroding.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your risks associated with stormwater leaving your property. In the Action Checklist on page 22, record your medium- and high-risk practices. Use the recommendations in Part 2.2 to help reduce your risks.

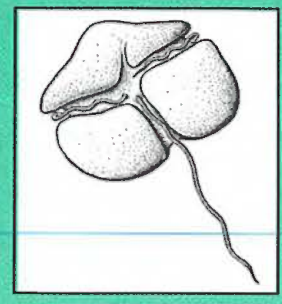
Action Checklist

Go back over the assessment tables to ensure that all medium and high risks you identified are recorded in the checklist below. For each medium and high risk, write down the improvements you plan to make. Use recommendations from this chapter and other resources to decide on actions you are likely to complete. A target date will keep you on schedule. You don't have to do everything at once, but try to eliminate the most serious risks as soon as you can. Often it helps to tackle the inexpensive actions first.

Stormwater Management

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action.
Sample: *Pet wastes left in areas where runoff occurs.*	*Bury wastes away from gardens, wells, ditches, or areas where children play.*	*One week from today: March 6*
Sample: *No vegetated buffer along the creek bank on my property.*	*Establish buffer of native vegetation by Spring.*	*Next month: April 3*

Harmful Algal Blooms



Algae are microscopic, plant-like organisms, called "phytoplankton," found in coastal lakes, rivers and estuaries. Most species of algae are not harmful. In fact, algae are the base of the global food web and release oxygen into the atmosphere, without which animals and humans could not exist.

Under some conditions, algae can grow very rapidly or "bloom," accumulating into dense patches near the surface of the water. The bloom may or may not be visible. A bloom of certain reddish-colored phytoplankton, such as the *Gymnodinium breve* shown above, is called a "Red Tide." Though the water does indeed appear red, the bloom is not associated with tides, and the organisms in it may not be harmful. On the other hand, some harmful species do not color the water or may be harmful at relatively low densities.

A small number of phytoplankton species produce powerful toxins that affect the nervous systems of animals. A few toxins can affect humans directly. Others are passed through the food web to humans who eat contaminated shellfish or fish. Scientists use the term harmful algal blooms, or HABs, to describe blooms that contain toxins or produce other negative impacts.

Recently, the alga *Pfiesteria piscicida* has been linked to fish lesions and fish kills in Southeastern coastal estuaries and is suspected to have caused some human illnesses. *Pfiesteria* is found along the Atlantic Coast from Delaware to the Gulf of Mexico, usually in slow-moving brackish water. *Pfiesteria* is not a problem along the beaches, in open ocean, or inland freshwaters. *Pfiesteria* has probably always been in our estuaries but escaped discovery until recently.

Pfiesteria is usually harmless, but it can become toxic under certain conditions. The powerful toxin stuns fish, causes surface lesions and can kill them. Severe nutrient pollution caused by runoff into shallow, poorly flushed estuaries appears to stimulate *Pfiesteria* growth. When large schools of fish congregate in these nutrient-rich estuaries, *Pfiesteria* may become active and toxic.

South Carolina estuaries have not yet been affected by toxic *Pfiesteria*, probably because our estuaries are well-flushed by tides and are not yet severely impacted by nutrient runoff. Protecting South Carolina's estuaries from excessive runoff may be the best way to avoid problems with *Pfiesteria* or other toxic algae.

Take precautions around water bodies if you see large numbers of dying or dead fish. Avoid direct water contact with them, and notify the Department of Health and Environmental Control at (888) 481-0125 or the Department of Natural Resources at (800) 922-5431. Remember, most fish kills are caused by factors other than toxic algae.

For More Information

Contact your local Cooperative Extension office and the affiliated Master Gardener groups for information on landscape management. Your local office of the Department of Health and Environmental Control (DHEC) can provide information on nonpoint source pollution and regulations regarding stormwater management for construction projects. See page 117 for a list of addresses and telephone numbers.

Bay Book: A Guide to Reducing Water Pollution at Home , is available from the Chesapeake Regional Information Service (CRIS), a project of the Alliance for the Chesapeake Bay, 6600 York Road, Baltimore, MD 21212; telephone (800) 662-2747.

For a copy of DHEC's *Citizens Guide to Stormwater Pollution*, call (803) 898-4187.

Request a copy of *Pet Waste and Water Quality* (publication GWQ006), by calling the University of Wisconsin Extension Service at (608) 262-3346.

Farming for Clean Water in South Carolina - A Handbook of Conservation Practices, is available from the South Carolina Department of Natural Resources (DNR) at (803) 734-9100.

Call OCRM at (843) 744-5838 to request a copy of *Vegetated Riparian Buffers and Buffer Ordinances*.

Harmful Algal Blooms

For information on harmful algal blooms in South Carolina, contact DHEC, DNR or your local Cooperative Extension office.

Refer to "The Facts on *Pfiesteria piscicida*," on DHEC's web site: http://www.state.sc.us/dhec/fspfies.htm

For general information about harmful algal blooms, take a look at a website called *The Harmful Algae Page*, supported by the National Office for Marine Biotoxins and Harmful Algal Blooms at Woods Hole Oceanographic Institution: http://www.redtide.whoi.edu/hab/.

This chapter was written by Carl DuPoldt, Environmental Engineer, Natural Resources Conservation Service, Somerset, NJ, and Carolyn Johnson, Water Quality Education Specialist, University of Wisconsin Cooperative Extension, Milwaukee, WI. Material has been adapted for South Carolina Coast-A-Syst by Barbara Speziale, Clemson University Cooperative Extension; Cal Sawyer, S.C. Sea Grant Extension Program; and Colton Bowles, South Carolina Department of Health and Environmental Control. Coastal hazards information was supplied by Beth Judge, S.C. Sea Grant Extension Program, and buffer information was supplied by Ward Reynolds, S.C. Office of Ocean and Coastal Resource Management.

Well Water: Keeping It Clean

Chapter 3

Keeping your well water free of harmful contaminants is a top priority — for your health and for the environment. This chapter helps you examine how you manage your well and how activities on or near your property may affect well water quality. This chapter will include the following topics:

1. *Well Location* - How close is your well to potential pollution sources? How might your soil type affect water quality?

2. *Well Construction and Maintenance* - Do you know how old your well is and what type of well it is? Is your well casing properly sealed?

3. *Water Testing* - Have tests of your well water revealed any problems?

4. *Unused Wells* - Are abandoned wells protected against contamination?

Why should you be concerned?

About 95 percent of rural residents use private wells to supply drinking water. These wells, which tap into local groundwater, are designed to provide clean, safe drinking water. However, improperly constructed or poorly maintained wells can create a pathway for fertilizers, bacteria, pesticides or other materials to enter the water supply. Once in groundwater, contaminants can flow from your property to a neighbor's well, or from a neighbor's property to your well.

Contaminants often have no odor or color and therefore are hard to detect. They can put your health at risk, and are difficult and expensive to remove. Once your water becomes contaminated, the only options may be to treat your water after pumping, drill a new well or get your water from another source.

How will this chapter help you protect your drinking water and home environment?

This chapter is a guide to help you better understand the condition of your well and how you take care of it. Easy-to-understand assessment tables help you identify situations and practices that are safe as well as ones that may require prompt attention. Some rural residents use water sources such as lakes, rivers or cisterns for their drinking water. Additional information on how to safeguard all water sources may be sought from local Cooperative Extension offices, soil and water conservation district staff, state and federal environmental agencies, and the library.

South Carolina Coastal Zone Groundwater

The South Carolina Coastal Plain region has abundant surface and groundwater resources. Rivers entering the Coastal Plain from the Piedmont start to meander, forming broad floodplains. Seasonal flooding occurs in these floodplains and bottomlands. These areas also serve as important recharge zones for regional groundwater aquifers. Well water is easily available — some deep wells yield up to 200 gallons per minute — but the quality of well water can be a concern in many areas of the Coastal Plain.

Most fresh water for drinking comes from wells, especially in rural communities. Some municipalities, such as Charleston, use aqueduct systems and tunnels to bring fresh water from Piedmont and Coastal Plain rivers and reservoirs. Rapidly increasing coastal populations are depleting available groundwater. In many areas of the coastal zone, groundwater is being used at a faster rate than it can be replenished. As a result, saltwater has entered many wells. This condition is called saltwater incursion. Because fresh water is less dense, it floats on top of the denser salt water. If a well is pumped too quickly, salt water can enter at the base of the well, contaminating the drinking water.

Part 3.1 Well Location

Your well's location in relation to other features on or near your property will determine several pollution risks. The nearness of your well to sources of pollution and the direction of groundwater flow between the pollution sources and your well are the primary concerns. At the end of Part 3.1, fill out the assessment table to determine your possible risks. The information in the following paragraphs will help you answer questions in the table.

Contaminants often have no odor or color and therefore are hard to detect.

What pollution sources might reach your well?

Whether groundwater in your area is just below the surface or hundreds of feet down, the location of your well on the land surface is very important. Installing a well in a safe place takes careful planning and consideration. Where the well is located in relation to potential pollution sources is a critical factor.

When possible, locate a well where surface water (stormwater runoff, for example) drains away from it. If a well is downhill from a leaking fuel storage tank, septic system or over-fertilized farm field, it runs a greater risk of becoming contaminated than a well on the uphill side of these pollution sources. In areas where the water table is near the surface, groundwater often flows in the same direction as surface water. Surface slope, however, is not always an indicator of groundwater flow.

Changing the location or depth of your well may protect your water supply, but not the groundwater itself. Any condition likely to cause groundwater contamination should be eliminated, even if your well is far removed from the potential source.

Does your well meet separation distance requirements?

Department of Health and Environmental Control (DHEC) regulations R.61-71 require that a completed water supply well be located no closer than 50 feet from a septic tank or its tile field, 3 feet from a building, or 100 feet from any other potential source of contamination. Potential contamination sources include animal pens, heating oil tanks and gardens. A certified well driller may suggest an increased distance from a potential contamination source (Figure 3.1). You should provide as much separation as possible between your well and any potential pollution source — at least 100 feet. Separating your well from a pollution source may reduce the chance of contamination, but it does not guarantee that the well will be safe.

What's underground?

Pollution risks are greater when the water table is near the surface, because contaminants do not have far to travel. Groundwater contamination is more likely if soils are shallow (a few feet above bedrock) or if they are highly porous (sandy or gravelly). If bedrock below the soil is fractured — that is, if it has many cracks that allow water to seep down rapidly — then groundwater contamination is more likely. Check with neighbors, local farmers or well drilling companies to learn more about what's under your property. For more information on coastal soil type and the water table, see Chapter 1, Part 1.1, "Physical Characteristics of Your Homesite."

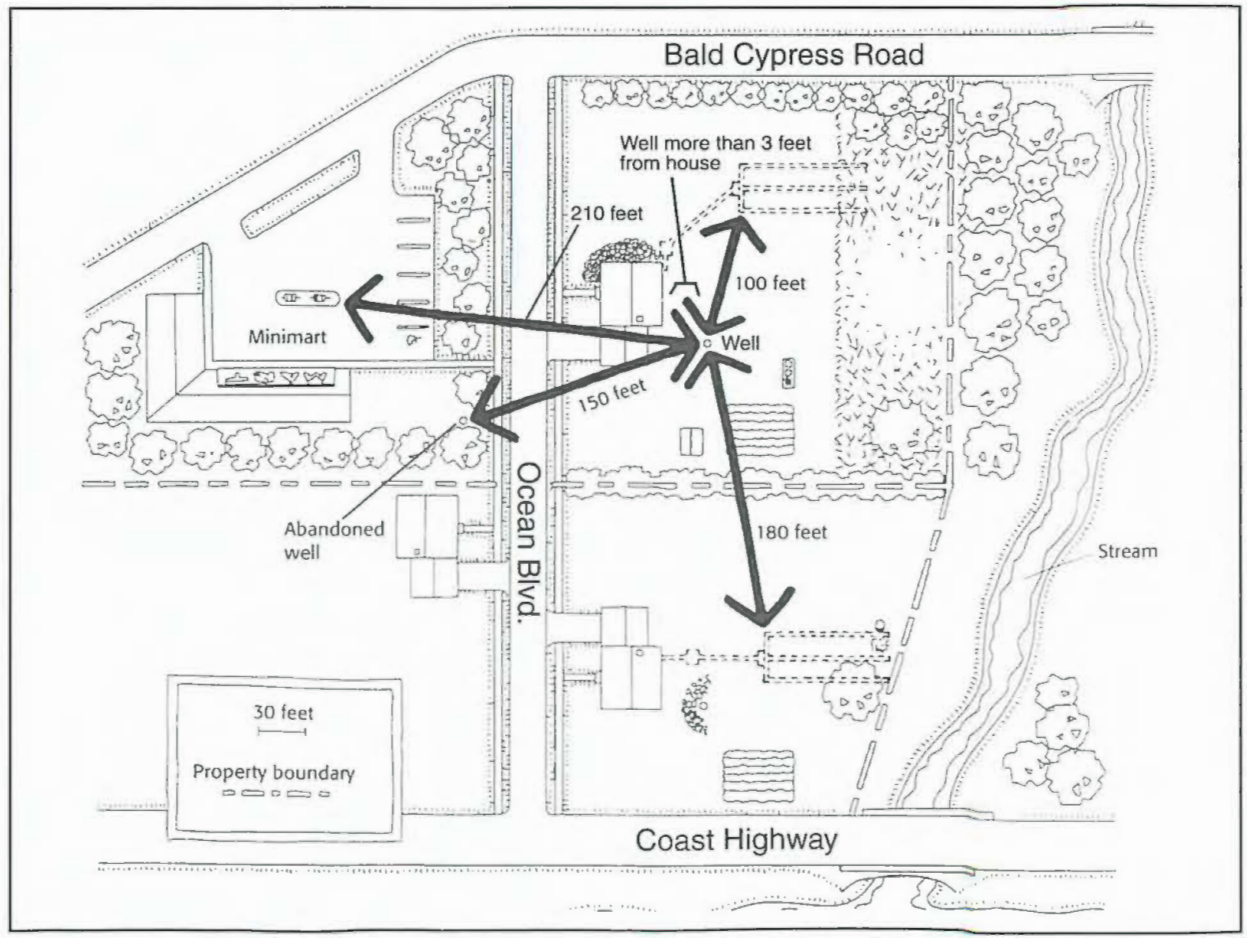


Figure 3.1. Map of homesite showing distances of pollution sources from well.

Risk Assessment 3.1 Well Location

Use the table below to rate your well location risks. For each question, indicate your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits. Refer to Part 3.1 above if you need more information to complete the table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Position of well	Well is uphill from all pollution sources. Surface water doesn't reach well or is diverted.	Well is level or uphill from most pollution sources. Some surface water runoff may reach well.	Well is downhill from pollution sources or in a pit or depression.	❑ Low ❑ Medium ❑ High
Separation distance*	Distances from potential pollution sources meet or exceed all state minimum requirements.	Some but not all distances from potential pollution sources meet state requirements.	Distances from most or all potential pollution sources do not meet minimum state requirements.	❑ Low ❑ Medium ❑ High
Soil type	Soil is fine-textured like clay loams or silty clay.	Soil is medium textured like silt or loam.	Soil is course-textured like sand, sandy loam, or gravel.	❑ Low ❑ Medium ❑ High
Subsurface conditions	The water table is deeper than 30 feet.	The water table is deeper than 20 feet.	The water table is less than 20 feet.	❑ Low ❑ Medium ❑ High

*Suggested minimum separation distance is 100 feet.

Responding to Risks

Your goal is to lower your risks. Turn to the Action Checklist on page 39 to record the medium- and high-risk practices you identified. Use the recommendations above to help you plan actions to reduce your risks.

Part 3.2 Well Construction and Maintenance

Old or poorly designed wells increase the risk of groundwater contamination by allowing rain or snowmelt to reach the water table without being filtered through soil. If a well is located in a depression or pit or is not properly sealed and capped, surface water carrying nitrates, bacteria, pesticides and other pollutants may easily contaminate drinking water.

You wouldn't let a car go too long without a tune-up or oil change. Your well deserves the same attention. Good maintenance means keeping the well area clean and accessible, keeping pollutants as far away as possible, and having a qualified well driller or pump installer check the well periodically or when problems are suspected. At the end of part this section, fill out Risk Assessment 3.2 to determine risks related to your well's design or condition.

Before You Begin Construction

A permit is required from DHEC before you construct a drinking water or irrigation well and a certified well driller is required to install the well. South Carolina must certify all well drillers operating in the state. The driller's certification indicates to the consumer that the driller has demonstrated a thorough working knowledge of well drilling and that the water can be expected to conform to established standards. Call the S.C. Environmental Certification Board at (803) 896-4430 for names of licensed well drillers in your area.

> Ask the driller to put in writing what responsibilities he will assume.

In South Carolina, residential well construction is covered under regulations R.61-44, "Individual Residential Well and Irrigation Well Permitting," and R.61-71, "Well Standards." Wells must be inspected, preferably during construction, to assure that they are compliant with these regulations. Owners are provided with a copy of the inspection results.

South Carolina regulation R.61-44 requires the owner, agent or well driller to file a Notice of Intent (NOI) and a $70 fee before the well is drilled. The fees collected fund inspectors in each of the 12 DHEC district offices. The NOI will include true and accurate information necessary for determining the location of and proper construction of individual residential wells, replacement wells and irrigation wells. This information should include owner name, address and telephone number; street address, including county, of the property on which the well is to be installed; proposed date of installation; proposed well location; whether the proposed well is a new well or replacement well; whether the proposed well is an irrigation well or individual residential well; signature of applicant and date, and (if available) name and license number of the licensed well driller constructing the well.

DHEC will review the NOI and either approve the well, provide comments or deny the application within 48 hours. The 48-hour period is calculated from the time and date of receipt of the NOI, excluding weekends and legal state holidays. If notice is not given to the applicant by the end of the 48-hour period, coverage under the general permit for individual residential wells and irrigation wells will be considered approved. The NOI is considered complete when a signed NOI with the necessary information and a check for the associated fees have been received by DHEC. The well driller must have a copy of the NOI before initiating well construction and must have a copy of the NOI on the drilling site at all times.

NOI forms can be obtained by contacting the Private Well Program, toll-free, at (888) 761-5989 or by contacting one of the 12 regional DHEC Environmental Quality offices (see the appendix, page 117). See Figures 3.2a and 3.2b on pages 29 and 30 for a copy of the NOI form. You may remove or copy this form and send it to DHEC.

NOIs and associated payment should be submitted to DHEC at the following address: S.C. Department of Health and Environmental Control, Private Well Program, Bureau of Water, 2600 Bull Street, Columbia, SC 29201.

Obtain a written contract with the well driller.

A written contract is necessary! To protect yourself, the written contract should include at least the following information:

- Cost per foot for drilling
- Number of feet of grout (at least 20 feet is required)
- Description of the pump, its horsepower and a copy of the manufacturer's warranty
- Guarantee that a commercial sanitary seal will be used to cap the well.
- Confirmation that the water will be free of sand, mud and harmful bacteria before or after the driller leaves the site (A bacteria sample should be collected to assure that the well was properly disinfected).
- Specification that the pump used by the driller to pump sand and mud out of the well is not the same one that he installs for your use.

What if the newly drilled well is dry?

Discuss the responsibility the well driller will accept in the event of a dry well. Some drillers will agree to drill another well in a different location at half price. Ask the driller to put in writing what responsibilities he will assume. Any abandoned boreholes must also be properly grouted to protect the groundwater and your new well located some distance away.

Keep Records

Get a copy of the water-well record form and your pump warranty. Keep these with your household record. The well driller must send a copy of the well record to DHEC. These records are very useful in solving future problems.

Figure 3.2a.. S.C. Department of Health and Environmental Control Notice of Intent (NOI), front

D H E C
PROMOTE PROTECT PROSPER

NOTICE OF INTENT (NOI)

CONSTRUCTION OF INDIVIDUAL RESIDENTIAL OR IRRIGATION WELL UNDER THE SOUTH CAROLINA GENERAL PERMIT #SCW00000000

BUREAU OF WATER

SEE REVERSE FOR INSTRUCTIONS

Submission of this Notice of Intent constitutes notice that the party identified in Section III of this form intends to be authorized by a permit issued for construction of an individual residential or irrigation well in the location identified in Section II of this form. Becoming a permittee obligates the construction to comply with the terms and conditions of the permit. ALL NECESSARY INFORMATION MUST BE PROVIDED ON THIS FORM. **A FEE OF $70 FOR INDIVIDUAL RESIDENTIAL WELLS OR $50 FOR IRRIGATION WELLS IS REQUIRED FOR COVERAGE UNDER THIS PERMIT.**

SCW ____—____

SCDHEC USE ONLY:

I. Well Owner Information

Name: _____ (last) _____ (first)

Address: _____ Phone: (___) _____

City: _____ State: ___ Zip: _____—____

II. Well/Site Location Information (if different from above)

Name: _____ (last) _____ (first) ☐ No Address Exists Location Map Attached

Address: _____

City: _____ State: SC Zip: _____—____

County: _____

☐ RESIDENTIAL ☐ IRRIGATION ☐ REPLACEMENT ☐ EMERGENCY

III. Well Driller Information

Well Drillers Name: _____ (last) _____ (first) SC Cert No: _____

Company Name: _____

Company Address: _____

City: _____ State: ___ Zip: _____—____

IV. Proposed Well Construction

Proposed Start Date: ___/___/___ (month day year) Check # _____

The Well Standards and Regulations R.61-71.8(A) requires a Water Well Record form be completed and submitted to SCDHEC within 30 days of well completion.

V. Certification:

I certify that this document and all attachments were prepared under my direction or supervision and the information submitted is, to the best of my knowledge and belief, true, accurate and complete.

Print Name: _____ Title: _____

Signature: _____ Date: _____

DHEC 3647(08/1999)

This Notice of Intent (NOI) must be completed properly with the appropriate fee attached in order to construct a new or replacement individual residential well or irrigation well. Submitting a completed NOI with payment attached is preferred. Please do not mail cash. However, the NOI may be faxed to SCDHEC's Central Office and payment made with credit card (Visa or MasterCard only) via telephone. It is also acceptable to fax the NOI with a copy of the check payable to *SCDHEC with receipt of the mailed check* by the Department within 5 days. Submitting the NOI with payment is Step One of the permitting process; construction of the well can begin 48 hours after the Department's receipt of the NOI . Step Two in the process is providing the Department 48 hours prior notice of well installation. Steps One and Two can be completed at the same time. The NOI may be completed by the well owner, well driller, or the owner's agent. KEEP a copy of the NOI; when the 48 hour prior notice is given, obtain the permit number from the Department and put the number in the 'SCDHEC USE ONLY' space on your Form. Completed forms accompanied by the $70 fee for an individual residential well or the $50 fee for an irrigation well are to be sent to the following address:

SC DHEC
Bureau of Water
Private Well Program
2600 Bull Street
Columbia, SC 29201

Toll-Free Telephone Number: 1-888-761-5989

Toll-Free Fax Number: 1-888-761-6681

ITEM BY ITEM INSTRUCTIONS FOR COMPLETING THIS FORM:

SECTION I: Well Owner Information

Enter the name of the well owner in the spaces provided. This can be the land owner or a developer. Enter the present mailing address and phone number of the well owner in the spaces indicated. This mailing address is not necessarily the well location. The Zip Code must be included. The area marked 'SCDHEC use only' is for the permit number which will be assigned by the Private Well Program.

SECTION II: Well/Site Location Information

If different from Section I above, enter the name of the well owner, the physical location of the well, to include the street or road, city, state, and zip code. This can also be a lot number for a new subdivision. Also enter the county , the phone number, and check the appropriate box for type of well to be installed. A residential well is intended to produce potable water for human consumption at a single residence. An irrigation well is intended to produce water for uses other than human consumption such as landscape watering and agricultural uses. A replacement well is being constructed to take the place of an existing well that is being taken out of service. An emergency well is intended to replace an existing individual residential well which has suddenly been rendered useless. The NOI and associated fee is to be submitted within 24 hours on construction of an emergency well.

SECTION III: Well Driller Information

Enter the name and SC certification number of the well driller installing the well. The NOI can not be submitted without the well driller's name; however, if the well driller changes after Step One, that change needs to be noted during Step Two. Enter the driller's company name and address in the spaces provided.

Section IV: Proposed Well Construction

Enter the date that construction is expected to begin. In accordance with R.61-44.D.5, the well driller shall give the Department 48 hours prior notice of well installation with the exact date, time, and location of well installation, which completes Step Two of the process. Indicate the check number for the check accompanying this application in the space provided.

Section V: Certification

Print the name of the well owner, well driller, or owner's agent in the appropriate spaces. The owner, or designated representative, must sign the application **(the signature must be original)** and enter the date the application was signed in the indicated area.

The application is not considered complete unless accompanied by the $70 fee for an individual residential well or the $50 fee for an irrigation well.

DHEC 3647 (08/1999)

Figure 3.2b. S.C. Department of Health and Environmental Control Notice of Intent (NOI), back

Emergency Well Replacement

When an existing residential well has suddenly been rendered useless or the water quality is not fit for human consumption, a replacement well is needed to provide a potable water supply. In such cases, a well driller may replace an existing residential well immediately. The NOI and associated fee should be submitted within 24 hours of well construction.

How old is your well?

Well age is an important factor in predicting the likelihood of contamination. Wells constructed more than 50 years ago are likely to be shallow and poorly constructed. Older well pumps are more likely to leak lubricating oils, which can get into the water. Older wells are also more likely to have thinner casings that may be cracked or corroded. Even wells with modern casings that are 30 to 40 years old are subject to corrosion and perforation. If you have an older well, you may want to have it inspected by a qualified well driller. If you don't know how old your well is, assume it needs an inspection.

What type of well do you have?

Using DHEC's definition, a well is a bored, drilled or driven shaft, or a dug hole, whose depth is greater than the largest surface dimension, for the purpose of extracting or injecting water. These include, but are not limited to, wells used for water supply for irrigation or drinking water.

Four types of wells are typically found in South Carolina (see map, Figure 3.3). In the northwestern portion of South Carolina, (A) open hole/rock wells, (B) screened wells and (C) dug wells predominate. In the Southeastern portion of the state, including the coastal zone, (A) open hole/rock wells, (B) screened wells, (C) dug wells and (D) jetted/driven wells can all be found.

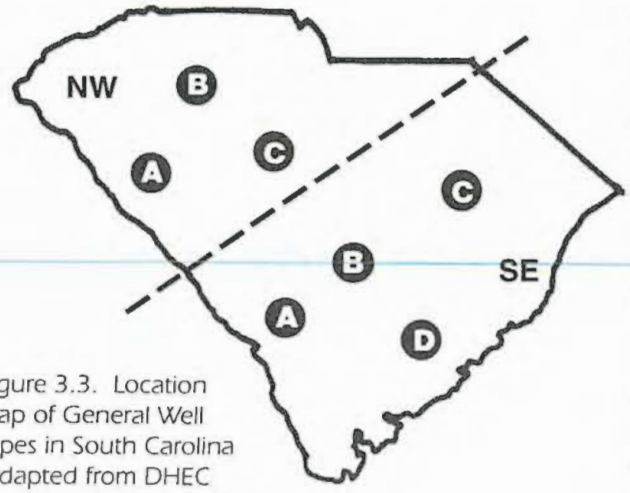


Figure 3.3. Location Map of General Well Types in South Carolina (Adapted from DHEC brochure, *Individual Water Supply Wells.*)

The general construction details of these four types of wells are shown in Figure 3.4.

A *hand-dug* or *bored well* is a large-diameter well, commonly greater than or equal to 24 inches in diameter, which is typically installed at a very shallow depth and constructed of rock, concrete or ceramic material and where water

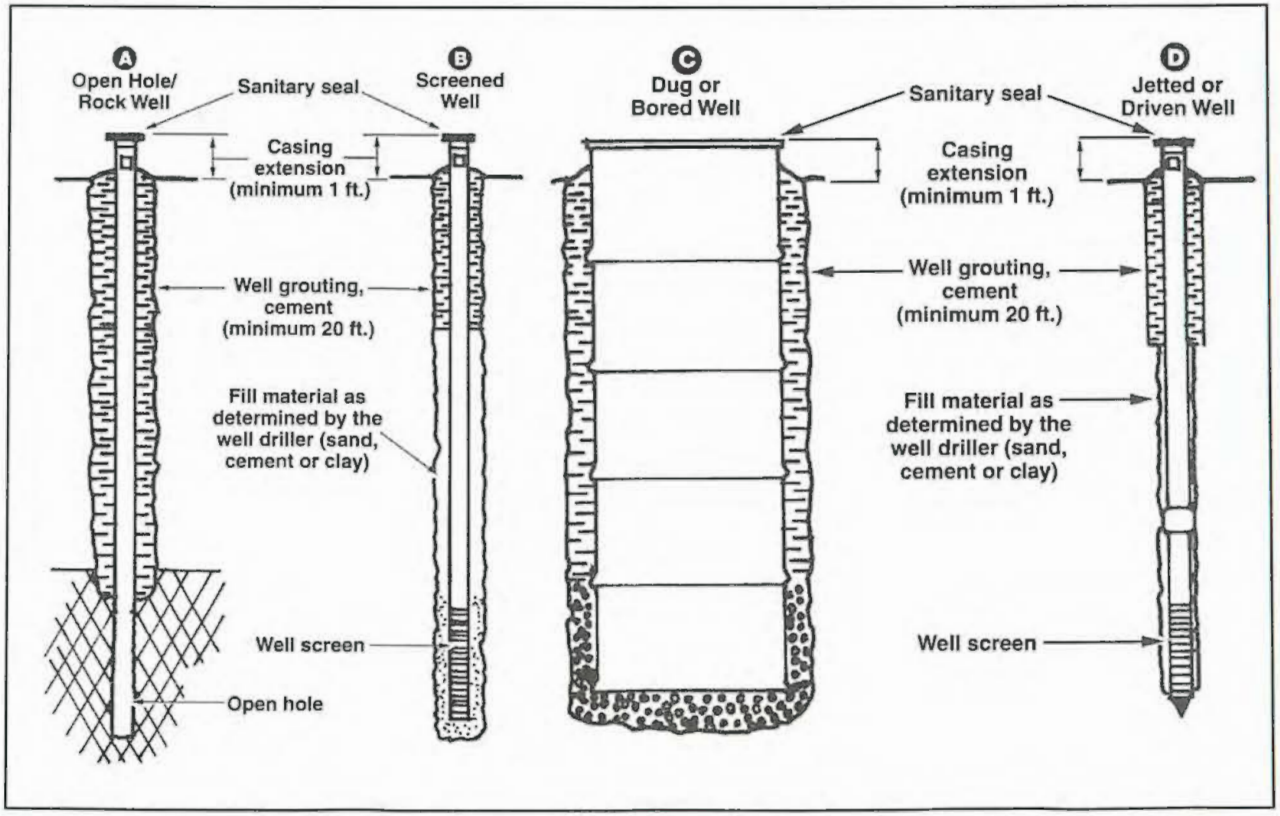


Figure 3.4. Types of Wells (Adapted from DHEC brochure, *Individual Water Supply Wells.*)

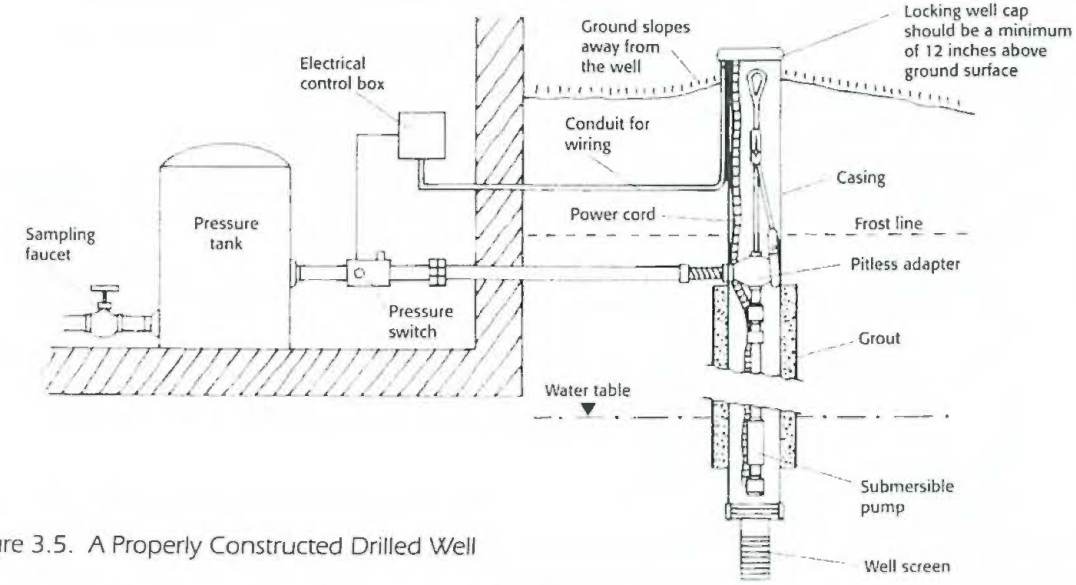


Figure 3.5. A Properly Constructed Drilled Well

can enter the well through joints in the top 20 feet of buried casing. Hand-dug or bored wells are not permitted as individual residential wells in South Carolina. *Jetted or driven-point (sand-point) wells* (D), which pose a moderate to high risk, are constructed by driving lengths of pipe into the ground. These wells are normally around 2 inches in diameter and less than 25 feet deep and can only be installed in areas with loose soils such as sand. The other types of wells (A and B) are *drilled wells* which, for residential use, are commonly 4 to 8 inches in diameter. Figure 3.5, above, shows a properly constructed drilled well.

State regulations require that the well have an attached plate that identifies it as a water supply well and includes the driller's name, the date the well was drilled, total well depth, casing depth, screen interval, well yield, water table depth and the date the well was completed. This information will be extremely valuable if the well requires any modification or repair.

Are your well casing, grouting and well caps protecting your water?

Well drillers install a steel or plastic pipe "casing" to prevent collapse of the well hole during drilling. The space between the casing and sides of the hole is a direct channel for surface water — and pollutants — to reach the water table (Figure 3.6, opposite). To seal off that channel, drillers fill the space with grout — cement or a type of clay called *bentonite*.

Properly installed grout is one of the most important protective features of your well. It ensures that contaminants from the surface do not seep down into the water you will drink. DHEC regulations require a water supply well to have cement or a mixed cement/bentonite grout from the ground surface down to a minimum depth of 20 feet. Grouting around the casing is done to seal the open space between the well casing and the drill hole wall. The seal is to prevent potential contaminants from entering the well by seeping down along the outside of the well casing. The minimum grouting required may occasionally be insufficient for this purpose. In such cases, a conscientious, experienced well driller will recommend the grout extend beyond the 20-foot minimum depth.

Watch while your well is being constructed. The driller should pump a wet grout mixture through a pipe that is lowered down the borehole to the bottom of the zone to be grouted. The pipe is raised slowly as the grout is pumped, sealing the well. This procedure is time-consuming and some well drillers might attempt to avoid it, or use minimal depth of grouting, to save themselves time and money. Ask your well driller how many feet of grout will be installed (and have that written in your contract). Show the driller that you are an informed consumer. Don't be pressured and then have to drink from a second-rate well!

You should inspect the condition of your well casing for holes or cracks. Examine the part that extends up out of the ground. Remove the cap and inspect inside the casing using a flashlight. If you can move the casing around by pushing it, you may have a problem with your well casing's ability to keep out contaminants. Sometimes damaged casings can be detected by listening for water running down into the well when the pump is not running. If you hear water, there might be a crack in the casing, or the casing may not reach the water table. Either situation is risky.

The depth of casing required for your well depends on the depth to groundwater and the nature of the soils and bedrock below. In sand and gravel soils, well casings should extend to a depth of at least 20 feet and should reach the

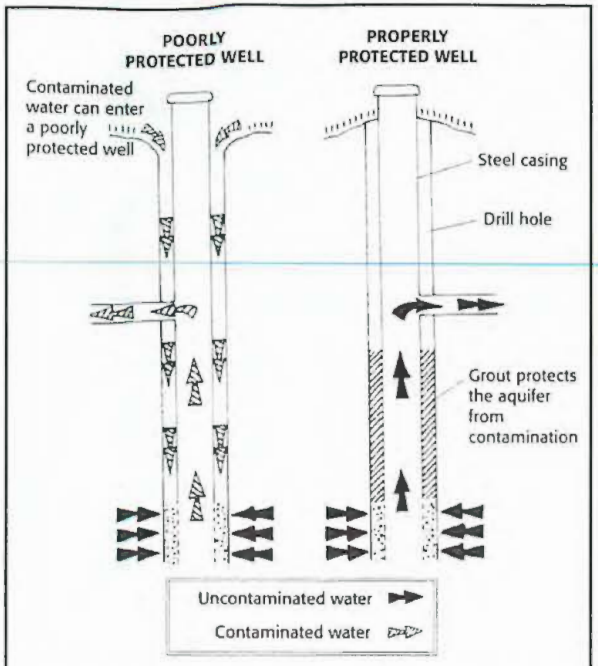


Figure 3.6. This drawing shows the difference between a poorly protected well and a properly protected well.

water table. For wells in bedrock, the casing should extend through the weathered zone and into at least 10 feet of bedrock. A minimum of 20 feet of casing should be used for all wells.

How is the top of the well sealed?

Make sure you get a commercially manufactured sanitary seal or well cap. Water pipes and electrical connections passing through the top of the well must be properly sealed to keep out insects and other surface contaminants. Make sure the breather hole in the seal is either sealed or screened to prevent insects from entering.

DHEC regulations require the well extend a minimum of a foot above ground level to the top of the casing to prevent rainwater runoff from flowing into the well. The cover on the well casing should be attached in such a manner that it is easily removable. Examine the seal periodically to ensure that it is in good condition and has not deteriorated. The casing must extend at least 12 inches above the ground surface. Since there are occasional floods throughout the coastal zone, the casing should extend 1 to 2 feet above the highest flood level recorded for your property. The ground around the casing should slope away from the well head in all directions to prevent water from pooling around the casing.

The well cap should be firmly attached to the casing, with a vent that allows only air to enter. If your well has a vent, be sure that it faces the ground, is tightly connected to the well cap or seal, and is properly screened to keep insects out. Wiring for the pump should be secured in an electric conduit pipe.

Is your well shallow or deep?

As rain and surface water soak into the soil, they may carry pollutants down to the water table. Local geologic conditions determine how long this takes. In some places, the process happens quickly — in weeks, days or even hours. Shallow wells, which draw from groundwater nearest the land surface, are most likely to be affected by local sources of contamination. Wells less than 50 to 75 feet have more chance for contamination.

Do you take measures to prevent backflow?

Backflow of contaminated water into your water supply can occur if your system undergoes sudden pressure loss. Pressure loss can occur if the well fails or, if you are on a public water system, if there is a line break in the system. The simplest way to guard against backflow is to leave an air gap between the water supply line and any reservoir of "dirty" water. For example, if you are filling a swimming pool with a hose, make sure that you leave an air gap between the hose and the water in the pool. Toilets and washing machines have built-in air gaps.

Where an air gap cannot be maintained, a backflow prevention device such as a check valve or vacuum breaker should be installed on the water supply line. For example, if you are using a pesticide sprayer that attaches directly to a hose, a check valve should be installed on the faucet to which the hose is connected.

Inexpensive backflow prevention devices can be purchased from plumbing suppliers.

Before you drink the water ...

A new well must be disinfected upon completion. Disinfectant, at a concentration of 50 milligrams of chlorine per liter of water, should remain in the well for a minimum of four hours before being flushed from the well. The disinfectant process is used to kill harmful bacteria. Household chlorine bleach is commonly used as a disinfectant. Calcium hypochlorite (HTH) or sodium hypochlorite (Perchloron) can also be used.

When was your well last inspected?

Well equipment doesn't last forever. Every 10 to 15 years, your well will require inspection by a qualified well driller or pump installer. You should keep well construction details, as well as the dates and results of maintenance visits for the well and pump. It is important to keep good records so you and future owners can follow a good maintenance schedule.

Risk Assessment 3.2 Well Construction and Maintenance

Use the table below to rate your risks related to well construction and maintenance. For each question, indicate your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits. Refer to part 3.2 above if you need more information.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Well age	Well is less than 20 years old.	Well is 20 to 50 years old.	Well is more than 50 years old.	❑ Low ❑ Medium ❑ High
Well type	Drilled well.	Driven-point (sand-point) well.	Dug well.	❑ Low ❑ Medium ❑ High
Casing height	Casing is 12 or more inches above the surface. If the area floods, casing is 1 to 2 feet above the highest recorded flood level.	Casing is at the surface or up to 12 inches above the surface.	Casing is below the surface or in a pit or basement.	❑ Low ❑ Medium ❑ High
Condition of casing and well cap	No holes or cracks are visible. Cap is tightly attached. A screened vent faces the ground.	No holes or cracks are visible. Cap is loose.	Holes or cracks are visible. Cap is loose or missing. Running water can be heard or seen.	❑ Low ❑ Medium ❑ High
Casing depth	Casing extends 50 or more feet below the land surface.	Casing extends 20 to 50 feet below the land surface.	Casing extends less than 20 feet below the land surface.	❑ Low ❑ Medium ❑ High
Backflow protection	Measures are taken to prevent backflow and, where necessary, anti-backflow devices are installed.	Measures are sometimes taken to prevent backflow. No anti-backflow devices are installed.	No measures are taken to prevent backflow. No anti-backflow devices are installed.	❑ Low ❑ Medium ❑ High
Well inspection	Well was inspected within the last 10 years.	Well was inspected 10 to 20 years ago.	Well was inspected over 20 years ago or date of last inspection is unknown.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your risks. Turn to the Action Checklist on page 39 to record the medium- and high-risk practices you identified. Use the recommendations above to help you plan actions to reduce your risks.

Part 3.3 Water Testing

Water testing helps you monitor water quality and identify potential risks to your health. Contaminants enter drinking water from many sources. Many contaminants can only be detected through a water test.

When was your water last tested?

At a minimum, your water should be tested *every year* for the four most common indicators of trouble: bacteria, nitrates, pH and total dissolved solids (TDS). If you haven't had a full-spectrum, comprehensive water test, then you don't know the characteristics of your water.

A more complete water analysis for a private well will tell you about its hardness; corrosivity; and iron, sodium and chloride content. You may also choose to obtain a broad-scan test of your water for other contaminants such as pesticides, if there is a good probability that such contamination has occurred.

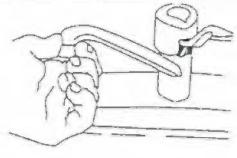
A good source of information on well water quality may be your neighbors. Ask them what their tests have revealed. Your county Extension agent or DHEC Environmental Quality Control office can also assist you to decide what sort of water testing is needed.

Some of the naturally occurring contaminants in water are listed in Table 3.1 (page 36).

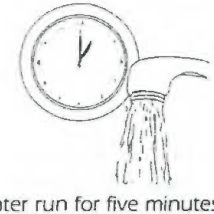
DHEC will analyze your water for you if there is reason to suspect a problem. For more information about the DHEC water testing program, consult the DHEC bulletin: *Drinking Water, Common Water Quality Problems and Their Treatment* (see page 40). The way in which you take the water sample, and the container that you use may affect the accuracy of the analysis (Figure 3.7). Before taking a water sample for analysis, contact your DHEC Environmental Quality Control office for specific instructions.

For routine chemical analysis of the water, a half-gallon sample of the water is required. The sample may be collected in a clean plastic container. DHEC analyses include lead, pH, alkalinity, chlorides, hardness, calcium, magnesium, copper, iron, manganese and zinc. Other analyses are available upon request and at the discretion of the DHEC laboratory. Because many types of analyses require special containers, preservatives or sample collection techniques, you should contact one of the DHEC Environmental Quality Control Offices or your county health department offices prior to submitting any special requests for analyses.

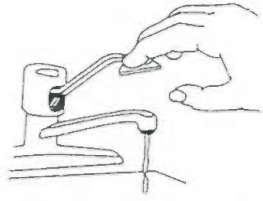
Drinking water samples may also be submitted for analysis at the DHEC Central Office, 2600 Bull Street, Columbia, SC. Water samples for routine chemical analysis must be received in the DHEC laboratory within three days of collection. You will receive your sample results by mail in approximately eight weeks.



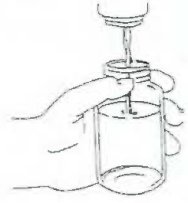
STEP 1: Remove the aerator from an indoor, leak-free cold water faucet. If testing for bacteria, flame the end of the faucet with a lighter. (Note: Flaming may discolor chrome or gold-finished faucets.)



STEP 2: Let water run for five minutes to bring in water that has not been in contact with household plumbing. (Skip this step if testing for corrosion of household plumbing—see notes.)



STEP 3: Reduce the water flow until the stream is about 1/4-inch in diameter.



STEP 4: Fill a specially prepared container as instructed by the laboratory. Do not let anything touch the inside of the cap or container.

STEP 5: Close the sample container and transport it as instructed by the laboratory.

Notes:

- Corrosive water may dissolve lead, copper, zinc or iron contained in household plumbing. If testing for evidence of corrosion, let water stand in the plumbing system at least 12 hours.
- Laboratories specially prepare containers for each category of contaminant. Do not rinse laboratory containers or fill them to overflowing.
- Always follow laboratory directions.

Figure 3.7. General Procedure for Collecting Water Samples for Mineral Analysis

Table 3.1. Drinking Water Analysis: Naturally Occurring Contaminants in Water

Contaminant	Description	Recommended Limits
Alkalinity	This is a measure of the water's ability to neutralize acids, a process known as buffering. As alkalinity increases, the water is less likely to corrode household plumbing.	An alkalinity of more than 30 mg/L is desirable for drinking water.
Calcium Magnesium Hardness	Hardness is a measure of the amount of dissolved calcium and magnesium in the water. Some hardness is desirable to reduce corrosion of plumbing.	Excessive hardness (above 150 mg/L) may produce a hard scale in water heaters and may limit the effectiveness of soaps.
Chlorides	Chlorides measure the "salt" content of the water.	Chloride concentrations less than 250 mg/L are recommended.
Iron and Maganese	The presence of iron in well water can indicate that groundwater is moving through and among rocks with a high iron content or that you have rust accumulating in the well piping.	0.3 mg/L Iron 0.05 mg/L Manganese or a total of no more than 0.3 mg/L for both
Copper	Copper is most commonly dissolved into drinking water from copper plumbing. Copper can give the water a bitter taste and produce green stains in plumbing fixtures.	Maximum recommended limit: 1.3 mg/L
pH	A scale used to measure acidity. A pH of 7 is neutral, neither acidic nor basic. As pH increases from 7 to 14, water becomes more basic. As pH decreases from 7 to 0, water becomes more acidic.	pH range for drinking water: 6.5 - 8.5
Total Dissolved Solids (TDS)	TDS measures the amount of dissolved and suspended material in water.	Maximum recommended: 500 mg/L
Zinc	Zinc in drinking water usually results from corrosion of galvanized plumbing but may also result from natural deposits. Above the recommended limit, zinc can cause a metallic taste and milky appearance in water.	Maximum: 5.0 mg/L
Lead	Excessive lead in drinking water usually results from contact with lead-painted roofs or the use of lead pipes in plumbing. Lead in excessive amounts is a cumulative poison that can cause serious illness or death.	Maximum: 0.05 mg/L
Nitrates and Nitrites	Excessive nitrate concentrations may indicate contamination from animal manure. Can cause 'blue baby disease' in infants who drink nitrate-contaminated water or formula prepared from that water.	Maximum: Nitrate: 45 mg/L (10 mg/L as Nitrogen) Nitrite: 1 mg/L
Pesticides	Careless use of pesticides, including termite treatments, near wells can contaminate the water	
Sulfates	High concentrations of sulfates in well water are caused by leaching from naturally-occurring deposits of sodium sulfate or magnesium sulfate.	Maximum: 250 mg/L
Sodium	Home water softeners add sodium to the water. The sodium content of water is unimportant for healthy persons but may affect persons on low-sodium diets. The usual low-sodium diet allows for 20 mg/L sodium in drinking water.	
Fecal Coliform Bacteria	Fecal coliform bacteria are organisms that normally live in the intestines of people and other animals. Though not themselves causes of disease, fecal coliform bacteria are used as indicators of fecal contamination of water.	Maximum approximately 1 bacterium per 100 mL water

Abbreviations: mg/L = milligrams per Liter. In water, this is the same as one part per million, or about one drop of water in 55 gallons of water.

What contaminants should you look for?

Test for the contaminants that might be found at your location. For example, if you have lead pipes, soldered copper joints or brass parts in the pump, test for the presence of lead. Test for volatile organic chemicals (VOCs) if there has been a nearby use or spill of oil, liquid fuels or solvents. Pesticide tests, though expensive, may be justified if your well has high nitrate levels — more than 10 milligrams per liter (mg/L) of nitrate-nitrogen (NO_3-N) or 45 mg/L of nitrate (NO_3). Tests are also warranted if a pesticide spill has occurred near the well. Pesticides are more likely to be a problem if your well is shallow, has less than 15 feet of casing below the water table, or is located in sandy soil and is downslope from irrigated lands such as farms or golf courses where pesticides are used.

You can seek further advice on testing from your local DHEC District Environmental Quality Control Office, Cooperative Extension office or county health department. You should test your water more than once a year if (1) someone in your household is pregnant or nursing; (2) there are unexplained illnesses in the family; (3) your neighbors find a dangerous contaminant in their water; (4) you note a change in water taste, odor, color or clarity; or (5) you have a spill of chemicals or fuels into or near your well. Water can be tested by both public and private laboratories. Once your water has been tested, keep a record of your results with your records on well construction and maintenance. This will allow you to monitor water quality over time.

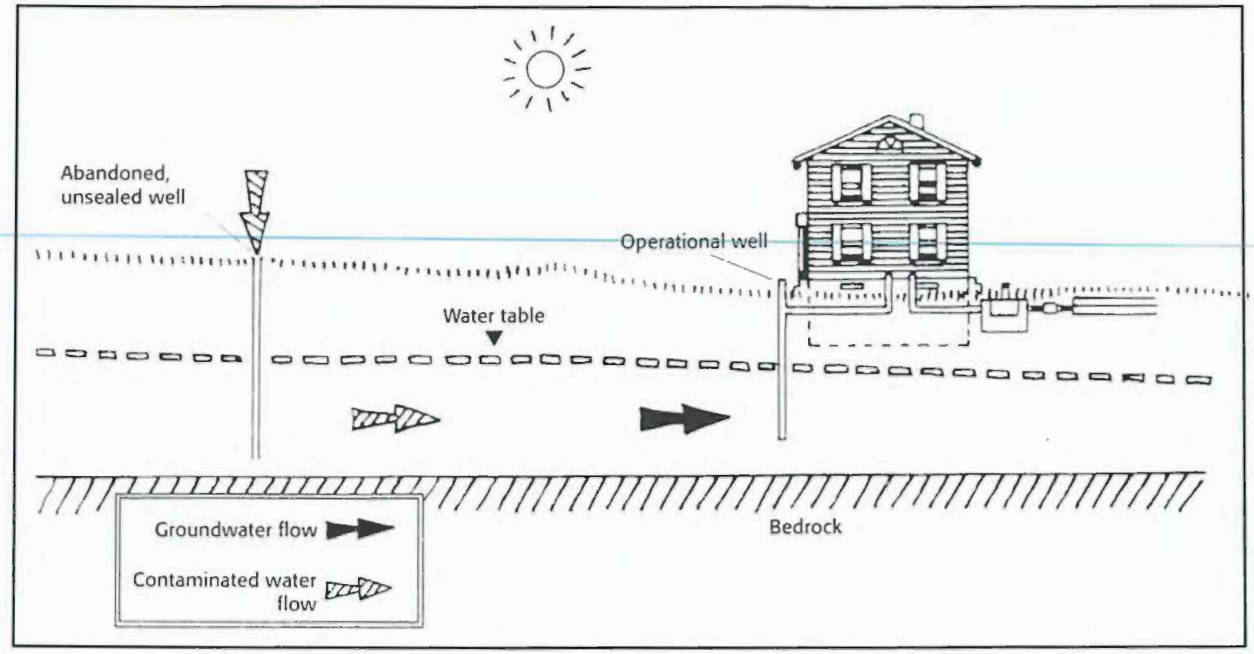


Figure 3.8. Abandoned wells that are not properly sealed provide a pathway for contaminants to reach groundwater.

Are there any abandoned and unused wells on your properly?

Many properties have wells that are no longer used. Sites with older homes often have an abandoned shallow well that was installed when the house was first built. If not properly filled and sealed, these wells can provide a direct channel for waterborne pollutants to reach groundwater (Figure 3.8).

A licensed, registered well driller or pump installer should be hired to close these wells. Effective well plugging calls for experience with well construction materials and methods, as well as knowledge of the geology of the site. The cost to close a well will vary with well depth, well diameter and soil/rock type. The money spent sealing a well will be a bargain compared to the potential costs of cleanup or the loss of property value if contamination occurs.

How to Sample Your Drinking Water for Total Coliform Bacteria

Obtain a sterile sampling bottle from a DHEC office.

The sample bottle is sterile and contains a dechlorinating compound. DO NOT open the bottle until the moment it is to be filled.

To collect the sample:

1. Remove any strainers or aerators from the faucet. Open the faucet and allow the water to run for two to three minutes.
2. Without changing the flow from the faucet, remove the bottle's cap and fill the bottle to about one inch from the top. Be careful not to touch either the inside of the bottle or the cap. Do not let water splash from your hands into the bottle. Replace the cap.
3. Fill in all of the information on the enclosed sample form that applies to you. You must fill out your name, your address and telephone number, and the date and time that the sample was collected.
4. Take the sample immediately to your county health department or the Environmental Quality Control District Office nearest you.
5. If you have questions about sampling your drinking water, please call the Bureau of Drinking Water protection at (803) 734-5310.

Please note: A total coliform sample must be received in the DHEC laboratory within 30 hours after you collect it. Samples received more than 30 hours old must be discarded. Samples are accepted on Monday, Tuesday and Wednesday (except on holidays) by 4:00 p.m. the same day collected.

Risk Assessment 3.3 Water Testing and Unused Wells

Use the table below to rate your risks related to water quality and unused wells. For each question, indicate your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits. Refer to part 3.3 above if you need more information.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Water testing	Consistent, good water quality. Tests meet standards for bacteria, nitrate and other contaminants.	Some tests do not meet standards or tests approach standards.	Water is not tested. Water is discolored after a rainstorm or during spring melt. There are noticeable changes in color, odor and taste.	❑ Low ❑ Medium ❑ High
Unused wells	There are no unused wells or there are unused wells that are properly sealed.	There are unused wells that are not sealed but are capped and isolated from contaminants.	There are unused, unsealed wells that are in poor condition, near pollution sources and/or uncapped.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your risks. Use the Action Checklist on the opposite page to record the medium- and high- risk practices you identified. Refer to the information throughout the chapter to help you plan actions to reduce your risks.

Action Checklist

When you finish the assessment tables, go back over the questions to ensure that every high and medium risk you identified is recorded in the checklists on pages 27, 34 and 38. For each risk, write down the improvements that you plan to make. Use recommendations from this chapter and from other resources. Pick a target date that will keep you on schedule for making the changes. You don't have to do everything at once, but try to eliminate the most serious risks as soon as you can. Often it helps to start with inexpensive actions.

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action.
Sample: *Water hasn't been tested for 10 years. Smells different than it used to.*	*Have sample tested in state office of public health.*	*One week from today: April 8*

For More Information

If you have further questions regarding well construction and maintenance, contact Jim Hess of the DHEC Source Water Protection - Private Well Program by calling (803) 898-3376, or at the following e-mail address: HESSJR@columb32.dhec.state.sc.us. You can also visit his website at http://www.state.sc.us/dhec/eqc/water/html/dwater.html.

Water Quality

For more information on water quality concerns and to request the following DHEC publications, contact DHEC's Outreach and Education Section, Bureau of Water, at (803) 898-4300 or http://www.state.sc.us/dhec/eqc/water.

Lead and Your Drinking Water
Drinking Water: Common Water Quality Problems and Their Treatment

Take a look at DHEC Environmental Quality Control's website:
www.state.sc.us/dhec/eqchome

You can receive the following Extension publications by contacting the Clemson University Bulletin Room at (864) 656-326 or your county Extension office:

Preventing Groundwater Contamination: Proper Well Construction, PIP 32
Water Quality and Laundry Problems, WQL 8
Iron and Manganese, WQL 9
Home Water Treatment Systems, WQL 5
Health Effects of Drinking Water Contaminants and How to Treat Them, WQL 3
Hard Water - To Soften or Not to Soften, WQL 6
Questions to Ask When Purchasing Water Treatment Equipment, WQL 4

Read the EPA publication, *Lead in Your Drinking Water*, EPA810-F-93-001 by going to the EPA Office of Ground Water and Drinking Water website at http://www.epa.gov/safewater/Pubs/lead1.html.

The following publications are available from the Northeast Regional Agricultural Engineering Service at (607) 255-7654 or http://rcwpsun.cas.psu.edu/NREAS:

Private Water Systems Handbook (MWPS-14)
Home Water Treatment (NREAS-48)
Private Drinking Water Supplies: Quality, Testing, and Options for Problem Waters (NREAS-47)

Well Water/Drinking Water Testing

DHEC conducts a Residential Well Program, which provides the general public with technical assistance on matters pertaining to the drinking water quality and construction standards of residential drinking water wells. One service provided by this program is the analytical testing of water from residential wells. For more information, contact your regional DHEC office.

Waccamaw Regional Office (Georgetown, Horry, Williamsburg Counties)
1705 Oak Street Plaza, Suite 2
Myrtle Beach, SC 29577
(843) 448-1902

Trident Regional Office (Berkely, Charleston, Dorchester Counties)
1362 McMillan Avenue, Suite 300
Charleston, SC 29405
(843) 740-1590

Lowcountry Regional Office (Beaufort, Colleton, Hampton, Jasper Counties)
1313 Thirteenth Street
Port Royal, SC 29935
(843) 522-9097

Drilling and Sealing Wells

Call the Environmental Certification Board at (803) 896-4430 for names of licensed well drillers in your area.

Drinking Water Quality Standards

Call the EPA's Safe Drinking Water Hotline toll-free at (800) 426-4791 from 9:00 a.m. to 5:30 p.m., EST, Monday through Friday.

This chapter was originally written by Bill McGowan, Agriculture/Water Quality Extension Educator, University of Delaware Cooperative Extension. Material was adapted for South Carolina Coast-A-Syst by Barbara Speziale, Extension Water Quality Coordinator, Clemson University Cooperative Extension, and Cal Sawyer, Coastal Environmental Quality Specialist, S.C. Sea Grant Extension Program.

Household Wastewater: Managing Your Home Septic System

Chapter 4

Most people don't give much thought to the wastewater created in their homes from kitchen, bathroom and laundry area drains. Wastewater treatment is usually out-of-sight and out-of-mind until problems occur. However, many people don't realize that a septic system failure is more than a nuisance: It's a health hazard and a significant danger to the coastal environment.

This chapter will help you evaluate your septic system and pinpoint risks before they become problems. It introduces you to what a septic system is and how it functions and provides general guidelines for safe management of household wastewater. The Department of Health and Environmental Control's (DHEC) Division of Environmental Health has regulatory authority governing the permitting, construction and use of septic systems in South Carolina. Local laws, however, may impose more stringent or additional requirements. Contact DHEC at your local county health department office for advice or assistance. A DHEC Environmental Health office is located in each county (see page 117).

In this chapter you'll learn ...

- How to plan the design and location of a new home's septic system.
- How to determine whether your septic system is the right size for your home.
- How to maintain a septic system.
- How to help prevent your septic system from failing.
- How to address special concerns in coastal areas.

Why should you be concerned?

Knowing the basics about your household system and taking simple precautions to safeguard it can prevent the health risks posed by inadequate wastewater treatment.

When municipal sewer systems or household septic systems fail, untreated sewage can end up both on land and in water. This untreated wastewater may contain dangerous bacteria or viruses that can threaten human life and pollute shellfish grounds and other environmentally sensitive coastal areas.

Wastewater treatment systems are designed to remove or break down these contaminants before they enter groundwater, a source of drinking water, or nearby lakes, streams, estuaries or wetlands.

Keeping your system working properly is a wise investment for environmental, human health and economic reasons. In addition to degrading natural resources, a failed system can cost thousands of dollars to replace.

> Septic system failure is more than a nuisance: It's a health hazard and a significant danger to the coastal environment.

Where is Your Wastewater Treated?

Do you have a septic system or other on-site system to treat wastewater?

This chapter is geared toward homeowners or tenants who have septic systems buried in their yards. When your wastewater is treated by such a system, you're responsible for how well the system does its job. You need to learn all you can about the routine maintenance and proper use of a septic system if you expect to keep your system in good working order.

Are you hooked up to a city or community sewer system?

Even if you don't have a septic system on your homesite, there are still ways you can reduce the impact your wastewater makes on your community and the environment. Conserving water and being careful about what you put down the drain are easy ways to help. Using your municipal sewage treatment system wisely saves taxpayers' dollars and protects our water resources.

What is a conventional septic system and how does it work?

Most residential septic systems consist of a 1,000-gallon-capacity watertight septic tank buried in the ground and a drainfield that can

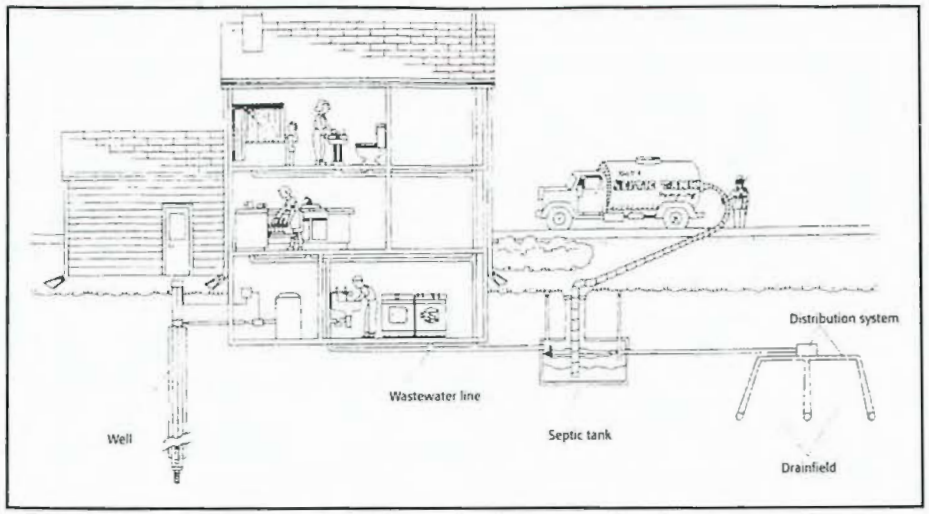


Figure 4.1. Household wastewater carries dirt, soap, food, grease, and bodily wastes "down the drain" and out of your house to an on-site septic or municipal wastewater treatment system.

fit within the front or back yard of the homesite (Figure 4.1). Household wastewater flows into the septic tank where the solids are retained. The liquid flows out of the tank to the drainfield where it leaches through the soil and is purified before reaching the groundwater.

The Septic Tank

First, wastewater flows through a sewer pipe out of your house and into the septic tank, a large container commonly made out of concrete (Figure 4.2). Fiberglass and polyethylene tanks are also used. The tank must be watertight to keep sewage from leaking out and groundwater from seeping in.

Lighter solids in the wastewater — such as grease, hair and soap — float to the top of the tank and form a scum layer. Heavier solids settle at the bottom and form a layer of sludge. Bacteria in the tank begin to break down some of the sludge into simple nutrients, gas and water. The remaining solids are stored in the tank until they are pumped out.

A baffle or a sanitary tee pipe at the tank inlet slows the incoming rush of water, so the sludge is not stirred up; another, located at the tank's outlet, keeps solids from leaving the tank. Access openings (i.e., removable sections of the tank lid) at the inlet and outlet ends of the tank make it easy to see how well the inlet and outlet pipes, baffles, and tee pipes are functioning, and allow access for pumping. Although not standard equipment, an effluent filter at the tank outlet is recommended for two-compartment tanks, because solids carried out of the septic tank can clog the drainfield. Effluent filters in single-compartment tanks may require cleaning too frequently, resulting in homeowner inconvenience.

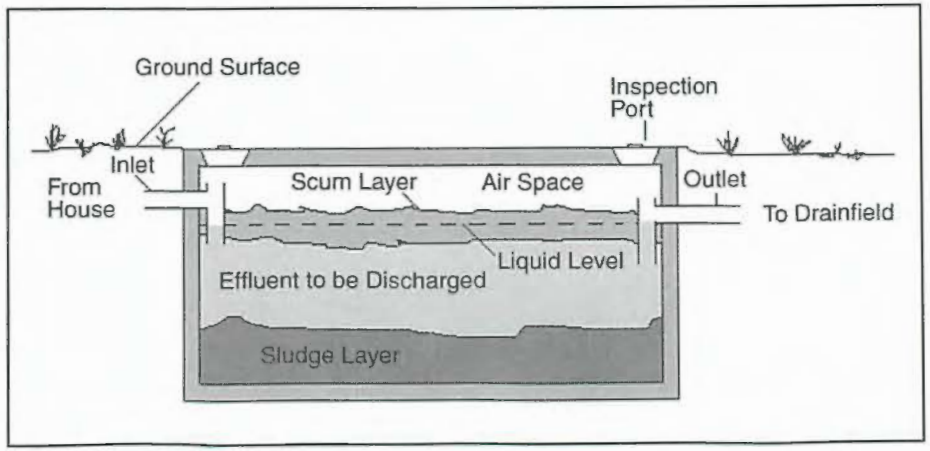


Figure 4.2. The Parts of a Septic Tank

The Distribution System

Next, the liquid waste, or effluent, flows out of the tank, through the distribution system, and into the drainfield or soil absorption field (Figure 4.3). The distribution system commonly consists of a series of perforated plastic distribution pipes laid in the ground, usually in gravel-filled trenches. Effluent can flow into the pipes by gravity or by a pump. The effluent moves slowly out of the trench and is absorbed into the soil.

The Drainfield

Good wastewater treatment depends on proper siting, design and operation of the system. The size and configuration of the drainfield area will vary from site to site based on soil texture and seasonal high water table characteristics. The soil must be of a suitable type and deep enough to treat wastewater before it reaches groundwater. The soil filters out larger particles and pathogens, which eventually die off in the inhospitable soil environment. Under the right conditions, beneficial soil microbes and natural chemical processes break down or remove most of the contaminants in the effluent.

Soils vary in their ability to absorb and treat wastewater. Well-drained soils are generally

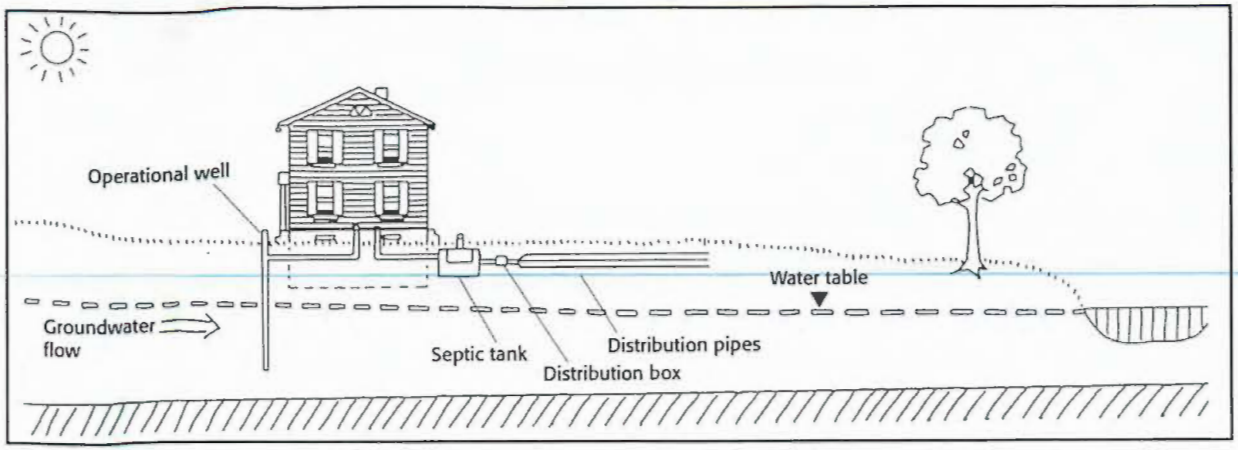


Figure 4.3. This cross-section of a septic system shows tank and distribution arrangement.

best; however, excessively drained soils such as coarse gravel or sands may allow wastewater to flow through too quickly for effective treatment. In fine clays or compacted soils, water may move too slowly. High seasonal water tables, which occur in many coastal soils, can affect both absorption and treatment. Septic systems don't work well when soils are poorly drained, groundwater levels are high, surface runoff saturates the drainfield or excessive amounts of water are used in your household.

Our beaches are a fragile environment due to their location, the type of soils present and the typically limited land area available for septic systems. Although the placement of all septic systems must follow state regulations, it is recommended that they be placed as far away as possible from the ocean and other environmentally sensitive coastal waters.

Good wastewater treatment depends on proper siting, design and operation of the entire septic system.

Part 4.1 Planning for a New Home: Septic System Design and Location

When buying property for a home, it pays to plan ahead, especially if the property doesn't have access to a public sewer. Most homes in rural and outlying suburban areas depend on individual septic systems for wastewater disposal. In the excitement of planning the appearance of your new house, it's easy to overlook practicalities like the disposal of your family's wastes.

It is important to note that not all property is suitable for a septic system. Unfortunately, not all soils can absorb wastewater or purify it. Septic systems installed in unsuitable soils usually malfunction by leaking raw, untreated sewage to the ground surface or into ditches or creeks or by contaminating the groundwater. Untreated sewage may contain deadly bacteria and viruses. It can be expensive to remedy the potential health hazards and odor problems that result from the use of septic systems in unsuitable soils.

South Carolina state law requires a comprehensive soil and site evaluation by the county health department to determine the suitability of the soils and the topography of the lot. A Permit to Construct must be obtained from DHEC before construction begins on the home or the septic system.

Reviewing Property Before Buying

Before purchasing a lot for your home, review the land yourself. Pay particular attention to any features that could affect the installation or operation of a septic system.

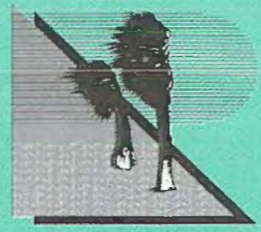
- Are there gullies, ravines, excessively steep slopes or other severe topographic conditions?
- Is the land prone to flooding? Are there streams or rivers near the property that are likely to flood?

Did You Know ...

Property that doesn't meet the standards for a conventional system may require a more expensive, alternative system. On the coast, alternative septic systems are designed to overcome site limitations such as seasonal high water table, soil texture and close proximity to environmentally sensitive areas. Alternative systems ...

- Are generally more expensive to construct (possibly $1,000 to $10,000 or more).
- May require more frequent maintenance.
- May require more space, special placement and fill material.

Coastal Natural Hazards



Following hurricanes Dennis and Floyd in 1999, more than 900 buildings were threatened on the North Carolina coast when erosion undermined at least part of the foundation. In many cases, these houses lost septic tanks and drain fields. The buildings were structurally repairable but required replacement sites for waste treatment. Where none existed, the owners had no choice but to move or demolish the buildings.

If you are thinking about purchasing beachfront or other property on a barrier island, you should be aware of the erosion risk near your home. Long-term erosion on South Carolina's beaches is monitored by the Office of Ocean and Coastal Resource Management (OCRM). Each year OCRM releases the "State of the Beaches Report." This report is a detailed study of approximately 400 monitoring stations along the coast, and is available free at each regional OCRM office.

A hurricane or other strong storm may also cause the beach to retreat. You have less to worry about from this type of short-term erosion if 1) the beach is wide near your home; 2) there is a large frontal dune field between the first line of houses and the beach; and 3) your house is well-sited significantly back from the shoreline. Know if your community is planning a beach nourishment project or has an ongoing project. Beach nourishment projects have in recent years reduced the amount of damage from storm-induced erosion and scour in several South Carolina communities.

For more information about long-term and short-term erosion in your area, contact OCRM at www.state.sc.us/dhec/eqc/ocrm/, or 1362 McMillan Avenue, Suite 400, Charleston, SC 29405, (843) 744-5838.

- Does the land seem to be wet or to hold water? Does surface drainage seem to be a problem?
- Does the land contain designated wetlands? Has the extent of any designated wetlands been mapped on the property? Contact your local Office of Ocean and Coastal Resource Management (OCRM) or the Army Corps of Engineers if needed (see page 118).
- Are there any utility or road easements?
- Is there enough space on the lot for the home, the septic system, the driveway and, if needed, a well? (See the box opposite for the required minimum separation distances.)

Even if the land appears suitable during your review, there may be conditions under the surface of the ground that make it difficult or impossible to install an adequate septic system. The only way to be sure is to make an application to your county health department to conduct a thorough evaluation of the property and determine its capacity to support a septic system.

Choosing a Site for Your Septic System

As you can see, there are many factors involved in evaluating property.

Keep in mind that the location of the septic system takes priority over the location of the house or other improvements. This is to assure that the best soils are used in treating your household wastewater in order to protect your family's health and the environment.

If you haven't already done so, create a homesite map, as described in Chapter 1. Add the proposed location of your septic tank and drainfield to that map.

Separation Distances for Septic Systems*

Distance From....	Minimum Distance
Building	5 feet
Property lines	5 feet
Private well	50 feet
Public well	100 feet
Surface water	50 feet
Drainage ditch	25 feet

*Office of Ocean and Coastal Resources Management.

Based on S.C. regulation as of 1999. Additional separation distances are required for certain types of alternative systems. Check with your county health department for any changes or additional local restrictions.

Getting Your Permit

Before you can begin to install a new septic system, you'll need to apply for a Permit to Construct and pay the appropriate fee. Taking the following steps can make the application process go smoothly:

- Obtain a petmit application packet from your county health department and ask about any other required permits (from agencies such as local planning and zoning offices or OCRM) and fees. Keep in mind that local laws may impose additional or more stringent requirements than state laws.
- Mark all of the property corners and stake the corners of proposed buildings and the center of the lot (as directed in the application packet).
- Display a site locator card at the front of your property so it is easily seen.
- Make a sketch (as described in Chapter 1) showing dimensions and locations of your proposed or existing house, driveway, pool, other buildings, septic system and well. Include distances from proposed buildings to road and property lines.
- Make sure to include any OCRM-designated critical areas on your map.
- Find out where wells on adjoining property are located, and include a sketch of their sites.
- Provide complete, detailed information on the application and add copies of any plats or deeds required. Include the tax map number.

Previously issued permits may not reflect current standards. If you have a previously issued permit, and especially if site conditions have changed since the permit was issued (such as regrading or bringing in fill), check with your county health department before installing the system.

How much wastewater can your system handle?

Make sure your septic system can meet the demands of your household, whether you're planning for a new home or evaluating your existing system. Both the septic tank and drainfield need to be large enough to treat all the wastewater generated in your house, even at times of peak use. The system must be designed for the maximum occupancy of your home. An average household produces about 100 to 200 gallons of wastewater per bedroom per day. The septic tank should be large enough to hold at least two days' worth of wastewater. (Two days is long enough to allow solids to settle out by gravity.)

Current DHEC standards require an 890-gallon tank for a one- or two-bedroom home. A new three- or four-bedroom house must be equipped with a 1,000-gallon tank. For each additional bedroom, an extra 250 gallons of capacity is required for the tank. A two-compartment tank or a second tank in series can improve sludge and scum removal and help prevent drainfield clogging, especially if an effluent filter is utilized.

The required length of the drainfield trenches is based on how much wastewater is put into the system and how much water a unit area of soil can treat. The better the soil type or longer the trenches, the higher the system's capacity for wastewater treatment. If you're unsure about your septic system's age, design and location, contact your home contractor, septic system installer or local health department office for any information they may have on file.

Keeping the size of your septic system in line with your needs is important. If water use in your household is greater than the system's designed capacity, you may suffer inadequate wastewater treatment or system failure. If you add rooms or water-using appliances to your home (such as a Jacuzzi, dishwasher or water softener) — or renovate a former vacation house for year-round use — you may need to increase the capacity of your system. Persons who intend to rent or lease their coastal property for high-use vacation rental should be aware that they could jeopardize their septic system, unless it has been specifically designed and installed to accommodate the maximum number of people that will occupy the unit.

Did You Know ...

In order to get electrical power to your home, your installed septic system must get final approval from the health department.

Risk Assessment 4.1 Septic System Planning

Use this assessment table to begin rating your risks related to septic system design and location. For each question, mark your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Planning a new home	Before purchasing property for a home, I had a comprehensive site evaluation done by the county health department to determine whether the property was suitable for a septic system. I investigated the type and cost of system needed for the property.	I walked the property myself to determine whether any obvious limitations existed to prevent my getting a septic system permit.	I purchased property for a home without investigating my wastewater disposal needs and options.	❑ Low ❑ Medium ❑ High
Installation	I had a licensed septic system contractor install my system.	I had an unlicensed person install my system.	I installed my own septic system.	❑ Low ❑ Medium ❑ High
Inspecting an existing system	Before purchasing an existing home with a septic system, I had the system evaluated by a professional.	Before purchasing an existing home, I asked the homeowner questions about the septic system location and what maintenance and repairs had been done.	I didn't even know the home had a septic system before I bought it OR I didn't ask any questions about the septic system.	❑ Low ❑ Medium ❑ High
Capacity of system	Tank is designed to handle more wastewater than required, based on the size of the home.	Capacity just meets load requirements, but I watch out for factors indicating system overload. Water conservation measures are taken.	Bathrooms, bedrooms or water-using appliances are added without reexamining the capacity of the wastewater system.	❑ Low ❑ Medium ❑ High
Separation distance	Drainfield is located farther than the required separation distance from any well or surface water.	Drainfield is located at the required separation distance from any well or surface water.	Drainfield is located closer than the required separation distance from any well or surface water.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower any health and environmental risks posed by your septic system's design or location. If your responses reflect any of the medium- or high-risk practices outlined in this self-assessment, record them in the Action Checklist on page 51. Make plans to reduce these risks by following the recommendations described in earlier sections of this chapter.

Part 4.2 Septic System Maintenance

Once you have the correct capacity septic system in place, don't forget about it! With proper maintenance, a septic system can last for 20 to 30 years or longer. Maintenance involves good daily habits as well as regular inspections and pumping accumulated solids out of the septic tank. Responsible maintenance also calls for using your system to dispose only of the types and amounts of wastes that it's actually designed to handle.

Why maintain your system?

There are three important health reasons for maintaining your septic system. The first reason is the health of your pocketbook! Poor maintenance results in failed systems requiring expensive repairs at a minimum — and sometimes system replacement. Repairs or replacement costs can be thousands of dollars, whereas a periodic inspection and pumping costs about $150 to $250.

The second reason is the health of your family, your community and the coastal environment. Untreated sewage water contains disease-causing bacteria and viruses, as well as unhealthy amounts of nitrate and other chemicals. Failed septic systems can allow untreated sewage to seep into wells, groundwater and surface water bodies, contaminating water meant for drinking and recreation.

Never flush...

- Coffee grounds
- Dental floss
- Paints, varnishes
- Thinners
- Cigarette butts
- Disposable diapers
- Kitty litter
- Waste oils
- Sanitary napkins
- Tampons
- Photographic solutions
- Pesticides
- Fats, grease, or oil
- Paper towels
- Condoms

The third reason is the health of your local economy. Contamination from failed septic systems pollutes water supplies, closes shellfish beds and recreational areas, and creates offensive odors. Quality of life, recreational opportunities and tourism may decline, and with them, the property values and economic vitality of an area.

An ounce of prevention is worth a ton of cure!

Committing a little attention to the care of your system can help you avoid the inconvenience and expense of a failing system. As long as your septic system was properly located, designed and installed according to state codes, good maintenance habits will help your system work properly for years to come.

Pumping your septic tank is probably the single most important thing you can do to protect your system. If the buildup of solids or grease in the tank becomes too high and solids move to the drainfield, this could clog and strain the system to the point where a new drainfield will be needed. Consult the table in Figure 4.4 for suggested pumping frequencies. To determine the optimum pumping frequency for your septic tank, have your system inspected yearly.

Sticking with other maintenance habits will also help to protect your system.

Do's:

- Conserve water to reduce the amount of wastewater that must be treated and disposed of by your system. Doing laundry over several days, for example, will put less stress on a system than doing many loads all day long.
- Repair any leaking faucets or toilets. To detect toilet leaks, add several drops of food dye to the toilet tank and see if dye ends up in the bowl.
- Divert down spouts and other surface water away from your drainfield. Excessive water keeps the soil from adequately cleansing the wastewater.
- Keep your septic tank cover or lids accessible for inspections and pumping. Install risers with lids if necessary.
- Call your county health department or a licensed septic tank contractor whenever you experience problems with your system, or if there are any signs of system failure.

Figure 4.4. Estimated Number of Years Between Septic Tank Pumpings

	Number of people in your household					
Tank size (gallons)	1	2	3	4	5	6
500	6	3	2	1	1	
1,000	12	6	4	3	2	2
1,5000	19	9	6	4	3	3
2,000	25	12	8	6	5	4

Note: More frequent pumping is needed if a garbage disposal is used.
Source: Adapted from Karen Mancl, *Septic Tank Maintenance*, Publication AEX-740, Ohio Cooperative Extension Service, 1988.

- Keep a detailed record of repairs, pumpings, inspections and other maintenance activities. Pass these on to the next homeowner if you sell your house.

Don'ts:

- Don't drive over your drainfield or compact the soil in any way.
- Don't dig in your drainfield or build anything over it, and don't cover it with a hard surface such as concrete or asphalt.
- Don't plant anything over or near the drainfield except grass. Roots from nearby trees and shrubs may clog and damage drain lines.
- Don't use a garbage disposal, or limit its usage at the very least. Disposals increase the amount of solid waste entering your tank by about 50 percent, so you have to pump your tank more often than normally suggested.
- For the same reason, don't use your toilet as a trash can.
- Don't poison your septic system and the groundwater by pouring harmful chemicals, cleansers or fuels down the drain. Harsh chemicals can contaminate sludge in the septic tank, kill the beneficial bacteria that purify your wastewater, and seep into groundwater.
- Don't put in a separate pipe to carry wash waters to a side ditch or the woods. This graywater contains germs that can spread disease.
- Don't waste money on septic tank additives. The bacteria needed to treat wastewater are naturally present in sewage. Additives can resuspend solids, causing your drainfield to clog. Additives do not eliminate the need for routine pumping of your tank.
- Don't allow backwash from home water softeners to enter the septic system.
- Never enter a septic tank. Toxic gases from the tank are deadly. If your system develops problems, get advice from your county health department or a licensed septic tank contractor.

How to Avoid Septic System Failure

Any time your septic system is not treating or disposing of sewage in an effective manner, the system is failing. There can be many reasons for system failure. By far the most common reason for early failure is improper maintenance by homeowners. Call your county health department or a licensed septic tank contractor if you suspect your system is failing.

The following symptoms may indicate the failure of your septic system:

- Sewage backs up in your drains or toilets.
- Sinks, bathtubs and toilets drain slowly.
- Wastewater appears on the surface of the ground above or near the system.
- Lush, green grass grows over the drainfield, even during dry weather.
- Unpleasant odors are noticeable around your house.
- The growth of aquatic weeds or algae seems excessive in surface waters adjacent to your home.
- Well water test results show the presence of nitrates or bacteria.

Before these symptoms appear at your home, do all you can to keep your septic system in good working order. You can prevent septic system failure with routine maintenance and by following a few simple guidelines:

Know when your septic system was installed.

Septic systems should last anywhere from 20 to 30 years (or even longer), depending on how appropriately they were designed for a site and how well they are maintained. If your septic tank is made of steel, it will eventually rust and need replacement. The older your system, the less likely it is to meet the latest standards. Even a relatively new system can fail if it is undersized, improperly installed or maintained, or located in poor soil.

Install an effluent filter and gas baffle at the septic tank outlet.

Solids that don't settle in the tank can be carried out of the tank with effluent, clog the drainfield, and lead to premature system failure. Effluent filters on the outlet capture small particles and prevent them from clogging the drainfield; it's important to clean the filter periodically.

Gas bubbles are produced by anaerobic bacteria slowly digesting wastes in the tank. A gas baffle near the outlet deflects the bubbles and the disturbed sludge away from the outlet.

Consider installing safety devices.

To prevent hazardous sewage overflows, tanks should have a storage capacity above normal working levels. In addition, an alarm should be installed on holding tanks or pumping chambers to warn you if the tank is nearly full. If your system depends on a pump, you may need to have a backup power supply available in addition to adequate storage capacity in the tank.

Risk Assessment 4.2 Septic System Maintenance

Use the table below to begin rating your risks related to septic system maintenance. For each question, mark your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Upgrades	I upgrade my system when I make changes that significantly increase water usage in my home. (This could include adding bedrooms or installing a sauna or whirlpool.)	I have my septic tank pumped more frequently when water usage increases in my home, but I don't upgrade my system.	I never consider upgrading or increasing the pumping frequency of my septic system when making significant increases to water usage in my home.	❑ Low ❑ Medium ❑ High
Drainfield protection	I protect my drainfield by landscaping it to shed excess surface water by diverting rain gutters away from it, by keeping vehicles off of it and by planting only grass over it.	I have a general idea where my drainfield is located, but I occasionally park cars over it, allow water to pond on top or have my rain gutters discharge near the drainfield.	My drainfield hasn't been protected. (You've extended your driveway or built a structure over part of the drainfield, allow water to pond over it or allow trees and shrubs to grow over or near it.)	❑ Low ❑ Medium ❑ High
Garbage disposal	I don't have a garbage disposal because I compost most of my vegetable waste or dispose of it in the trash can.	I rarely use my garbage disposal, or if I do, I have my septic tank pumped out more often than normally suggested.	I use my garbage disposal regularly and don't have my tank pumped out more often than is called for.	❑ Low ❑ Medium ❑ High
Inspection and pumping	I have my septic tank inspected annually and pumped out as needed.	I have my septic tank pumped out on a regular schedule, based on the number of people in my home (or more frequently because I use a garbage disposal).	I never have my septic tank inspected or pumped out OR I only have my tank pumped when the plumbing backs up.	❑ Low ❑ Medium ❑ High
Hazardous materials	I don't use my toilet as a trash can or poison my septic system by letting harmful chemicals and cleansers go down the drain.	I'm aware of what should and shouldn't go into a septic system, but sometimes I allow harmful items down the drain.	I routinely dispose of cleaners, solvents, other chemicals or trash (such as coffee grinds, grease, paper towels, tampons, sanitary napkins, condoms, dental floss, cigarette butts and kitty litter) down the drain.	❑ Low ❑ Medium ❑ High
Water conservation	I have installed water-conserving showerheads, faucets and toilets.	I put bricks in my toilet tank or try to conserve water as best I can by taking short showers, washing only full loads of clothes and dishes, or limiting water use in other ways.	I make no attempts to conserve water by adjusting my habits or using water-saving devices.	❑ Low ❑ Medium ❑ High

Risk Assessment 4.2 Septic System Maintenance (continued)

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
System failure	I contact a licensed septic tank contractor or the county health department when I suspect my septic system is failing.	I periodically notice signs of failure, such as during and after a heavy rain, but choose not to investigate further or have the problem fixed. Instead, I alleviate the problem by not using my system during those periods of failure.	I continue to use my septic system despite obvious signs of failure.	❑ Low ❑ Medium ❑ High
Age of system	System is 5 years old or less.	System is between 6 and 20 years old.	System is more than 20 years old.	❑ Low ❑ Medium ❑ High
Effluent filter	An effluent filter is installed and cleaned regularly.	An effluent filter is installed but not cleaned often enough.	There is no effluent filter installed on the septic tank outlet.	❑ Low ❑ Medium ❑ High
Safety devices	An alarm on the pumping chamber or holding tank indicates that the tank is full or power has been cut off to the pump.		There is no alarm to indicate tank overflow or that power has been cut off to the pump.	❑ Low ❑ High
Septic tank additives	I never use septic tank additives.	I use biological additives to "re-seed" my tank after having it pumped.	I use additives on a regular basis as a replacement to pumping.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your risks. Your private well and nearby public waters are least likely to be contaminated by a home septic system if you follow as many of the low-risk practices outlined in this self-assessment as you can. Use the Action Checklist on the opposite page to record medium- and high-risk practices. Reduce your risks by following recommendations in the preceding text.

Action Checklist

Go back over both assessment tables to ensure that all medium and high risks you identified are recorded in the following checklist. For each medium- and high-risk habit you identified, write down the improvements you plan to make. Use recommendations from this chapter and other resources to decide on actions you are likely to complete. A target date will keep you on schedule. You don't have to do everything at once, but try to eliminate the most serious risks as soon as you can. Often it helps to tackle the inexpensive actions first.

Household Wastewater

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action.
Sample: *I've never had my septic system inspected or pumped out.*	*Consult the Yellow Pages for a licensed septic system contractor and call for an inspection appointment.*	*Within 48 hours: By April 10*

For More Information

Septic System Homeowner's Guide and Record Keeping Folder, is available from DHEC by telephoning (803) 898-4187.

The National Small Flows Clearinghouse (NSFC) has several publications on septic system design and maintenance, as well as information about alternative systems. Contact them at NSFC, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064, or call (800) 624-8301 to request their catalog. Publications available from NSFC include the following:

Your Septic System: A Reference Guide for Homeowners, WWBRPE17. This brochure describes a conventional septic system and how it should be cared for to achieve optimal results.

The Care and Feeding of Your Septic Tank System, WWBRPE18. This brochure describes septic tanks and drainfields and provides guidelines to prolong their usefulness.

So ... Now You Own a Septic Tank, WWBRPE20. This publication describes how a septic tank system works and how to keep it functioning properly.

Preventing Pollution Through Efficient Water Use, WWBRPE26. This brochure describes efficient water use and its role in preventing pollution.

For information on the regulations and risks associated with purchasing coastal property, request a copy of *Questions and Answers About Purchasing Coastal Real Estate in South Carolina* from the S.C. Sea Grant Extension Program by calling (843) 727-2078 or by visiting their website at www.scseagrant.org.

This chapter of *South Carolina Coast-A-Syst* was developed cooperatively by West McAdams, Clemson University Cooperative Extension Service, and Lisa Hajjar, South Carolina Department of Health and Environmental Control, Office of Ocean and Coastal Resource Management. Contributing editors include Ben Bozardt, Steve Calk, Rod McCormick, Stuart Crosby, Blaine Lyons, Clif Roberts and Leonard Wilson, DHEC Division of Environmental Health; and Cal Sawyer and Beth Judge, S.C. Sea Grant Extension Program. Material was adapted from similar publications by the National Onsite Wastewater Recycling Association, Cornell Cooperative Extension and the North Carolina Cooperative Extension Service. Barbara Speziale, Clemson Cooperative Extension, adapted materials from the Northeast Regional Agricultural Engineering Service's *Home-A-Syst*, by Barbara Keenen Avery of Cornell Cooperative Extension.

Understand the Risks: Managing Hazardous Household Products

Chapter 5

Some commercial products commonly used at home have the potential to harm your health and the coastal environment. This chapter will help you identify potential product hazards and minimize your risks. It covers safe management of products, from purchase to disposal. The chapter is divided into three parts:

1. *Product Selection, Purchase and Use*
   - Product selection criteria
   - How much of a product to purchase
   - Safety precautions

2. *Safe Storage*
   - Child safety considerations
   - Containers and spill protection
   - Proper ventilation

3. *Product Disposal*
   - Importance of recycling
   - Products that require special attention

Why should you be concerned?

Although many people may not realize it, virtually every household produces hazardous wastes. Some products used around the home contain ingredients that can pose threats to your health or the coastal environment if not handled properly (Figure 5.1).

Vapors from paint thinner and other solvents can be hazardous to breathe. Products such as motor oil or pesticides — if disposed of on the ground — may contribute to the pollution of your drinking water or a nearby lake. Even everyday personal care products like nail polish, spot removers, mothballs, shoe polish and some medicines produce potentially hazardous wastes when leftovers are discarded.

Unlike hazardous farm and industrial wastes, household hazardous wastes are not regulated by law. But since they often contain the same chemical ingredients, you still need to handle these products with care.

For each chemical or product, there are many questions to consider. Which product best meets your needs? Are there safer alternatives? Is it dangerous to children? How much should you buy? What is the best way to store it? How can you use it safely? How do you dispose of leftovers?

Figure 5.1. Some household products contain chemicals that can threaten your health or the environment if not used, stored and disposed of properly.

This chapter will help you make choices that will reduce risks to your family and your coastal watershed. Remember: You are responsible for the safe use, reuse or disposal of any products in and around your home. It's up to you to understand how to make good decisions about controlling hazardous household products.

What does the word hazardous mean?

A thing or situation is hazardous if it has the potential to cause harm. For example, a child's roller-skate left on a stair is hazardous. The United States Environmental Protection Agency (EPA) defines a substance as hazardous if it is flammable, corrosive or toxic, or if it can react or explode when mixed with other substances.

Flammable: Material is capable of being set on fire or bursting into flame either spontaneously or from interaction with another substance or material.

Corrosive: Material can cause destruction of living tissue or metal surfaces by chemical action.

Toxic: Material can cause injury, illness or damage to humans or animals by a single exposure (acute) or through prolonged or

repeated exposure (chronic) over a period of days, weeks, months or years.

Reactive: Material can cause an explosion or release poisonous fumes when exposed to air, water or other chemicals.

Household products are hazardous if they include ingredients that, when improperly managed, pose dangers to human health or the environment. Not every product in a category of products is hazardous — for example, some paints and strippers are less hazardous than others are. To be safe, learn how to use, store and dispose of products properly.

It is also important to know the difference between hazards to human health and hazards to the environment. These are explained below.

Hazards to Human Health

Health problems can be caused by chemicals in some of the products in your home if product warnings and directions for proper use are not heeded. Health effects can range from minor problems, such as irritated skin or watery eyes, to more serious problems, such as burns, poisoning or even cancer. The following box lists some common household products that must be handled carefully to avoid illness or injury.

You can be exposed to a hazardous product ingredient by (1) ingestion, including accidental ingestion by drinking, eating or smoking when a substance is on your hands; (2) breathing dust or fumes (inhalation); or (3) contact with skin or eyes.

The potential for harm from exposure to a hazardous product depends on ...

Potentially Hazardous Household Products

Building Supplies - Sealants, some adhesives, wood preservatives

Vehicle-Related Products - Antifreeze, oil, cleaning solvents, lead-acid batteries, gasoline, lubricants

Home Maintenance Products - Oil-based paints, mineral spirits, products that can remove difficult greases or adhesives, paint stripper

Hobby and Recreational Supplies - Photo developer chemicals, marine paints and solvents, electronic equipment cleaners, swimming pool chemicals

Pesticides - Herbicides, insecticides, rodent poison, yard insect foggers, chemical strips, fungicides, aquacides

- The type of chemicals in the product.
- The quantity of the chemical to which you are exposed.
- How frequently you are exposed.
- Your size, weight and health.

If exposure occurs, some harmful effects may appear immediately. Typical symptoms are nausea, skin irritation, burning eyes, dizziness and headaches. Other effects, such as kidney or lung damage or cancer, take a long time to develop. A person who uses hazardous products frequently — without adequate safety precautions or proper ventilation — may experience these serious health effects.

To avoid accidental exposure ...

- Follow the safety precautions recommended on the product label.
- Always work in a well-ventilated area, especially if the product contains a volatile solvent. (These products are labeled "Flammable," "Combustible," or "Contains Petroleum Distillates.")
- Wear protective clothing such as gloves and goggles when the product label recommends it.
- Remember that label precautions are there for a purpose — to ensure your safety while using the product.

Hazards to the Environment

The way you handle products used on or near your property can affect the environment. Ingredients in some household products can be hazardous to plants and animals in natural environments. Pesticides or motor oil washing into a stream, for example, can harm fish. Human health can also be threatened if our food, water or air become contaminated through improper use or disposal of a household product.

Once released, some chemicals can be absorbed into the environment without any harmful effects. Others have lasting effects. Some chemicals can become integrated into living systems — including plants and animals — and pass from one organism to another. If enough of a toxic chemical accumulates within an organism, it can destroy the ability to reproduce, damage the nervous system, or impair the function of internal organs.

Federal law regulates most chemicals likely to cause environmental problems. But because it is difficult to keep track of the small quantities

used by homeowners, we all need to do our part to minimize the impact of use and disposal of hazardous household products. Some cleanup or disposal practices may seem safe, but even old habits should be examined for potential risks.

To protect the coastal environment ...

- Avoid the following practices:
  - Dumping oils, paints, pesticides or any other household chemicals on the ground, on roads or down storm sewers.
  - Dumping products in a wetland, creek or any other body of water.
  - Washing chemicals off the driveway with a hose.
  - Pouring pesticides or chemicals into a drain that leads to a septic tank.
  - Spraying pesticides on a windy day.
  - Burning containers in a barrel or outdoor fire.
- Use up a product according to label directions.
- Share any leftovers with a neighbor or local organization.
- Find out if a product can be recycled and where to recycle it in your community.
- Find out if your community has a hazardous waste collection program. Contact information for county household hazardous waste disposal sites is provided on page 69.

Figure 5.2. Labels can provide details about how to safely use, store and dispose of a hazardous household product.

Part 5.1 Product Selection, Purchase and Use

Your choice of products is the first step. If you carefully select a product for the job needed, you can control the degree of risk you bring to your home or property. Assessment 5.1 on page 58 will help you evaluate your risks regarding product choice and use. The information below will help you answer the questions in the assessment.

How can you tell which products are hazardous?

It pays to learn as much as you can about a household product and its potential hazards before bringing it home. Labels contain important information and often tell if a product can be hazardous. Health problems can be prevented by carefully following directions for use and safety.

Remember: The absence of a warning on a product label does not necessarily mean that the product is safe. Old products or products not designed for household use may not provide consumer information on the label. ***When using any chemical product, use it with care and caution.***

In addition to product labels, up-to-date publications and advice from experts are also good sources of information. Ask questions, and look for helpful ideas from health agency employees, Cooperative Extension staff, articles and books.

What can product labels tell you?

Information on the product label can help you decide whether the product is right for the job and if it can be used safely in your situation. Before you purchase or use a product, take the time to read the label, even though the print is often tiny. Labels provide details about how to safely use, store and dispose of a product. First aid instructions are also provided when needed.

Household consumer products that are hazardous or contain hazardous substances are required to have human safety information, or warning labels. Pesticide labels are also required to provide detailed information on use, storage and disposal. As you read this section, take a look at the labels on some of the products in your home.

The signal words DANGER, WARNING and CAUTION draw your attention to important

human safety information. However, they can mean different things, depending on the product.

Beware of terms on labels that are vague and possibly misleading. The Federal Trade Commission has provided manufacturers with guidelines about vague environmental terms such as "ozone safe" or "environmentally friendly," but the use of such terms is not regulated on any products except pesticides.

If you need more information about a product than is provided by the label, you may want to request a Material Safety Data Sheet (MSDS) from the manufacturer or consult a Poison Control Center. Most manufacturers provide a phone number on their product label and are willing to answer questions by phone.

If you are not sure whether a particular household waste is hazardous or if you need other information, contact your county Solid Waste Department, local Department of Health and Environmental Control (DHEC) office or county Extension office.

Identification of Hazardous Household Products by Signal Words

- **DANGER/POISON:** These household products are very toxic; from a taste to a teaspoon can kill an adult. Most poisons fit into this category. Such products require substantial precautions in their use, storage and disposal.
- **WARNING:** This label indicates moderate toxicity; from a teaspoon to two tablespoons can kill an adult. Caustic cleansers are mostly considered moderately toxic.
- **CAUTION:** Generally means low toxicity; from an ounce to over a pint can still kill an adult. Household bleach is relatively low in toxicity, and therefore has CAUTION on the label. Bleach is nevertheless very dangerous.

Can an alternative product do the job?

When choosing from among several brands of the same kind of product — paint strippers or degreasers, for example — read the labels to learn which product will meet your needs most safely. If you don't check first, you might buy a hazardous product such as a solvent-based cleaner when a detergent-based cleaner is available or a common alternative like kitchen cleanser will work.

Manufacturers are aware of consumer safety issues, and many offer a range of products. Some alternatives are suggested in the box on the next page. For more help in deciding which products to buy, consult the resources listed at the end of this chapter.

In an effort to reduce risk from hazardous chemicals, many organizations have distributed information about making mix-at-home cleaners using readily available ingredients. Be advised, however, that your homemade product may not always be a safer alternative. Several homemade alternatives are described in "Homemade Cleaners: Recipes for a Healthy House" on the next page. If you choose to make your own household products, be sure to consider these precaurions:

IN CASE OF EMERGENCY

Poison Control Centers: These resources feature a national computer data network that can provide emergency health information about a product. **The South Carolina Poison Control Center phone number is (800) 922-1117.** Keep this number close to your phone.

Accidental Spills: For information about spills of hazardous products, contact DHEC at (888) 481-0125.

Harmful Exposure: To report products that have caused you harm, contact the U.S. Consumer Products Safety Commission at (800) 638-2772.

- Use only one ingredient at a time. Never mix ingredients or products. Be sure to rinse the surface between products used on one place.
- Always test any cleaner on a small area before applying it to the whole surface.
- Do not use food products for cleaning (such as vegetable oil or milk). Food products may spoil or support growth of bacteria or mold on the surface being cleaned.
- Use clean containers when storing homemade products, and clearly label them with the contents and date. Never store homemade products in old containers from commercial products.

Looking for an Alternative?

Adhesives: Use a water-based or latex adhesive.

Batteries: Choose rechargeable batteries (removable, so they can be recycled) and mercury-free batteries when possible.

Cleaners: Choose soap- or detergent-based cleaners when possible. Avoid non-water-soluble and corrosive cleaners when others offer an effective substitute.

Household Pesticides: Look for ways to reduce your need for these products through appropriate cleaning and maintenance habits.

Floor and Wood-Finish Strippers: Use a detergent or water-based stripper.

Paint Stripper: Use sandpaper, a scraper or heat gun for small jobs.

Wood Preservative: Use a water-sealing coating.

Do you buy only what you need?

If you buy more than you need, household products will accumulate and create storage problems. If unused for long periods, product containers may become damaged and leak, and products may change chemically and not be effective when you finally try to use them. Some products such as pesticides may have been restricted or banned since they were purchased. If that occurs, safe and legal disposal becomes much more difficult. Avoid these problems by purchasing and using only what you need.

Homemade Cleaners: Recipes for a Healthy House

All-purpose Cleaner I
4 tablespoons baking soda
1 quart warm water
Dissolve baking soda in warm water. Apply with a sponge. Rinse with clear water.

All-purpose Cleaner II
Apply baking soda to a damp sponge. Rinse with clear water.

All-purpose Cleaner III
1 tablespoon ammonia*
1 tablespoon liquid detergent
1 pint water (2 cups)
Mix ingredients and put in spray bottle. Spray on surface. Wipe. Rinse with clear water.
**Ammonia is a toxic ingredient. Handle it with care and store it safely.*

Window and Mirror Cleaner I
4 tablespoons ammonia*
1 quart warm water
Mix ingredients and put in spray bottle. Spray on surface. Wipe.
**Ammonia is a toxic ingredient. Handle it with care and store it safely.*

Window and Mirror Cleaner II
2 tablespoons vinegar
1 quart warm water
Mix ingredients and put in spray bottle. Spray on surface. Wipe.

Drain Opener*
Use a plunger (plumber's helper). It may take a number of plunges to unclog the drain.
**Do not use this method if you have used a commercial drain opener and it may still be present in the drain.*

Drain Cleaner and Opener
Use a flexible metal snake. The mechanical snake may be purchased or rented. Thread it down the clogged drain, and you'll be able to push the clog away.

Furniture Cleaner and Polish
Wet a washcloth. Wring out as much water as possible. Wipe furniture surface with damp washcloth. Dry immediately with a clean, soft, dry cloth. (You can remove sticky fingerprints and dust safely from wood surfaces using this method, but furniture with an oil finish needs an oil-based cleaner.)

Lime and Mineral Deposit Remover
Soak cloth rags in vinegar. Apply the wet rags to the lime deposits. Leave them on for approximately one hour. The deposits will be softened and can be removed easily.

Aluminum Cleaner
2 tablespoons cream of tartar
1 quart water
To clean aluminum cookware, combine ingredients in cookware. Bring solution to a boil and simmer for 10 minutes. Wash and dry as usual.

Brass Cleaner I
Lemon juice
Baking soda
Make a paste about the consistency of toothpaste. Rub onto brass with a soft cloth. Rinse with water and dry.

Brass Cleaner II
Lemon juice
Cream of tarter
Make a paste about the consistency of toothpaste. Apply to surface; leave on for five minutes. Wash with warm water. Dry with a soft cloth.

Chrome and Stainless Steel Cleaner
Dip soft cloth in undiluted white vinegar. Wipe surface.

Oven Cleaner I
Baking soda
Very fine steel wool
Sprinkle water on oven surface. Apply baking soda. Rub using very fine steel wool. Wipe off scum with a damp sponge. Rinse well and dry.

Oven Cleaner II
While oven is still warm, sprinkle water on the spill, then sprinkle salt on it. When the oven cools down, scrape the spill away and wash the area clean. Leave a layer of salt on the bottom of the oven to catch drips and make cleaning easy.

Toilet Bowl Cleaner
Baking soda
Vinegar
Sprinkle baking soda into the toilet bowl. Add vinegar. Scour with a toilet brush.

Skin Cleaner
Clean oil paint or stain off skin by rubbing with vegetable oil and then washing with soap.

Risk Assessment 5.1 Product Selection, Purchase and Use

The risk categories and recommendations found in the assessment table below apply to hazardous products in general. Management options for some products are not covered. If you are not sure what to do, don't take chances. Remember that your actions can have a profound effect on coastal water quality. Find out what is safe!

Use the table to rate your risks related to the selection, purchase and use of household products. For each question, check your risk level in the right-hand column. Some choices may not be exactly like your situation, so choose the response that fits best. Refer to Part 5.1 above if you need more information to complete this table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Product selection	I always read labels, understand signal words, and respect the health or environmental hazard labels describe. I choose the least hazardous product needed for the job.	I don't read labels or don't understand what they mean, but I use a "common sense" approach to safety.	I never read labels. I purchase products without considering what the product is made of or how it will be used.	❑ Low ❑ Medium ❑ High
Quantities purchased	I buy only what is needed for a specific job. I use up most of the product within a few months after purchase or give excess away to someone else.	I buy excess product, but provide safe and accessible storage.	I buy more than is needed, then purchase additional product without checking on current supplies.	❑ Low ❑ Medium ❑ High
Safety precautions	I follow label instructions and take recommended precautions against exposure (such as providing good ventilation and wearing safety goggles and gloves). I never mix products.	I occasionally read label instructions. I take some precautions. I occasionally mix products for specific cleaning tasks, but I always check safety precautions first.	I never follow label instructions and take no precautions — even when recommended. If one product doesn't work, I add in another without checking safety precautions.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your health risks and reduce potential harm to the environment. Turn to the Action Checklist on page 65 to record the medium- and high-risk practices you identified. Use the recommendations in Part 5.1 to help you plan actions to reduce your risks.

Part 5.2 Safe Storage

Leftover or used chemicals such as strippers, paint, waste oil, used antifreeze, and solvents may need to be stored until their next use or disposal (Figure 5.3). How and where you store household products can determine how much risk may be present. Use the information below to help you fill out Assessment 5.2 on the next page.

Are your storage locations and containers really safe?

When storing household products, the primary concerns are child safety (Figure 5.4), indoor air quality, water contamination and prevention of damage to household equipment or the environment. If you can smell a household product while it is in storage, the product lid may be loose or ventilation may be inadequate to protect your health.

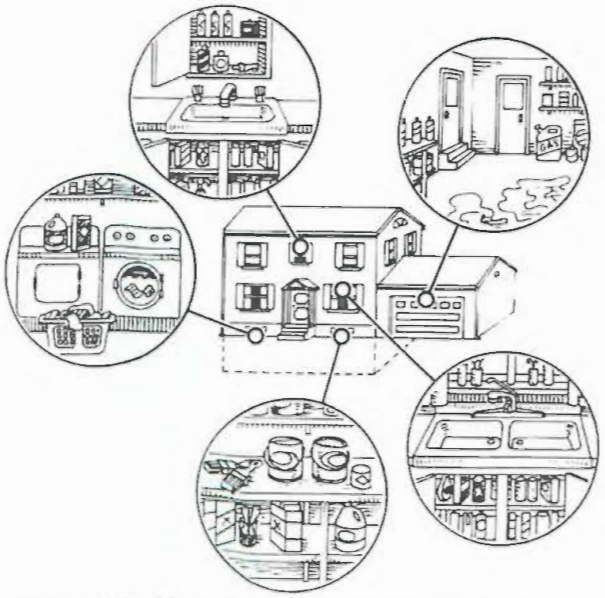


Figure 5.3. Hazardous products may be stored throughout a household.

When you store household hazardous products, do you ...

- Keep them out of the reach of children and pets, preferably in a locked, secure area?
- Store them in their original containers?
- Clearly label and date any alternative containers?
- Keep containers tightly sealed and dry?
- Store products at least 150 feet from a well or waterway?
- Keep products in a well-ventilated area and away from sources of ignition?
- Store batteries and flammable chemicals in an area shaded from direct sunlight?

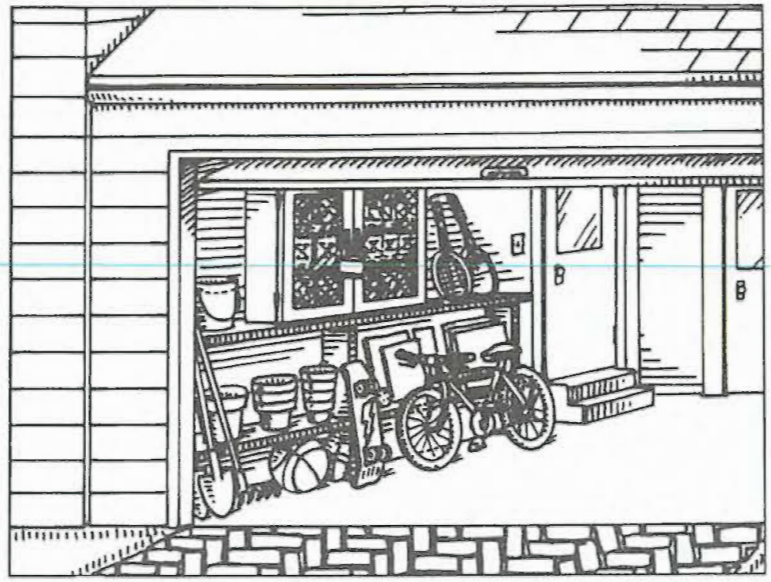


Figure 5.4. Hazardous products should be stored in a locked cabinet or other location inaccessible to children and above potential flood levels.

Use and store potentially hazardous products as far as possible from a private well. Do not use a wellhouse to temporarily store home pesticides or other hazardous products. Use care when using lawn or garden pesticides if your well is less than 100 feet away or if it is downhill of the application area. Immediately clean up oil, antifreeze, fuel or solvent spills.

Be sure to separate corrosives like acids or lye from each other and from other hazardous products to prevent dangerous chemical reactions. Reactions occur when corrosives leak from their containers and drip or mix with other products. Corrosive materials are often stored where equipment and appliances are located; be aware that they can corrode air conditioning and heating systems, hot water heaters, and other equipment or appliances. Routinely check areas where you store household products (under the kitchen sink, in the basement or garage) to make sure that containers are closed tightly and not leaking, and that the sides of containers are not bulging.

> How and where you store household products can determine how much risk may be present.

Risk Assessment 5.2 Safe Storage

Use the following assessment to rate your risks related to product storage. For each question, check your risk level in the right-hand column. Some choices may not be exactly like your situation, so choose the response that best fits. Refer to Section 5.2 if you need more information to complete this table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Child safety	I store hazardous products in a locked cabinet or other location inaccessible to children.	I keep products out of the direct reach of children (on a high shelf, for example) but still accessible.	My products are easily accessible to children (for example, in an unlocked cabinet on the lower shelf).	❑ Low ❑ Medium ❑ High
Containers and spill protection	I store leftovers in their original containers, properly sealed. Products are stored by type. My home environment is protected against leaks or spills.	I store original containers in a disorganized way. I don't provide protection against leaks or spills	I transfer leftovers to other containers such as used milk jugs or glass jars. I store leftovers without caps or lids. I don't provide protection against leaks or spills.	❑ Low ❑ Medium ❑ High
Ventilation	I store volatile products (like solvents and petroleum-based fluids) in places with good ventilation.	I don't pay attention to storage location, but each container is in good shape and tightly sealed.	I store products in areas with poor ventilation such as basements, closets or crawl spaces. Containers are damaged or left open.	❑ Low ❑ Medium ❑ High
Flood precautions	I store hazardous products as high as possible in my house and garage.	I keep some of my hazardous products on the upper shelf where possible, but it's not convenient out in the garage, where I place products on the floor.	I store hazardous products low to the ground such as on the floor of my garage or on the bottom shelves of my cabinets.	❑ Low ❑ Medium ❑ High

Responding to risks

Your goal is to lower your health risks and reduce potential harm to the environment. Turn to the Action Checklist on page 65 to record the medium- and high-risk practices you identified. Use the recommendations above to help you plan actions to reduce your risks.

Part 5.3 Product Disposal

Unless a product is used up, you will have to dispose of it. For some products that are especially hazardous — like pesticides — even the product container will have to be disposed of properly.

In South Carolina, hazardous wastes from individual households are not yet regulated by law; however, specific wastes are banned from disposal in a municipal solid waste landfill by the South Carolina Solid Waste Policy and Management Act of 1991. These include: lead-acid batteries; used oil; yard trash and land-clearing debris; whole waste tires; and white goods (refrigerators, freezers, water heaters, washers and dryers).

Some of these items can be taken to your local recycling convenience center. Items accepted for recycling vary in each city and county. Local recycling center telephone numbers for each of the coastal counties are listed on page 69 at the conclusion of this chapter.

You may be able to donate leftover paint, household cleaners or other products to local charity, church or service organizations. Theater groups, the local housing authority, or non-profit organizations such as Habitat for Humanity or the Harmony Warehouse may be able to use small quantities of paint or cleaning products.

This section provides tips for disposal of certain hazardous product categories. The disposal guides listed under *For More Information* on page 69 at the end of this chapter provide more detailed management recommendations.

What is the best way to dispose of leftover hazardous products?

Disposal should be your last option because it is wasteful and, if not done properly, can be unsafe for you and the coastal environment. ***You can avoid the disposal dilemma by buying only what you need, using up your leftovers or recycling.*** By giving leftover products to a neighbor or local organization that can use them, you can turn a potential waste problem into a cost-saving opportunity.

Some communities sponsor swap programs to encourage sharing, and options for recycling are increasing. Used motor oil and batteries, for example, are accepted at many automobile repair shops or recycling center sites (Figure 5.5). Some pesticide containers may be returned to where they were purchased for safe disposal.

Figure 5.5. Used motor oil is accepted at many automobile repair shops or recycling center sites.

Coastal Natural Hazards

Do you store things like paints, oils and gasoline in a storage room below your elevated coastal home? This may seem like a safe place, but if the area floods due to heavy rains or a storm surge, these chemicals will be swept into the surrounding water.

Storing hazardous household products in a locked cabinet above the expected flood level will stop them from contaminating surface and ground water. To learn what the expected 100-year flood level (Base Flood Elevation, or BFE) for your home site is, consult FEMA's Flood Insurance Rate Maps (FIRMs). The FIRMs for your community should be available for review at your local community map repository site. Typically, this is your local planning, zoning or engineering office.

If you would like a copy for yourself, call the FEMA Map Service Center at (800) 358-9616. If you are looking for information regarding a specific piece of property it is important to know the community number and panel number, which can be obtained by calling the above toll-free number. Less specific maps for counties, cities or towns do not require this information. Each map is $.50 and each order is $2.50 for shipping and handling.

Some cities and communities sponsor either occasional or permanent household hazardous waste collection programs. Because only certain hazardous products may be accepted, contact the program to learn exactly what materials are accepted in your area. If your community does not sponsor such a program, contact local sanitation officials for disposal advice.

Household quantities of some products can be safely sent to a landfill. For example, leftover paint — if local regulations permit — can be evaporated in its can. When dry, the can with its hardened contents can be discarded in household garbage.

Paint and pesticides merit special attention

We all buy too much paint. Municipalities that collect leftover hazardous household products report that paints make up about half of the material that people bring and are a costly (but avoidable) disposal expense. The best practice is to avoid leftovers by estimating how much paint you'll need before you buy. Salespeople at paint stores can help you with these calculations.

Most leftover paint can be safely managed by sharing it with neighbors or organizations. In Charleston County, for example, leftover latex paint is collected, combined into 55 gallon drums, and then sold for institutional use.

Unless a product is used up, you will have to dispose of it.

However, leftover lead-based paints or exterior paints containing mercury or pesticides should be treated as hazardous waste.

We don't pay enough attention to how we manage pesticides. A 1992 EPA study of pesticide use in homes and gardens provided disturbing information about how pesticides are used, stored and thrown away. Household practices showed that people fail to recognize the danger that pesticides pose to child safety, human health or the environment when managed improperly.

By giving leftover products to a neighbor or local organization that can use them, you can turn a potential waste problem into a cost-saving opportunity.

Before you choose a pesticide, be sure that you have exhausted other options for managing the pest, weed or fungus problem. If you do need to use a pesticide, read label information carefully before purchasing a product. Buy only what you need.

Pay attention to use and disposal recommendations described on labels. Before disposal, use up the product if possible. Rinse empty containers of liquid pesticides. Use the rinse water as part of your yard and garden management.

To reduce your need for pesticides in the home ...

- Maintain regular cleaning habits, especially in the kitchen.
- Caulk cracks and other openings to the outside.
- Keep screens repaired.
- Keep houseplants healthy by providing appropriate care.

Is dumping or burning a safe alternative?

In a coastal environment, it's never appropriate to dump or burn hazardous products, particularly near wells or water sources. Nor should products ever be poured down storm sewers. Water-soluble cleaning products may be safely disposed down the drain if you flush the drain with plenty of water.

Burning hazardous wastes in a barrel or stove is never an alternative. Burning may release toxic gases and produce hazardous ash.

Septic system owners need to be especially careful, however. With septic systems, the rule of thumb is moderation. Don't dump large amounts of anything into the septic system. Septic systems are not designed to treat chemicals. If the product is specifically designed to be used in the home with water, then moderate use should not harm the system.

Risk Assessment 5.3 Product Disposal

Use the table below to rate your risks related to hazardous household product disposal. Check the waste category in the left column and see if any of your disposal practices present risks to human health or the environment. Consult the Hazardous Product Inventory on page 66 for specific product disposal planning.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Household trash (trash containing plastics or empty containers of hazardous ingredients	I rinse empty yard and garden pesticide containers and include the rinse water in yard and garden management. I dispose of mixed trash and empty product containers at the landfill or recycle them when appropriate. I do not burn trash.	I dispose of mixed trash, leftover pesticides and solvents on my property, but away from my well or waterway.	I always dispose of ash from mixed trash, leftover pesticides and solvents near a well or waterway. I burn hazardous containers near people or animals. (NOTE: *This is illegal!*)	❑ Low ❑ Medium ❑ High
Strong acids and bases (found in hobby and recreation products, concentrated building cleaners, and repair products)	I share any leftover products. I dilute strong acids and bases and pour them down a drain that connects to a sewage treatment facility.	I pour strong acids and cleaners down the drain without first diluting them with water. I send leftovers to a landfill (with proper protection for garbage haulers and employees).	I dump strong acids and cleaners directly into a storm sewer or waterway or on a paved slope leading to a waterway. (NOTE: *This is illegal!*)	❑ Low ❑ Medium ❑ High
Antifreeze; waste motor oil	I recycle antifreeze and waste oil by taking them to properly qualified disposal stations.	I pour my used antifreeze into a septic system or municipal treatment system.	I dump my used antifreeze and waste oil always in the same place, near a well or waterway. (NOTE: *This is illegal!*)	❑ Low ❑ Medium ❑ High
Batteries (may contain mercury, cadmium or lead)	I recycle batteries or take them to a hazardous waste disposal program.	I dispose of batteries in a community landfill.	I always dump batteries near a well or waterway. (NOTE: *This is illegal!*)	❑ Low ❑ Medium ❑ High
Bottled gas	I recycle bottled gas containers.	I store containers that may still contain some gas.	I put containers in my trash or leave them lying around.	❑ Low ❑ Medium ❑ High

Risk Assessment 5.3 Product Disposal (continued)

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Fluorescent bulbs (contain mercury)	I recycle burned-out fluorescent bulbs or lamps.	I put my burned-out bulbs in the trash.	I leave my burned-out bulbs at a dump.	❑ Low ❑ Medium ❑ High
Cleaning and repair products containing hazardous solvents (non-water-soluble) and paint	I share leftovers when possible. I take leftover products containing mercury, pesticides or hazardous solvents to a hazardous waste disposal program.	I dispose of leftover products in a community landfill.	I dump leftovers near a well or waterway OR I dump all my leftovers directly into a waterway. (NOTE: *This is illegal!*)	❑ Low ❑ Medium ❑ High
Pesticides	I use preventive actions to control pests, indoors and outdoors. I explore options for nonchemical pest controls. I properly choose, store, handle, apply and dispose of chemical pest controls.	When solving pest problems, I do not practice much prevention or explore nonchemical options.	I do not handle pesticides as directed on the label.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your risks. Turn to the Action Checklist opposite to record the medium- and high-risk practices you identified. Use the recommendations above to help you plan actions to reduce your risks.

Action Checklist

When you finish the assessments, go back over them to make sure you have recorded all medium and high risks in the checklist below. For each risk you identified, write down the improvements you plan to make. Use recommendations from this chapter and other resources to decide on actions that you are likely to complete.

Pick a target date to keep you on schedule for making changes. You don't have to do everything at once, but try to eliminate the most serious risks as soon as you can. Often it helps to start with inexpensive actions first.

Managing Hazardous Household Products

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action
Sample: *Cabinet with antifreeze and paint stripper is not child-proof.*	*Buy a lock and install it on cabinet.*	*Two days from now: November 23*
Sample: *Liquid and granular pesticides are stored on the floor in the garage.*	*Raise all pesticides to the top shelf of the garage cabinet.*	*One week from today: November 28*

Hazardous Products Inventory

Check for hazardous products stored in your home. Use the list below to plan ways to improve your use, storage and/or disposal of these products. If you are unsure about disposal, contact your local Cooperative Extension or DHEC.

Category/product	Is it properly stored?	Is information about proper disposal needed?	Are there special precautions to keep in mind?
HOUSEHOLD TRASH			
Fluorescent bulbs/lamps			
Waste motor oil			
Pesticide or solvent containers			
Empty containers from other product categories listed below			
CLOTHING AND FABRIC CARE PRODUCTS			
Mothballs			
Dry-cleaning fluids			
Spot removers (solvent-based)			
Shoe/leather polishes			
HOBBY AND RECREATION PRODUCTS			
Artist paints and solvents			
Charcoal lighter fluid			
Strong acids/bases*			
Bottled gas			
Household batteries (may contain mercury or cadmium)			

*See note, page 68

Category/product	Is it properly stored?	Is information about proper disposal needed?	Are there special precautions to keep in mind?
BUILDING/WOOD CLEANERS AND REPAIR PRODUCTS			
Building and wood cleaners with organic solvent ingredients:			
- Wood polishes			
- Products for wood floor and panel cleaning			
- Building and equipment maintenance products:			
- Strong acids, bases*			
- Oil/alkyd paints and primers			
- Marine and exterior paints containing mercury and/or pesticides			
- Aerosol paint products			
- Stains and finishes			
- Roof coatings and sealants			
- Rust removers			
- Adhesive removers			
- Paint and finish preparation products			
- Adhesives such as glues and caulk			
- Wood-preserving products			
- Products for brush or spray gun cleaning			
- Water repellents for wood and cement			
- Solvents, as those used in degreasers and paint thinners, stains and varnishes			

*See note, page 68

Category/product	Is it properly stored?	Is information about proper disposal needed?	Are there special precautions to keep in mind?
PESTICIDES			
Pesticides labeled "restrictive use"			
General-use pesticides			
Old pesticides			
Unwanted pesticides			
VEHICLE MAINTENANCE CHEMICALS			
Vehicle maintenance products such as antifreeze, oil and grease, and transmission fluid			
Solvents for oil and grease removal and disposal			
Engine and parts cleaners such as carburetor and brake cleaner			
Paints and paint preparation products			
Lead acid batteries			
Battery terminal protector			
Tire cleaners			
Rust removers			
Aerosol paint and primer products			
Brake quieter			

* NOTE: You can identify strong acids or bases in the product you are using by noting:
- If the hazard warning label recommends that the user wear skin protection or avoid breathing the vapors or aerosol mists
- If the product was intended for commercial use (industrial-strength cleaner, for example)
- If the product was intended to manage difficult stains or dirt on hard surfaces (for example, rust or lime remover)

Now that you have completed the Hazardous Products Inventory, you are more familiar with hazardous products that may be found in your home. Review the inventory once again and consider the following:

- Do I need all of these products in my home?
- Are there less hazardous alternatives I can use?
- Do I have as much information as I need to make good use, storage and disposal decisions?

For More Information

Hazardous Household Products

If you are not sure whether a particular household waste is hazardous or if you need other information, get in touch with your county Solid Waste Department, local DHEC office or county Extension office. Contact information for local DHEC and Cooperative Extension offices is listed on page 117.

Solid Waste Disposal and Recycling

The Office of Solid Waste Reduction and Recycling was created by the South Carolina Solid Waste Policy and Management Act of 1991. As part of DHEC's Division of Solid Waste Management, the Office is committed to helping the state reach its goals to reduce the amount of solid waste generated in South Carolina. The Office has educational, public awareness and grant programs to attain these goals. For information on solid waste reduction and recycling, contact:

South Carolina Department of Health and Environmental Control
Office of Solid Waste Reduction and Recycling
2600 Bull Street
Columbia, SC 29201
(800) 768-7248

For the most accurate information about local recycling programs, including recyclable materials accepted from the public, collection method (curbside, convenience centers, etc.), locations of recycling convenience sites and drop-off centers, and hours of operation at convenience sites, please contact the coastal county numbers listed below:

Beaufort County
120 Shanklin Rd.
Beaufort, SC 29202
(803) 846-3926

Berkeley County Water and Sanitation Authority
Scale House (landfill entrance)
2111 Redbank Rd.
Goose Creek, SC 29445
(803) 572-4400 ext. 015

Charleston County Recycling Center
13 Romney St.
Charleston, SC 29403-3844
(803) 720-7111

Colleton County
P.O. Box 157
Walterboro, SC 29488
(803) 549-5221

Dorchester County
2120 E. Main St.
Dorchester, SC 29437
(803) 832-0070

Georgetown County
P.O. Drawer 1270
Georgetown, SC 29442
(803) 546-4189

Horry County
P.O. Box 1664
Conway, SC 29526
(803) 347-1651

Jasper County Recycling Station
P.O. Box 1244
Ridgeland, SC 29936
(803) 726-7740

South Carolina Recycles: A Directory of Recycling Programs and Markets. This directory is available from the South Carolina DHEC Office of Solid Waste and Recycling (see address above).

Contact your local Cooperative Extension office or the Clemson University Bulletin Room (864-656-3261) for the following publications:

Disposal of Household Hazardous Waste, WML 2.
Reducing Hazardous Products in the Home, WML 1.
Health Effects of Drinking Water Contaminants and How to Treat Them, WQL3.

The Water Environment Federation's (WEF) waste disposal guide provides disposal recommendations for many kinds of products. You may be able to get one from your local sewage treatment facility or by contacting WEF, Public Information Department, 601 Wythe Street, Alexandria, VA 22314-1994; phone (800) 666-0206 or (703) 684-2452.

For detailed guidance on pesticide management, see *Guides to Pollution Prevention: Non-Agricultural Pesticide Users*, United States Environmental Protection Agency, 1993, document EPA/625/R-93/ 009. This 58-page guide, which includes nine worksheets, is available from the National Center for Environmental Publications and Information, P.O. Box 42419, Cincinnati, OH 45242-2419; fax (513) 489-8695.

This material was adapted for South Carolina Coast-A-Syst by Cal Sawyer, S.C. Sea Grant Extension Program. Additional input was provided by Chip Boling, Charleston County Extension agent. The chapter was originally written by Elaine Andrews, Environmental Education Specialist, Environmental Resources Center, University of Wisconsin Cooperative Extension, and adapted for South Carolina Home-A-Syst by Barbara J. Speziale and Janet Ensor, Clemson University Cooperative Extension. Information on accidental exposure to hazardous products was adapted from a fact sheet produced by the Minnesota Pollution Control Agency. Information on reducing hazardous products in the home and the "Recipes for a Healthy House" were adapted from Clemson Extension publications by Joyce H. Christenbury. The boxed material regarding health hazards of household chemicals was developed by Francis C. Graham, Extension Housing Specialist, Mississippi State University. Information on the disposal of household hazardous waste was adapted from the Clemson Extension *Master Waste Educator Handbook*.

Gardening Safe and Sound: Home Landscape Management

Chapter 6

Gardening is a favorite pastime for many homeowners in coastal South Carolina. If yours is like most homes, it's surrounded by lawns, gardens, shrubs and trees that require regular maintenance to remain healthy, attractive and pest-free. Unfortunately, the products and practices that keep your yard looking its best can also send contaminants flowing into coastal creeks, rivers and estuaries.

This chapter will examine the potential impact of landscape management on the coastal environment and your family's health. The following topics will be covered:

- Landscape planning
- Vegetative buffers
- Soil testing
- Fertilizer and pesticide usage
- Lawn type and maintenance
- Woody ornamental type and maintenance
- Ground covers and erosion protection
- Water conservation
- Choosing a lawn care company
- Integrated Pest Management
- Composting

Completing this chapter will help you identify and evaluate pollution risks that can occur from landscape management practices and provide tips for reducing those risks.

The products and practices that keep your yard looking its best can also send contaminants flowing into coastal creeks, rivers and estuaries.

What are the environmental concerns?

Your home landscape, which includes the natural settings of your home and property, might be the last place you would look for pollution problems. However, behind this beautiful landscape are activities that may threaten your health and the health of the coastal environment.

On average, homeowners use 10 times more chemical fertilizers and pesticides per acre on their lawns and gardens than farmers use on cropland. These chemicals can find their way into wells used for drinking water and pollute nearby lakes, streams and oceans. Closer to home, children and pets are particularly vulnerable to pesticides that are stored improperly, applied improperly or used while ignoring proper safety precautions.

Other problems can occur when exposed soils wash away. Soils moving off your landscape can harm wildlife habitat and choke waterways. Indiscriminate watering of lawns and gardens wastes large amounts of water while washing away fertilizers and pesticides.

Gasoline-powered mowers, weed cutters, leaf blowers and other devices make noise and pollute the air. Powered by a two-cycle engine, a lawnmower in one hour spews the same amount of exhaust as a car driven 350 miles!

Environmental problems can arise as residential and commercial development expands along the coast, imposing modern landscape management practices on previously rural areas. These practices usually involve the clearing of all natural habitats along both natural and manmade waterways or lakes. These natural buffers have provided a filtering system to eliminate the movement of pollutants into the watershed, degrading the quality of the system.

Traditional landscape management also encourages the "perfect lawn." To achieve this type of landscape, homeowners commonly use a variety of chemicals and fertilizers. ***Although it may seem that your contribution to pollution is minor, the cumulative effects of chemicals, soil loss and wasted water from hundreds or thousands of homes in your region can really add up.***

Are you using your time and money effectively?

Americans spend lots of money on garden items such as flowers, seeds and chemical products. They also dedicate many hours of their leisure time to caring for their lawns, shrubs and vegetable gardens. Valuable time and money may be wasted, however, if you manage your lawn and gardens in a hazardous, environmentally unsound way.

Think about the cost, time and effort it would take to replace a lawn or injured plants damaged by over-fertilization or misuse of pesti-

cides. Consider the hard work required for returning unsightly, eroded areas back into productive use. Imagine how much less time lawn care would take if grass clippings were left on the lawn instead of being raked and bagged.

You can have a low-maintenance landscape without losing the well-kept appearance of your home. Good management practices not only benefit the environment — they can save you time and money as well. Think of an environmentally sound landscape management program as a preventive process. Proper planning, monitoring and tailoring of plantings to local conditions will reduce the amount of pests present, thus reducing the amount of chemicals needed.

Part 6.1 Designing an Environmentally Friendly Landscape

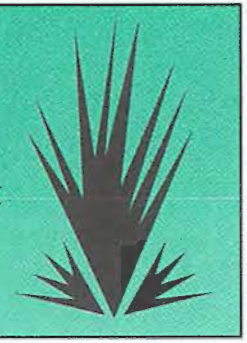
Planning a landscape is one of the most important aspects to producing an environmentally sensitive area. Two main components of producing an attractive landscape, while reducing the use of potentially harmful chemicals, are proper site preparation and plant selection. Both goals may be achieved through planning.

Planning Your Beneficial Landscape

The first step in planning your landscape is to draw up a master plan. This map will help you stay on track as you remove, add, replace and nurture your landscape to a finished level. Ideally, the entire landscape should be constructed at one time. However, if the entire area to be developed is large, you may want to divide the landscape into phases that can be planted in stages as money and time become available.

As you look over your project, think about creating outdoor rooms using various types of plant material and the natural features of the site. The process of developing your landscape should be well-planned before the initial clearing begins on your site. Planning early will allow you to save native plant species and work with the natural contours of the area to eliminate potential erosion problems.

You can have a low-maintenance landscape without losing the well-kept appearance of your home.



Planning Tips

- Plant native sedges, rushes or grasses in and near the water to filter stormwater runoff.
- Minimize lawn throughout your property particularly at the waterfront.
- Add native shrubs and ground cover especially at the top of a slope. Select ground cover instead of hard surfaces to absorb rainfall and reduce heat buildup.
- Position larger shrubs and trees for screening or privacy.
- Vary height and shape of trees to create framed views along the shoreline.
- Locate tall trees on the east and west side of the house to shade the roof and walls. On the north and west sides plant evergreens to block winter winds.
- Select mulch, stone or flagstones for paths. Build steps of timber or stone so as to divert rainfall into adjacent plantings.

What plants should I use?

Proper plant selection is an extremely important aspect to landscape development. Learn as much as you can about native species at your site and how they can fit into your overall design. Clear cutting of the site should be avoided if possible since this will remove those native species that can benefit your design. Soil erosion will also become a problem if plant material is not replaced quickly or exposed soil somehow protected.

When selecting plants to add to your landscape, choose those species that are adapted to the site; resistant to pests; drought-tolerant if the area is sandy or able to tolerate wet soils if the area is poorly drained; and expected to mature to a height that you want (see chapter appendix, page 91. Try to avoid using exotic or non-native species as they often are not adapted to your site, may be prone to disease and insect problems, and could possibly be a noxious plant in South Carolina.

Site Preparation

Once plant selection is made according to your master plan, site preparation will be the next important process. Find out all you can about your soil type, soil fertility, natural drainage, existing vegetation and any problems you may have with excess water and how it will flow off site. Soil testing would be a good idea at this point to acquire some important data.

The majority of turf and woody ornamentals planted in the home landscape need adequate drainage to produce quality growth without the use of pesticides. Healthy plants can withstand minor infestations of insects and disease and recover without introducing potentially harmful chemicals. To maintain healthy growth, eliminate all poorly drained areas by adding organic amendments to the soil. This will allow water to percolate through the soil, reducing root problems. In very poorly drained soils, the addition of underground drainage may also be needed. Planting moisture-sensitive plants on raised beds is another option to help reduce root rot. Before any planting is done, smooth and slope the soil so surface drainage will carry excess water off-site.

Riparian Buffers

Homeowners who live near surface water bodies are usually not aware that their actions toward landscape management may actually be harming aquatic life. This can occur not only in nearby small creeks but downstream in larger lakes, rivers and oceans as well. Landscaping down to the water with inappropriate species increases riverbank erosion and the potential for flood damage while decreasing the available habitat for wildlife. Scenic natural views are lost as well.

One way to avoid polluting our environment is to establish vegetated buffers on your property. The term riparian refers to areas of land along a stream, river, marsh or shoreline. In its natural state, this land has native plants growing on it, such as trees, shrubs and tall grasses.

Buffers along water bodies are easy to establish and maintain if provided for at the outset of construction

These buffers offer a number of benefits to you, your property and the coastal environment. They reduce the amount of runoff that actually reaches a water body in addition to improving the quality of the runoff by removing pollutants. A vegetated buffer acts as a filter by reducing the amount of sediment reaching the water; by slowing the movement of stormwater runoff, and by allowing more time for sediment contained in the stormwater to settle out.

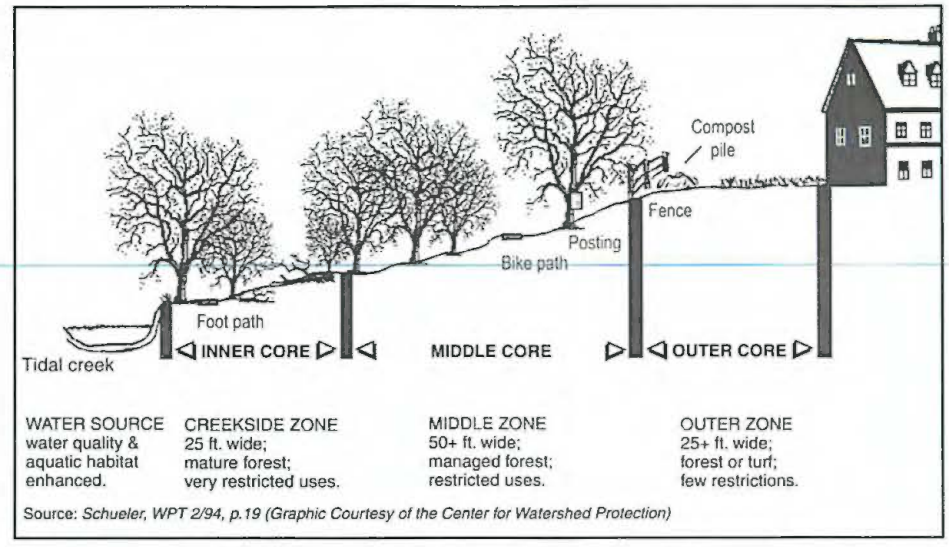


Figure 6.1. Diagram of a Three-stage Coastal Riparian Buffer

Vegetated buffers also reduce downstream flooding by slowing stormwater velocity, storing some water in soils, and allowing more water to percolate to the water table. Riparian buffers are also useful for flood zone management by keeping development back from the immediate banks of waterways and out of most floodways.

In addition, many animals either live in the riparian area or use the buffer as a travel corridor. Wildlife diversity within a buffer is linked to a buffer's size. For example, wider buffers support a greater variety and number of species. A continuous buffer is of particular value in protecting amphibians, waterfowl and coastal fish spawning and nursery areas.

Buffers can even minimize property destruction by maintaining some undeveloped land along waterways and by keeping developing areas away from floodwaters, storm surges and extreme high tides.

Recommendations for Establishing Vegetated Riparian Buffers

For vegetated buffers to provide important protection from environmental pollution, they should be designed properly. Buffers along water bodies are easy to establish and maintain if provided for at the outset of construction (see Figure 6.1, above). For the creation of new buffer areas, native plants that establish rapidly and are suitable for flood zone conditions should be used (see chapter appendix on page 91). Native plants that have an extensive root system work best to stabilize the soil and take up nutrients. The denser the vegetation is in a buffer, the better it will filter runoff and remove pollutants.

The ability of a buffer to provide multiple benefits is also closely linked with its width. Coast-A-Syst recommends buffers of a minimum average width of 50 feet where possible, although wider buffers will provide more benefits. Some professionals recommend buffers of 100 feet or more, with zones of different vegetation and management practices.

Establishing or maintaining a buffer on your property doesn't mean that you won't be able to see the water from your window or deck. To have a better view of the water and opposite bank from their home, homeowners can establish a view corridor in their buffer. A view corridor is a small section of the buffer where the vegetation is pruned to a certain height but still contains native vegetation below that height to preserve the beneficial functions described above. Trees can be removed but should be replaced with lower-growing native vegetation. A view corridor allows for a framed view of the water from a house while maintaining privacy for the homeowner from boats and other water traffic.

Developing Windbreaks in Coastal Areas

Landscapes that are designed and installed in very close proximity to the ocean can be damaged or destroyed by high, salty winds that continually blow. These landscapes will need protection from the normal prevailing winds, storm-force winds, salt spray and blowing sand. Natural or constructed windbreaks, walls, fences or other structures will allow plants that are not normally adapted to this harsh environment to survive. Plants in the lee (an area sheltered from the wind) should provide the necessary protection from all but the most severe of storms. Keep in mind that as you move farther from the shoreline, your choice of plant material will increase. Also be mindful that you should not stray from the overall recommendation to use only native vegetation. Use these tips to plan an effective windbreak:

- The optimum solid space or foliage density for a windbreak is about 60 percent. Fences with 1-inch gaps and 1-inch pickets would meet this criterion.
- Windbreaks are most effective when they reach the ground. Do not remove lower branches of trees and shrubs.
- The depth of planting is important as it relates to the ability of wind to penetrate. For most evergreen plants, two to three rows is sufficient to slow wind speed. Deciduous plants will need four to five rows to be effective. Rows should be staggered.

Coastal Natural Hazards

If you have beachfront property, remember that the dunes on or near your property are important protective barriers between you and the sea. During storm attack, dunes function as flexible barriers and provide sand to nourish the beach. Numerous bird species and sea turtles along South Carolina's coast also use coastal dunes as nesting areas.

Coastal dunes are fragile structures that require protection and maintenance. Build a walkway (and use it!) to avoid trampling and damaging dunes. Extend the life of your dunes by vegetating bare patches, fertilizing the new beach grasses and protecting them from foot traffic.

If there is a small dune or no dune on your property, consider taking some steps to build one. To initiate dune formation, use sand-fencing parallel to the shoreline. Once sand has accumulated, a native plant species can be transplanted to stabilize the dune and encourage its growth. All plantings should take place as far from the surf as possible. Dunes are an effective sand reservoir for storms and abnormally high tides, but a dune won't last and vegetation won't grow in an area that is regularly inundated by the sea.

Whether you are working on a new dune or patching bare areas on an existing dune, selection of the right plant species is important. There are only a few species that are tolerant of the blowing sand, salt spray, saltwater flooding and low soil nutrient levels characteristic of a beach environment. The primary stabilizers of the frontal dune system along the Atlantic Coast are perennial grasses, including sea oats, American beachgrass and bitter pancium. Once these species have been established, others follow as their seeds are carried to the new environment.

For detailed instructions on building and maintaining your coastal dunes, see "How to Build a Dune," available free from the South Carolina Office of Ocean and Coastal Resource Management, 1362 McMillan Avenue, Suite 400, Charleston, SC, 29405, telephone (843) 744-5838.

- For smaller landscapes, a well-maintained hedge, wider at the base, would serve as an effective windbreak.

Windbreaks can be any type of barrier that is designed and placed for the specific purpose of slowing down the speed and redirecting the flow of wind. A well-designed windbreak will not cause uncomfortable wind turbulence on the lee side. Caution should be taken when choosing the material for a windbreak. Breaks consisting of plant material will not stop wind completely but slow it to a tolerable level.

Examples of windbreak materials include picket and board fences designed with gaps between the pickets, berms, natural sand dunes, and rows or hedges of plants. Temporary windbreaks can be made out of snow fencing or shade cloth.

Risk Assessment 6.1 Environmentally Friendly Landscape Design

The assessment table below will help you identify potential environmental risks related to the design of your home landscape. For each question, indicate your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits. Refer to the previous pages if you need more information to complete the table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Plant selection	I use only native vegetation in my home landscaping.	I try to use native vegetation where possible, but sometimes an attractive ornamental looks too good to resist, even though it will require occasional fertilizers and pesticides.	I never plant native vegetation even though I must use more water, pesticides and fertilizers to keep my landscape looking good.	❑ Low ❑ Medium ❑ High
Vegetated buffers	I have a wide, uncut vegetated buffer of greater than 100 feet along the waterfront. I maintain different zones of trees, shrubs, and lawn.	I have a fairly wide buffer of around 50 feet along the waterfront. I do not maintain different zones of vegetation.	I have no vegetated buffer at my home along the waterfront.	❑ Low ❑ Medium ❑ High
Native plants	The buffer along the waterfront at my home is made up entirely of native vegetation.	Half of the buffer along the waterfront at my home is woody vegetation, but the other half is manicured lawn, which requires high maintenance.	I have no vegetated buffer along the waterfront at my home.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your risks related to home landscaping practices in the coastal zone. Turn to the Action Checklist on page 89 to record medium- and high-risk practices. Use the recommendations in Part 6.1 to help you make plans to reduce your risks.

Part 6.2 Managing Your Lawns, Gardens and Woody Ornamentals

Most homeowners want a well-kept home landscape with attractive flowers, woody plants and a green lawn. Normal usage of lawn- and garden-care products, when applied as recommended, generally poses few problems. A properly maintained home landscape, in fact, can help reduce soil erosion, increase water retention and improve soil fertility. Poor maintenance — either through neglect or excessive chemical use — can lead to soil problems and polluted runoff.

Look over the topics below and read the ones that will help you better understand your yard and garden practices. Fill out the assessment table on page 80 to see where you might need to make improvements.

Has your soil been tested?

Adding fertilizer without first testing your soil is like taking medicine without knowing if you need it. Your soil already has some of the nutrients needed for good plant growth such as nitrogen, phosphorus and potassium. It is important to find out how much of each nutrient is present along with the soil's natural pH. Soil pH is an important chemical component of your soil, as this will tell you the quantity of nutrients available to your plants. Soil testing takes the guesswork out of how much fertilizer to use. Check with your local Cooperative Extension office, garden supply stores and neighbors about testing your soil.

Testing involves taking small samples from several places in your yard and garden. The soil is analyzed and you receive a lab report that lists the amounts of each nutrient in each sample. Because of local differences, some parts of your property may need regular applications of fertilizer while other areas may need few or no applications. Soil tests should be conducted every three years.

Taking a Soil Sample

You should test only one soil sample from your lawn, home garden or ornamental beds. To obtain a composite sample in these individual areas, you will need to collect samples from several locations as outlined below.

To take the sample, use a soil auger or shovel to collect soil from the surface to a depth of 3 inches. Collect and combine samples from twelve or more locations within your designated lawn, home garden or ornamental beds. Each of these twelve samples should be of equal size. Place all of the samples in a clean bucket and mix thoroughly. Fill a clean, one-pint bag or a soil sample box (available from your local Cooperative Extension office) with the mixed soil. Label and number the box or bag. Take the labeled sample to your local Cooperative Extension office for processing. There will be a small charge for testing each soil sample.

Adding fertilizer without first testing your soil is like taking medicine without knowing if you need it.

What fertilizers are needed for the various areas of your landscape?

Your soil tests will let you know if your lawn, shrubs or vegetable garden need fertilizer, and if so, how much and where. Nitrogen, for instance, is the key plant nutrient for building a thick, green lawn. Applied at the right time, in the right amount and in the right form, fertilizers will supply the nitrogen your plant needs.

If you apply fertilizer at the wrong time, or in the wrong amount, you may make conditions in your landscape worse. Insect and disease problems can actually increase due to excess fertilizer applications. Excess fertilizer is likely to wash away before plants take it up. This lost fertilizer can move offsite in runoff water and contribute to unwanted plant and algae growth in nearby streams or lakes. Especially in sandy soils, nitrogen and other chemicals can seep downward and enter groundwater used for drinking. On heavier, clay soils water will have a tendency to runoff the site carrying excess nutrients with it.

If you hire a lawn-care service, make sure they test your soil before applying fertilizer. Insist that lawn fertilizers only be applied when the weather is favorable — when rain is not expected for at least 24 hours. Be sure to keep children and pets away from treated lawns for at least 24 hours after fertilizer application. Sweep excess fertilizer off of walks and back onto the lawn before it is washed away by rain. Nonchemical fertilizers — such as compost, fishmeal and other soil amendments — should be applied based on the actual needs of your lawn as well.

Maintaining the Proper Soil pH

Acidity and alkalinity of a soil is expressed as the soil pH. The pH will affect your lawn's ability to absorb fertilizers and other nutrients. A pH below 7 is considered acid; a pH above 7, alkaline. For most lawn grasses and ornamental plants, the soil pH should be between 6 and 7. This will help the plants as well as earthworms and other beneficial organisms in the landscape.

There may be certain plants that need a particular pH value to survive. As you review your soil pH values, know what plants are growing in your landscape and what pH they may need. The amount of lime required on your lawn should be based on the results of a soil test. The results of the test will determine the amount of limestone required to increase the pH or the amount of sulfur necessary to lower the pH to the desirable level.

Applying the Proper Amount of Fertilizer

Too much fertilizer can be harmful to the lawn, burn roots on plants and may also lead to water contamination through run-off or leaching of nutrients. The general rule for fertilizing shrubs is 1 tablespoon of fertilizer per 1 foot/height of growth. This should be done twice per growing season for mature plants and three times per growing season for newly planted shrubs.

Use a fertilizer that is no less than 50 percent slow-release nitrogen. When using fertilizers developed especially for shrubs, such as polycoated, resin-coated or 100 percent slow-release, follow the manufacturer's rate on the label. Mulched beds do not need to have the mulch removed to fertilize. Spread the fertilizer evenly under the shrubs from the trunk to the drip line. Be sure to water the fertilizer in after application. Again, follow all label directions on application rate and method.

Centipede and carpetgrass are low-maintenance lawn grasses and do not tolerate excessive use of fertilizer, especially nitrogen and phosphorous. Use one-quarter the application rate for these grasses. For example, if you have a 12- 4- 8 fertilizer, apply 2 1/2 pounds per 1,000 square feet to your centipede or carpetgrass lawn. For an established lawn, the fertilizer ratios, analyses and rates on the following page are recommended during the growing season:

What Those Numbers on Fertilizer Bags Mean

The numbers on a fertilizer bag—from left to right—give the percent by weight of nitrogen (N), phosphate (P_2O_5), and potash (K_2O). For example, in a 10-4-6 fertilizer, nitrogen makes up 10 percent of the total weight of fertilizer, phosphorus accounts for 4 percent, and potassium makes up 6 percent. The remaining weight of fertilizer (the total must add up to 100 percent) is comprised of a nutrient carrier material.

Table 6.1. Basic Fertilizing Schedule

Lawngrass	Application Rate[2] lb. N/1000 sq. ft.	Application Time[3]
Bermudagrass	1	May, June, July, August
Carpetgrass	1/2	May, August
Centipedegrass	1/2	May, August[4]
St. Augustinegrass	1	May, June, July, August
Zoysiagrass	1	May, July, August
Fescue, bluegrass[5]	1	January, September
	2	November
Ryegrass (overseeded)[5, 6]	1	December, February

1 The kind of fertilizer you use should be based on current soil test recommendations. Without a soil test report, use a complete, balanced (N-P-K) fertilizer.

2 Use a nitrogen fertilizer which contains at least one-half of the total amount of nitrogen in a slow-release form.

3 On warm-season turfgrass, the first fertilizer application should be made 2 to 3 weeks after the lawn turns green in the spring.

4 Fertilize centipede using a low phosphorus, high potassium fertilizer. An additional fertilizer in late June may enhance centipede performance in sandy soils.

5 For late fall and winter applications, use a fertilizer source containing quick-release nitrogen or slow-release nitrogen in the form of isobutylidene diurea (IBDU). The nitrogen release is independent of microbial activity; therefore, IBDU nitrogen is released more readily during cool weather when compared to other slow-release sources.

6 When applying a fertilizer to warm-season lawns overseeded with ryegrass, the warm-season grass should be dormant before fertilizing.

Fertilizer Ratio N-P-K	Fertilizer Analysis	Application Rate
3-1-2	12-4-8 15-5-10 18-6-12 21-7-14	8 6 6 4
4-1-2	16-4-8 20-5-10	6 5
1-0-1	15-0-15 18-0-18	6 5

Treat your lawn with the proper amount of fertilizer at the right time. Use Table 6.1 to determine the appropriate fertilizer application times for your lawn grass.

To determine the proper amount of fertilizer needed, especially if the N-P-K analysis of your fertilizer is not listed above, use the following procedures:

- To apply one pound of nitrogen per 1,000 square feet, divide the first number on the fertilizer bag into 100. For example, a 16-4-8 fertilizer should be applied at a rate of 6.25 pounds per 1,000 square feet (100/16 = 6.25).

- To apply one-half pound of nitrogen per 1,000 square feet, divide the first number on the fertilizer bag into 50. For example, a 10-10-10 fertilizer should be applied at a rate of 5 pounds per 1,000 square feet (50/10 = 5).

For slow, even, sustained growth, consider using "slow-release" fertilizers. These products make nitrogen available slowly over a long period of time, say several months, which results in gradual, even growth. Slow-release materials include natural fertilizers, such as manure or composted sewage sludge. Synthetic slow-release fertilizers include UF (urea formaldehyde), SCU (sulfur-coated urea), IBDU (isobutylidene diurea) and methylene urea. These slow-release fertilizers are also good choices for areas where the potential for runoff is very high — slopes, compacted soil or sparsely covered lawns. Since the nutrients are released slowly, the potential for runoff and water contamination is less.

If a fertilizer contains a slow-release nitrogen source, it will be listed on the label. For urea formaldehyde-based fertilizers, the portion of the nitrogen that is slow-release is listed on the fertilizer bag as Water Insoluble Nitrogen (WIN). If WIN is not listed on the label, you should assume that all nitrogen in the fertilizer is in the quick-release form. For example, a fertilizer label might provide the following information like that listed in the box opposite.

For applications on sloped areas, choose a fertilizer in which more than 50 percent of the nitrogen is in WIN form.

Too much fertilizer can be harmful to the lawn, burn roots on plants and may also lead to water contamination through run-off or leaching of nutrients.

Fertilizing Near Coastal Water Bodies

As covered earlier, pesticides and fertilizers applied to landscape plants and turf can cause pollution problems to nearby aquatic environments if applied improperly. Most current landscape designs have cultivated turf or open areas directly adjacent to the water's edge. Not only does this cause a problem in water movement off the landscape but also can cause problems with pesticide and fertilization application near these sensitive areas. If natural or designed buffers are not feasible on your site, use extreme caution when applying chemicals and fertilizers in this area.

Make sure all application equipment is well-calibrated. Thoroughly research the specific problem you have and apply a chemical remedy only as a last resort. If it is determined that a chemical is needed, read all label directions as to the aquatic hazards of the chemical to be applied.

Guaranteed Analysis
Total Nitrogen1 ..... 6%
8.50% Ammoniacal Nitrogen
2.00% Nitrate Nitrogen
5.50% Water Insoluble Nitrogen (WIN)
Available Phosphoric Acid (P_2O_5) 4%
Soluble Potash (K_2O) 8%

Because the WIN is less than half of the total amount of nitrogen in the bag, this is a quick-release fertilizer.

$$\frac{\%\ \text{WIN} \times 100}{\%\ \text{total}} =$$ % of total nitrogen that is WIN or slow-release nitrogen

Therefore:

$$\frac{5.5 \times 100}{16} =$$ 34% of the total nitrogen is WIN or slow-release nitrogen

Be very careful not to apply any pesticide or fertilizer directly into any body of water. Leave a buffer zone as wide as practical between the area treated and the shoreline. To avoid this problem altogether, design and implement a vegetative buffer zone to filter out these chemicals.

Calibrating a Sprayer for Broadcast Pesticide Application

When applying a pesticide over a large area, broadcast spraying a uniform application will ensure that you cover the entire area with the amount of pesticide recommended on the product label. Uneven, heavy applications can result in damaged turf and shrubs along with the potential for environmental pollution. An application that is too light will result in poor pest control, wasted money and repeated applications of the product, which can also lead to environmental pollution.

To accomplish a uniform application of pesticides, you must establish some standard practices regarding the sprayer pressure, walking speed during application and height of boom above the area being sprayed. A constant walking speed is critical during pesticide applications. Practice maintaining a constant speed, since slowing down while spraying can cause significant damage to your turf or ornamentals.

Steps in sprayer calibration

There are different ways to calibrate a sprayer. This method is one that is easier to use with backpack or hand-held sprayers.

- Add water to the sprayer and spray a small area on the ground or dry pavement to check that the sprayer is operating properly. You should see a uniform spray pattern. If this is not the case, remove the boom and nozzle and check for obstructions. You can also check for leaks while doing this.
- Once the sprayer is checked out, add 1 gallon of water to the tank.
- Mark your starting point.
- Spray the water as if you are actually applying a pesticide to your landscape. If you want to see your spray pattern, a commercially available marker or food coloring can be used mixed with the water. Remember: You must maintain a constant pressure, constant walking speed and constant height of nozzle or boom above the surface.
- When all the water has been sprayed from the tank, stop and mark your final spot.
- Measure the area you have sprayed and calculate the square footage (length of sprayed area times the width).
- Calculate how much of an acre you covered.

$$\frac{\text{Number of ft}^2 \text{ you sprayed}}{43560 \text{ ft}^2/\text{acre}} = \text{acres sprayed}$$

If you are spraying small areas, divide the acres sprayed by 43 to change the units to 1000 ft^2.

- Calculate how many gallons/acre or / 1000ft^2 you sprayed:

$$\frac{1 \text{ gal sprayed}}{\text{acres or 1000 ft2 sprayed}} = \text{gal/acre or / 1000 ft2}$$

BE CAREFUL!!!

Always read and follow all label directions on all pesticides you use with regard to plants it will be used on, target pest, environmental hazards, applicator safety and disposal of the container and any unused product. Do not deviate from these instructions.

Risk Assessment 6.2 Your Fertilizer Use

The assessment table below will help you identify potential environmental risks related to your use of fertilizers. For each question, indicate your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits. Refer to the previous pages if you need more information to complete the table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Applying fertilizers	I test my soil for pH and nutrients every three years. Fertilizer and lime are used only as recommended.	I do not test my soil. Fertilizer and lime are used according to label instructions when it's convenient.	I do not test my soil. Fertilizer and/or lime are used in large amounts with no regard for approaching weather changes.	❑ Low ❑ Medium ❑ High ❑ High
Selecting fertilizers	I only use slow-release fertilizer on a sloping lawn near a waterbody or storm drain.	I use fast-release fertilizer according to soil test results on a sloping, dense lawn near a waterbody or storm drain.	I use fast-release fertilizer on a thin, sparsely covered lawn near a waterbody or storm drain.	❑ Low ❑ Medium ❑ High
Fertilizer storage	I never store fertilizers.	Fertilizers are stored away from the well and waterbodies and all spills are promptly cleaned up.	Fertilizers are stored in or near well pump house and spills are not cleaned up.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your risks related to the use of fertilizer around your home. Turn to the Action Checklist on page 89 to record medium- and high-risk practices. Use the recommendations in Part 6.2 to help you make plans to reduce your risks.

Part 6.3 Taking Care of Your Lawn

It will be easier to keep your landscape healthy if the type of grass and shrubs are suited to local growing conditions. This will include rainfall amount, temperature, soil type and available light. Contact your local Cooperative Extension office and the references at the end of this chapter for a list of recommended turfgrasses and shrubs for your region.

Cut your grass to the proper height.

Mow your lawn regularly. A good rule of thumb is to remove no more than one-third of the grass height at any one mowing. For example, if you are maintaining your centipede lawn at 1.5 inches, mow the lawn when it is about 2 inches high. Cutting off more than one-third at one time can stop the roots from growing and would require frequent watering during dry summers to keep the plants alive. Also, following the one-third rule will produce smaller clippings that will disappear quickly by filtering down to the soil surface.

Mow with a sharp mower blade. Sharp blades cut the grass cleanly, which ensures rapid healing and regrowth. When dull blades tear and bruise the leaves, the wounded grass plants become weakened and are less able to ward off invading weeds or to recover from disease and insect attacks.

Mow your lawn at the recommended height for your grass type. Cutting your grass to

Lawn Type	Mower Setting (inches)	Mow At or Before This Height (inches)
Common Bermuda	1	1 1/2
Hybrid Bemuda	1	1 1/2
Zoysia	1	1 1/2
Carpetgrass	1 1/2	2
Centipede	1 1/2	2
St. Augustine	3	4
Tall Fescue	3	4

the right height is important; lawns cut too short invite weeds to invade. Use the table above as a guide to proper mowing heights.

Recycle your grass clippings.

In the early 1950s, the first bagging mowers made their debut on American lawns. Somehow collecting and removing grass clippings and sending them to landfills caught on. Bagging clippings became an established ritual across the country, accounting for 20 to 50 percent of the solid waste entering landfills between the months of March and September.

However, faced with the rapid disappearance of landfills in South Carolina, new legislation prevents grass clippings and other yard wastes from entering our landfills as of May 27, 1993. So where will all the clippings go? That's easy: adopt the old practice of returning them back to the lawn. "Recycle" the grass clippings by not collecting them.

Recycling your grass clippings makes up part of a lawn care plan designed to produce a healthy lawn with savings in time, energy and money. At the same time, this lawn care plan will benefit your community and the environment. Grass clippings should be left on the lawn — in many cases, they supply enough natural fertilizer so that only minimal additional fertilizer is needed to keep your lawn green and healthy. Grass clippings contain nitrogen, phosphorus, potassium and smaller amounts of other essential plant nutrients — basically a 4 -1- 3 fertilizer. When left on the lawn, these nutrients are eventually returned to the soil. Clippings should be swept off of paved surfaces so they aren't carried away by stormwater.

Use a human-powered mower for small lawns.

Switching to a human-powered mower can cut down air and noise pollution and provide exercise. If you reduce your lawn size and grow plants that require little maintenance, such a mower can be practical. Consider using an electric mower for smaller-sized lawns.

Do your yard care practices save water?

The average American uses approximately 200 gallons of water each day. About half of that water may be used for landscaping and gardening, depending on climate, time of year, and plant species in the landscape. This is an immense amount of clean water — and only a small portion is actually used by your plants. If you convert your landscape plants to ones adapted to your region and climate, you will take the biggest step in conserving water and reducing the amount of pollutants moving offsite into the environment.

In places with dry climates, there are many plants that are drought-tolerant. Consider using drought-resistant turfgrass species like bermudagrass. Perennial flowers conserve water because their roots grow deeper than annual plants and require little or no watering once established. A shallow mulch (about 2 inches deep) of wood or bark chips over bare soil will reduce stormwater runoff and keep water from evaporating.

Water wisely.

Because most plants can tolerate at least short dry periods, watering should be timed to meet the biological needs of plants. Watering

What About Thatch?

Grass clippings do not contribute to thatch in any lawn. Thatch is a layer of living and dead plant parts that lies between the grass leaves and the soil surface. The plant tissue that makes up thatch contains a high amount of hard-to-decompose cell wall material called lignin. Grass leaves are mostly comprised of water (75 to 85 percent by weight), high amounts of protein, and little lignin. The clippings break down quickly once they fall between the grass blades and onto the soil surface.

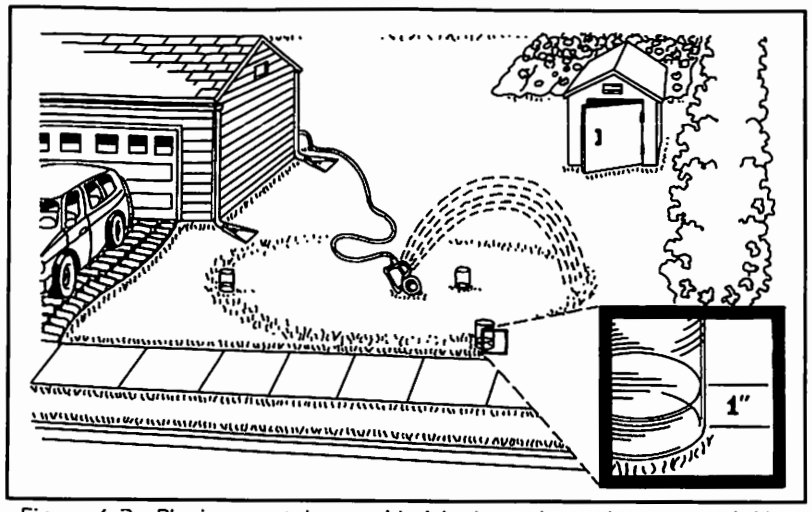


Figure 6.2. Placing containers with 1-inch marks under your sprinkler will help you measure how much water you are applying.

slowly and deeply helps develop strong roots and in the long run, your plants will need less frequent watering. The plants that seem to benefit most from shallow watering are the ones you don't want — weeds!

Remember that plants can absorb only so much water. ***Over-watering wastes water, can injure certain plants and lead to runoff carrying hazardous fertilizers and pesticides.*** Placing several containers with 1-inch marks under your sprinkler will help you gauge how much water your lawn or garden is getting (Figure 6.2).

When designing an irrigation system, place shrub beds on separate valves so they can be watered differently than your turf grass. Shrubs and trees need longer and slower water applications to thoroughly wet their root systems. If watered the same as turf areas, shrubs will usually develop shallow, weak root systems making them prone to diseases and insects. Shallow roots are also not able to absorb a large amount of the fertilizer applied. These nutrients may leach into the ground water.

You can choose not to water your lawn. During long, dry hot periods in the summer, you have two choices: (1) water the grass and keep it green, or (2) do not water and watch the lawn turn brown. Each choice has consequences. Watering will increase the need for mowing, raise your water bill and may stimulate disease outbreaks and weed growth. If you do not water, you can expect warm-season grasses, such as centipede, bermuda, St. Augustine or zoysiagrass to remain alive, and resume growth when conditions become more favorable. Cool-season grasses, such as tall or red fescue may be severely injured or killed.

If you irrigate your lawn, water early in the morning for efficient water use and to discourage the development and spread of diseases. During the driest part of our year, from April through September, plants and soil lose about 1.5 inches of water every seven days. Therefore, our lawns require about an inch of water every five to seven days. This will vary depending on soil type, turfgrass growth and rainfall. Sandier soils will require more frequent irrigation than do heavy soils. Apply a half-inch of water on coarse, sandy soil and an inch of water on heavy or finer-textured soil.

Most hose sprinklers apply 1/4 to 3/4 inch of water per hour, so they would need to run about four hours in one spot. If water runs off the lawn before an inch is applied, turn the sprinkler off, let the water soak in for about an hour, and then continue watering.

Use the following techniques to identify signs or indications of water need:

Color Test: When water is unavailable for an extended period of time, your lawn will turn a bluish-gray color.

Footprinting: Walk across your lawn and examine the lawn behind you to see if your steps left any "footprints." Your footprints will appear in a lawn when the grass plants have low levels of water in their tissues. When you press the grass blades down with your feet, the low water levels prevent the grass blades from springing back up. If your footprints remain for an extended period, the lawn should be watered to prevent the grass from turning brown and becoming dormant.

Screwdriver Test: Press a screwdriver or similar tool into the lawn. If the soil is very dry, it will be difficult to push the screwdriver into the ground. Use this test to confirm the results of the footprint method to help judge when you should water your lawn.

Leaf Check: During dry periods, grass leaves respond by wilting, rolling or folding. Use these symptoms as signs that you need to water your lawn to prevent it from becoming dormant.

Aerate your lawn regularly.

Physically removing cores of soil and leaving holes in the lawn is called core aeration. Aeration loosens compacted soil and improves your lawn's growing conditions by making air, water and nutrients available to the grass roots. It also creates ideal conditions for the growth of earthworms and microorganisms that break down clippings and thatch.

Are you applying pesticides wisely?

Although removing weeds, insects and other pests by hand is safest for the environment and your health, pesticides, if properly used, may pose only a minimal risk. The key is doing your homework before you start treatment. Correctly identifying the pest is the first step. ***Many plant problems are not caused by insects or disease but are related to temperature extremes, waterlogging, drought, damage caused by lawn mowers or an overuse of chemicals.***

Learn when and where pesticides may be needed to control problems. Apply them only where pests occur. Select chemicals that are the least toxic or that break down quickly into less harmful substances. Check with your local Cooperative Extension office or garden supply stores for information. Remember to read the pesticide label carefully and follow the directions for application rates and methods.

Pest prevention is often simpler (and cheaper) than pest removal. If you have disease-resistant grasses or other plants and keep them healthy, pests will be less of a problem. Be sure to ask yourself, for the sake of clean groundwater and an environment with fewer chemical pollutants, if you can tolerate a few more weeds and "bugs" around your home.

Choosing a Lawn Care Company

Most gardeners interested in a beautifully landscaped home want a healthy lawn. To accomplish this some people may want or need to hire a lawn care service to maintain their turfgrass. Before selecting a lawn care company, decide on the quality of turf you desire. An average quality lawn can be obtained with a minimum of money and effort. An above-average or superior lawn will require additional care that may need to be preformed by a lawn care company.

Inexperienced homeowners can be more likely to make mistakes than lawn care professionals in mixing the right chemical dilutions, calibrating application equipment, employing safety measures to protect the applicator, and properly storing or disposing of containers.

If you choose to have a company meet your level of lawn quality with chemicals, follow these guidelines to help you make an informed choice:

- Know what lawn or landscape care services you want provided. Ask several companies what services they offer if you are not sure what level of care or management you want. Once you decide what services you want, get several cost estimates from companies offering these services. Ask neighbors and friends who have had such service for recommendations.
- See if the company is willing to listen to your concerns about your lawn or landscape and if they can provide effective and acceptable solutions to your problems. If they are unwilling to address your concerns, look elsewhere. Lawn care companies should have competent personnel who can respond to your questions and diagnose problems. Ask how much training and experience the company's consulting employees have with lawns in your part of the state.
- Obtain a written service agreement. Ask if the service is automatically renewed each year. If so, request an annual written confirmation. If you choose to cancel your service agreement, ask if there are any penalties.
- Do not simply accept service over the telephone without other contact with the company. Ask that a company representative visit your property. Many companies provide a free on-site landscape survey to determine problems, level of maintenance and pricing.
- Ask if the company is licensed and insured. Don't be afraid to ask for proof.
- Ask if the company is a member of a trade association, such as the Professional Lawn Care Association of America or the International Society of Arboriculture. This can be an indication of the company's dedication to good service. Trade associations often have consumer protection codes of ethics to be followed by their members. Also, these associations help keep their members informed of the latest technical information in the industry, as well as keeping members educated in the safe use of pesticides.
- Pesticides and other lawn care chemicals should be used only as needed. Ask the company to tell you what lawn care chemicals it plans to use and why. Some

companies will provide you with a copy of the label and material safety data sheet (MSDS) for pesticides they apply.

- A company should always provide advance notice of chemical applications so that lawn furniture, sports equipment, toys, and pet accessories can be removed from the area before treatment, The company should also tell you how long to keep children and pets off the lawn after treatment.
- Ask if the company will put up notification signs after any chemical application.
- Lawn care chemicals must often be watered into the soil to be effective. Determine if the company will do this, or if you will be responsible. Ask for detailed instructions on the tasks that you will need to perform.
- Ask if the individual(s) applying pesticides will be a Certified Commercial Pesticide Applicator or be working under the supervision of one. While this is not a requirement by law for general use pesticides, a Certified Pesticide Applicator has studied for and passed a licensing examination on the safe use of pesticides.
- Request that the company properly dispose of any fertilizer or pesticide containers.
- Check on the company. A common complaint against some companies is that lawn care chemicals are applied without the knowledge or consent of the homeowner. Other complaints include delays in services and, occasionally, damage to desirable plants with herbicides or chemical applications that may be made on — or drift onto — a neighbor's property. Check with the Clemson University Department of Pesticide Regulation (864-646-2150) to see if the company has any pesticide-related violations. Check with the Better Business Bureau to see what types of complaints, if any, have been made against the company. Ask the company for references from local customers.

Integrated Pest Management

It sounds fancy, but integrated pest management, or IPM, is simply a systematic approach to controlling pests in your landscape.

Although the use of nonchemical controls is preferred, chemicals may be used selectively as a last resort when nothing else has worked to reduce pest damage. Weeds can be controlled by hand-pulling (Figure 6.3) or hoeing, and bugs can be removed by picking them off vegetables and garden plants. Proper planting techniques along with selecting plants adapted to your local site are also important. Try to plant native varieties that are resistant to common pest problems. Cleaning up dead leaves and debris removes potential homes to pests. Using natural predators to control pests is another method: you can release beneficial insects and microorganisms that feed on pest insects into your garden and allow them to control pest problems naturally.

Figure 6.3. Pull weeds by hand instead of controlling them with chemicals.

When you have no other choice, try to find nontoxic or low-toxic chemicals such as insecticidal soaps. Follow directions carefully, and mix only the amount you need. For IPM strategies to work, you will have to give more time and attention to your yard and garden.

It's very important to identify the pest problem and understand its life cycle before choosing appropriate control measures. Consider controlling pests with cultural methods, such as properly mowing and fertilizing, or use biological controls, such as milky spore, to control Japanese beetles. If cultural or biological controls are unsuccessful, or if the pest population has gone out of control, then consider pesticides. It is best to avoid general, catchall pesticide applications. Remember to read and follow all label directions with any pesticide used.

Beneficial Insects

There are many beneficial insects. Listed here are varieties you'll likely see around your garden. Find a book with color pictures of both adult and larval form of these insects and protect them when you see them: spiders, ground beetles, bees, lady beetles, lacewings, hover flies, predatory mites, ants, predacious bugs, centipedes, and wasps.

Risk Assessment 6.3 Yard Care

The assessment table below will help you identify potential environmental risks related to your yard and garden maintenance practices. For each question, indicate your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits. Refer to the previous pages if you need more information to complete the table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Lawn type and maintenance	Lawn grass is suited to soil type, available sunlight and climate. Grass is pest-resistant and mowed to the proper height.	Lawn grass is suited to the site but is well-fertilized and mowed short.	Grass type is not suited to available sunlight, soil type or climate. Grass is pest-prone and mowed too short.	❑ Low ❑ Medium ❑ High
Mowing Height	I mow the lawn frequently, removing no more than 1/3 of the height at each mowing.	I mow the lawn once every two weeks.	I mow the lawn when I have the time.	❑ Low ❑ Medium ❑ High
Pesticides	I use nonchemical or low-toxicity methods to control pests. Pest is identified and its life cycle is understood before choosing control methods. I then decide if control is warrented.	I use chemicals according to label instructions. A pesticide to control pests is used, according to label instructions, when I see the pests.	I use chemicals without regard to label instructions or conditions. A pesticide is used to control pests when I see them. I use a little more than is recommended on the label.	❑ Low ❑ Medium ❑ High ❑ Low ❑ Medium ❑ High
Ground cover and other plantings	Ground covers, flowers, trees and shrubs are planted to reduce soil erosion. Plantings resist insects and disease.	A slow-spreading ground cover is used.	A hilly landscape or lack of ground cover causes soil erosion. Plants require insect- and disease-fighting chemicals to survive.	❑ Low ❑ Medium ❑ High
Water requirements of plants	Grass, flowers, trees and shrubs are able to survive with normal rainfall.	Landscape plants require light to moderate watering.	Heavy watering is required to keep the lawn and other plants alive.	❑ Low ❑ Medium ❑ High
Water usage	Watering is done in the morning or at night following dewfall, only as needed. Low-water-use devices (like soaker hoses) are used. The sprinkler system is on manual control.	Watering is excessive. (For example: The sprinkler is left unattended, and much water lands on the pavement.)	Watering is done during the heat of the day. The sprinkler system is used daily without regard to weather conditions. There is excessive water runoff.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your risks related to the way you care for your lawn and garden. Turn to the Action Checklist on page 89 to record medium- and high-risk practices. Use the recommendations in Part 6.3 to help you make plans to reduce your risks.

Part 6.4 Home Composting

Garden trimmings and food scraps make up more than 25 percent of what is thrown away in an average household. Composting is a cost-effective, natural way to handle leaves, grass clippings and other yard trimmings — materials that might otherwise end up in a landfill. Composting creates an organic, slow-release fertilizer and soil-enhancing material. It takes advantage of nature's recycling system for breaking down plant and other organic materials.

Most natural organic matter will be effective in your compost pile. However, not all material belongs in a compost pile. Some wastes will attract pests while others can contain pathogens that will survive the heat of composting. Fatty food waste such as meat and bones should be avoided. These products will attract animals that can leave manure deposits in your compost containing harmful bacteria. You should also avoid adding diseased plants and extremely noxious weeds such as morning glories and those grasses that have tuberous or rhizomatous root systems. The composting process may not kill these weeds and you can spread them as you use your compost.

So, what can you add to your compost pile? Any carbonaceous material will work fine. Be sure to finely chop all woody material before adding it. The finer the organic waste is the faster it will compost. When adding these "brown" materials, be sure to add an equivalent amount of "green" material, such as grass clippings, to help feed the microbes.

Materials that break down slowly should be mixed with easily decomposed material to allow the pile to get hot. If high-nitrogen sources, such as manure or grass clippings, are not available, you can use the material as mulch or add a small amount of fertilizer to the pile. Although materials such as wood chips and straw break down slowly, they add bulk to the pile allowing air to circulate. Remember, a compost pile is a living product and needs air to run. When composting a large amount of dense high-nitrogen materials such as manure, the addition of this bulking material may be needed to facilitate the process.

Never add pet wastes (from cats and dogs) to compost piles because of potential parasite and disease problems.

Location

A good location is helpful for a successful compost pile. Direct sunlight in the summer dries the pile. Exposure to high winds can dry and cool the pile, slowing the decomposition process. The pile location should not interfere with lawn and garden activities. Water should be readily available. There should also be enough space for temporary storage of organic wastes. Good drainage is important; otherwise, standing water could impede the decomposition process. The compost pile should not be located against wooden buildings or trees; wood in contact with compost may decay.

> Composting is a cost-effective, natural way to handle leaves, grass clippings and other yard trimmings — materials that might otherwise end up in a landfill.

In the coastal environment, precautions should be taken about your compost pile's proximity to water. Try to locate your pile well away (at least 100 feet) from any wells, lakes or rivers.

Volume

A pile should be large enough to hold heat and small enough to admit air to its center. As a rule of thumb, the minimum dimensions of a pile should be 3 feet x 3 feet x 3 feet (1 cubic yard) to hold heat.

If space is a limiting factor, the pile sides should be insulated so that higher temperatures can be maintained in a much smaller volume. Smaller, commercially available units can be insulated with foam board. Piles larger than 5 feet tall and wide may need to be turned to prevent their centers from becoming anaerobic. As the material decomposes, the pile will become smaller.

Pile Maintenance

Maintenance of the compost pile involves turning the pile and adding water to maintain conditions conducive to the composting process. If the pile is not turned, decomposition will occur, but at a slower rate. The following maintenance procedure will yield compost in the shortest time.

In a properly constructed pile, the temperature will increase rapidly and soon reach about 110 F. After about a week, the pile should be opened to the air and any compacted material should be loosened. Then the pile should be reconstructed; material previously on the top and sides of the pile should be moved to the center.

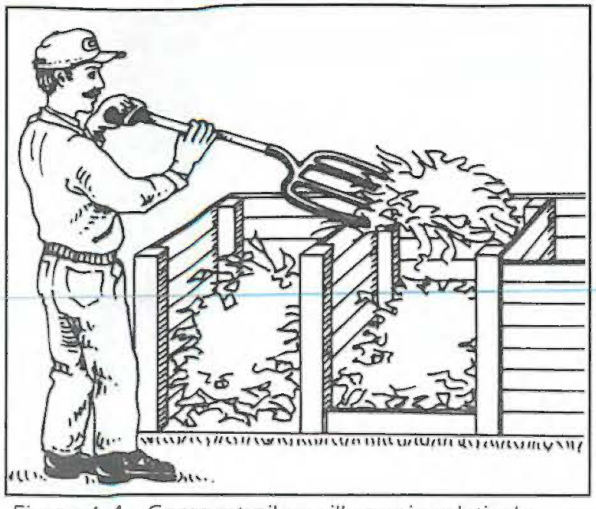


Figure 6.4. Compost piles will remain relatively odor-free if they are turned and aerated regularly.

At the second turning (after about another week), the material should be a uniform coffee-brown color and moist. The outer layer, relatively undecomposed, can be scraped off and turned back in to the center of the pile. The center material should be spread over the outer layer of the reconstructed pile. By the third turning, the original materials should not be recognizable. At each turning, the moisture content should be checked so that squeezing the compost material would produce a slight trickle of water. Water should be added, if necessary.

During the first few weeks of composting, the pile should reach apeak temperature of about 140 F. If temperatures surpass 140 F, the pile should be turned to cool it off. Extremely high temperatures can kill many beneficial organisms. If the pile does not reach at least 120 F, more nitrogen or water may be needed. Cold weather can also prevent the pile from heating. Piles that give off strong ammonia smells contain too much nitrogen, and may need more high-carbon ingredients.

Simple carbohydrates and proteins provide most of the energy for the initial, rapid stages of decomposition. When the more resistant materials, such as lignin and cellulose, become the main food sources, the activity in the pile will slow down. Less heat will be produced, and the temperature will begin to fall to about 100 F. Even after the temperature falls, the compost will continue to stabilize slowly.

The compost will be finished when the pile cools off and decreases to about one-third of its original volume (depending on the original ingredients). It will be dark, crumbly and have an earthy odor. Unfinished compost can be toxic to some vegetation, especially seedlings and newly established plants. Therefore, compost must be allowed to decompose thoroughly before use.

Check with your local Clemson Extension office, garden stores, the library and your neighbors for other ideas.

Avoiding Pests

Given a comfortable or even nourishing environment, rodents and other animals may be attracted to your compost pile. Rats are probably the most undesirable pests. In a hospitable environment with plenty of food, they can multiply very quickly and can become disease transmitters. Therefore, it is crucial to keep high-protein and fatty food wastes out of the compost pile in areas where pests may be a problem. Meat and fish scraps, bones, cheeses, butter and other dairy products should be excluded. Bread and other high-carbohydrate or high-sugar wastes can also attract pests.

Materials That SHOULD and SHOULD NOT Be Added to a Compost Pile

Yes

Aquatic weeds	Leaves
Bread	Paper
Coffee grounds	Sawdust
Egg Shells	Straw
Evergreen needles	Sod
Fruit	Tea leaves
Fruit peels and rinds	Vegetables
Garden wastes	Wood ash
Grass clippings	Wood chips

No

Butter	Mayonnaise
Bones	Meat
Cat manure	Milk
Cheese	Oils
Chicken	Peanut butter
Dog manure	Salad dressing

Many flies, including houseflies, can spend their larval phase as maggots in compost piles. To control their numbers, compost piles with food in them must be turned frequently to encourage heating (larvae die at high temperatures). The piles should also be covered with finished compost or a dry material that has a lot of carbon, such as straw. Pest-proof sides and covers may also be installed on compost units to help control pests.

Composting with Worms

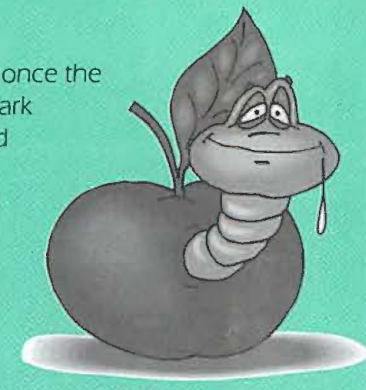
The process of worm composting involves worms digesting food waste and leaving behind high-quality castings called "vermicompost." Worms work most efficiently at 50 and 70 F. This makes worm composting ideal for some type of semi-heated area indoors or out. If you're not too squeamish, you can even vermicompost right in your own kitchen!

"Red worms" are used for the composting process, not soil-dwelling worms. They are placed in a bin with bedding and food waste. These red worms, sometimes referred to as red wigglers, evolved in manure piles and are efficient processors of food and other organic material. You can find these worms sold in the back of many fishing magazines or local fishing stores.

Worms do not need elaborate accommodations to work. A shallow box with a lid will serve as a good composting bin. For the worms to do their job they need a dark, moist environment. They will also need to be "bedded" within these boxes. Many materials will work: peat, sawdust, most cellulose materials, and shredded and moistened newspaper or corrugated cardboard.

Vegetable and food scraps can be incorporated into the bin by digging small holes in the bedding, filling this hole with scraps and then covered back with the bedding. Small amounts of meat scrap can be used if the top is latched down tight to prohibit unwanted guests like raccoons from entering. Burial spots must be rotated so that wastes are distributed throughout the bin.

Compost can be harvested and used once the bin contents have become fairly uniform, dark "worm castings." You can move this finished compost to one side of the bin and fill the empty side with fresh bedding. The worms will move to the fresh bedding within a month and the compost can then be removed and used.



Risk Assessment 6.4 Home Composting

The assessment table below will help you identify potential environmental risks related to home composting practices. For each question, indicate your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits. Refer to Part 6.4 if you need more information to complete the table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Compost maintenance	The compost pile is well-maintained: It is aerated regularly and contains yard waste, vegetable food scraps and a nitrogen source such as manure.	The compost pile is poorly maintained: It is not aerated or lacks the proper mix of materials.	The compost pile is poorly maintained: It contains excessive high-nitrogen material and is not turned regularly.	❑ Low ❑ Medium ❑ High
Compost pile location	The compost pile is more than 100 feet from a shallow well or surface water.	The compost pile is less than 50 feet from a shallow well or surface water.	The compost pile is less than 25 feet from a shallow well or surface water.	❑ Low ❑ Medium ❑ High
Compost contents	The compost pile only contains yard or garden trimmings and vegetable food scraps.	The compost pile mostly contains vegetable food scraps and yard trimmings, but occasionally other items are added by mistake.	Dog, cat and other pet wastes are added to the pile.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your risks. Complete the Action Checklist on the opposite page to help you make plans to reduce your risks.

Action Checklist

In the checklist below, write all medium- and high-risk practices you identified in the assessment tables throughout the chapter. For each risk, write down the improvements you plan to make and a target date for action. Use recommendations from this chapter and other resources to decide on actions that you are likely to complete. You don't have to do everything at once, but try to eliminate the most serious risks as soon as you can. Often it helps to tackle the inexpensive actions first.

Home Landscape Management

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action.
Sample: *Fertilizers applied but soil has never been tested.*	*Submit soil samples to Clemson extension office for testing.*	*One week from today: March 15*
Sample: *I have a creek on my property that does not have a riparian buffer.*	*Look into establishing a suitable riparian buffer with native vegetation.*	*Next spring*
Sample: *I have been bagging my grass clippings and yard waste and sending them to the landfill.*	*Establish a compost pile where I can recycle all my grass clippings and other yard wastes.*	*Next week: March 15*

For More Information

Clemson Extension Publications

Centipede Grass Problems, EC 583. ($2.00)
Home Lawn Care, EC 687. ($2.00)
Home Landscaping, EC 671. ($2.50)
How to Choose a Lawn Care Company, PIP 36.
Protecting South Carolina Groundwater Quality, PIP 6.
Recycling Yard Trimmings: Home Composting, IL 48.
South Carolina Master Gardener Training Manual, EC 678. ($30.00)
Store Pesticides Safely, PIP 37.
Wildlife Planting Guide and Native Wildlife Plants in South Carolina, AFW 2. ($8.50)
Rainwater Runoff: Protecting Your Landscape, IL 49.
Xeriscape, EC 672. ($4.50)

To request any of these publications, call the Clemson University Cooperative Extension Bulletin Room at (864) 656-3261 or your county Extension office.

Other Publications

Building and Stabilizing Coastal Dunes with Vegetation, UNC Sea Grant Publication 82-05, ($1.50), N.C. Sea Grant, Box 8605, North Carolina State University, Raleigh, NC 27695-8605, telephone (919) 515-2454.

Riparian Buffers

Vegetated Riparian Buffers and Buffer Ordinances, 1999. DHEC's Office of Ocean and Coastal Resource Management, (843) 744-5838.

Native Plants

Wildflowers of the Carolina Lowcountry and Pee Dee, Richard D. Porcher, University of South Carolina Press, 1995.

The Lawn: A History of an American Obsession, Virginia Scott Jenkins, Smithsonian Institution Press, 1994.

Additional references and information on the selection and purchase of native plants can be obtained from John Brubaker, Lowcountry Chapter of the South Carolina Native Plant Society, 600 Flatfield Farm Road, Awendaw, SC, 29429, telephone (843) 928-4001.

Soil Testing

Send samples to your local Cooperative Extension office or contact:

Agricultural Service Laboratory
171 Old Cherry Road
Clemson University
Clemson, SC 29634

Telephone: (864) 656-2068
FAX: (864) 656-2069

Composting

DHEC recently instituted a statewide program to encourage backyard composting. The program offers backyard composting bins made out of recycled plastic to participating cities and counties at a discounted price. Local governments that purchase these bins from DHEC can then re-sell them to community residents and demonstrate how to make compost. For more information about this program, contact your local recycling coordinator or call DHEC's Office of Solid Waste Reduction and Recycling at (800) 768-7348.

This material was originally developed by K. Marc Teffeau, Regional Extension Specialist, Wye Research and Education Center, University of Maryland Cooperative Extension, and Ray Bosmans, Regional Extension Specialist, Home and Garden Information Center, University of Maryland Cooperative Extension. It was adapted for South Carolina Coast-A-Syst by Gary Forrester, Extension Horticulture Agent; Barbara Speziale and Marty Watt, Clemson University Cooperative Extension; and Brian Smith, Charleston County Extension agent. Portions of the text were adapted from Clemson University Extension publications by Robert Polomski and L.C. Miller and from North Carolina Home-A-Syst. Riparian buffer material was developed by Ward Reynolds, S.C. Office of Ocean and Coastal Resource Management.

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Native Plant List for Coastal South Carolina

Chapter 6 Appendix

This list of plants is composed only of plants native to the Coastal Plain of South Carolina. As native plants, they require less water, fertilizer and pesticides than non-native plants when properly located. Species designated with an asterisk (*) have been successfully incorporated into landscapes on Dewees Island and are therefore somewhat tolerant of salty or brackish conditions.

Trees: SCIENTIFIC NAME	COMMON NAME	EVERGREEN/ DECIDUOUS	COMMENTS	BLOOM TIME
Acer barbatum	Southern Sugar Maple	Decid	Bottomland forests, mesic slopes	Apr-Jul
Acer negundo	Boxelder	Decid	Streambanks, bottomlands	Mar-Apr
*Acer rubrum**	Red Maple	Decid	Red fall color; wet areas	Feb-Mar
*Betula nigra**	River Birch	Decid	Streambanks, floodplains	Mar-Apr
Carya aquatica	Water Hickory	Decid	Swamp forests	Apr-May
Carya cordiformis	Bitternut Hickory	Decid	Rich or low woods	Apr
*Carya glabra**	Pignut Hickory	Decid	Dry or moist areas	
Carya myristicaeformis	Nutmeg Hickory	Decid	Rich bottomlands	Apr
Carya ovalis	Sweet Pignut Hickory	Decid	Dry conditions	Apr-May
Carya pallida	Pale Hickory	Decid	Fertile slopes	Apr-May
Carya tomentosa	Mockernut Hickory	Decid	Dry fertile uplands	Apr-May
*Carpinus caroliniana**	Ironwood	Decid	Smooth bark; moist areas	
*Celtis Laevigata**	Hackberry	Decid	Corky bark ridges	
Fraxinus americana	White ash	Decid	Rich and low woods	Apr-May
Fraxinus pensylvanica	Green ash	Decid	Low woods	Apr
Fraxinus tomentosa	Pumpkin Ash	Decid	Low woods	Apr-May
Juglans nigra	Black Walnut	Decid	Rich woods	Apr
*Liriodendron tulipifera**	Tulip Poplar	Decid	Moist areas	
*Magnolia grandiflora**	Southern Magnolia	Evg	Large, fragrant, white flowers	May-Jun
Magnolia virginiana	Sweetbay Magnolia	Decid	Acid bays, pocosins	Apr-Jul
Nyssa aquatica	Tupelo	Decid	Swamps, floodplains	Apr-May
Nyssa biflora	Swamp Gum	Decid	Swamps, depressions	Apr-Jun
*Nyssa sylvatica**	Black Gum	Decid	Red fall color; moist or dry areas	
Ostrya virginiana	Hop Hornbeam	Decid	Sea islands, hammocks, bluffs	Dec-Mar
Pinus echinata	Shortleaf Pine	Evg	Xeric fertile uplands	Mar-Apr
*Pinus elliottii**	Slash Pine	Evg	Low areas	
Pinus glabra	Spruce Pine	Evg	Rich woods, bottomland forests	Mar-Apr
*Pinus palustris**	Longleaf Pine	Evg	Sandy areas	
Pinus serotina	Pond Pine	Evg	Savannas, pocosins, swamps	Apr
*Pinus taeda**	Loblolly Pine	Evg	Throughout	
Populus deltoides	Cottonwood	Decid	Streamsides, floodplains	Mar-Apr
Populus heterophylla	Swamp Cottonwood	Decid	Swamp forests, floodplains	Mar-Apr
Quercus alba	White Oak	Decid	Rich woods, mesic to xeric forests	Apr
Quercus austrina	Bluff Oak	Decid	Rich slopes, over calcareous sediments; rare	Apr
*Quercus coccinea**	Scarlet Oak	Decid	Dry areas	
*Quercus falcata**	Southern Red Oak	Decid	Dry areas	
Quercus hemisphaerica	Upland Laurel Oak	Evg	Maritime forests, dry sandy soils	Mar-Apr

Trees: SCIENTIFIC NAME	COMMON NAME	EVERGREEN/ DECIDUOUS	COMMENTS	BLOOM TIME
Quercus incana	Bluejack Oak	Decid	Sand ridges	Apr
Quercus laevis	Turkey Oak	Decid	Sand ridges; very xeric soils	Apr
*Quercus laurifolia**	Laurel Oak	Evg	Low or sandy areas	
Quercus margaretta	Sand Post Oak	Decid	Sand ridges with loam or clay	Apr
Quercus marilandica	Blackjack Oak	Decid	Clay-rich upland woods, droughty soils	Apr
Quercus michauxii	Swamp Chestnut Oak	Decid	Bottomlands	Apr
Quercus muehlenbergii	Yellow Chestnut Oak	Decid	Rich slopes, over calcareous sediments; rare	Apr
Quercus nigra	Water Oak	Decid	Ubiquitous, especially bottomland forests	Apr
Quercus pagoda	Cherrybark Oak	Decid	Bottomlands	Apr
*Quercus phellos**	Wlillow Oak	Decid	Low areas	
Quercus shumardii	Shumard's Oak	Decid	Bottomlands; moist, fertile soils	Apr
Quercus similis	Bottomland Post Oak	Decid	Rich calcareous stream bottoms; rare	
Quercus stellata	Post Oak	Decid	Dry uplands; clay or rocky soils	Apr
Quercus velutina	Black Oak	Decid	Dry woods; xeric, sandy soils	Apr
*Quercus virginiana**	Live Oak	Evg	Dry or wet areas	
*Sabal palmetto**	Cabbage Palmetto	Evg	Dry or wet areas	
Taxodium ascendens	Pond Cypress	Decid	Cypress savannas, acid swamps	
*Taxodium distichum**	Bald Cypress	Decid	Freshwater wet areas	
Ulmus alata	Winged Elm	Decid	Rich woods	Feb-Mar
Ulmus americana	American Elm	Decid	Bottomlands	Mar-Apr
Ulmus rubra	Slippery Elm	Decid	Sea islands; basic soils	Feb-Mar

Small Trees: SCIENTIFIC NAME	COMMON NAME	EVERGREEN/ DECIDUOUS	COMMENTS	BLOOM TIME
*Aesculus pavia**	Red Buckeye	Decid	Red flowers; fresh wet areas	Apr-May
Alnus serrulata	Tag Alder	Decid	Streambanks, marshes	Feb-Mar
Amelanchier arborea	Service Berry	Decid	Rich woods, bluffs, bayheads	Feb-Mar
*Amelanchier canadensis**	Serviceberry	Decid	White flowers; red fruit	Mar-Apr
*Cercis canadensis**	Redbud	Decid	Lavender flowers; dry aeas	Mar-Apr
*Chionanthus virginicus**	Fringe Tree	Decid	Off-white flowers	Jul-Sept
*Cornus florida**	Dogwood	Decid	White flowers; part shade; red fall	Mar-Apr
*Crataegus marshallii**	Hawthorn	Decid	White flowers; red fruit; wet areas	Apr-May
*Crataegus uniflora**	Hawthorn	Decid	White flowers; red fruit; dry areas	Apr-May
Fraxinus caroliniana	Carolina Ash	Decid	Floodplains, swamps	Mar
*Gordonia lasianthus**	Loblolly Bay	Evg	White flowers; wet areas	Jul-Sept
Halesia carolina	Carolina Silverbell	Decid	Rich woods, calcareous hammocks; rare	Mar-Apr
*Hamamelis virginiana**	Witch-Hazel	Decid	Pale yellow flowers; dry areas	Oct-Dec
*Ilex opaca**	American Holly	Evg	Red berries	
*Ilex cassine**	Cassena Holly	Evg	Red berries; moist areas	
*Juniperus virginiana**	Red Cedar	Evg	Salt-tolerant; dry or wet; blue fruit	
*Magnolia virginiana**	Sweetbay Magnolia	Semi-Evg	White flowers; moist areas	Apr-Jul
*Malus angustifolia**	Crabapple	Decid	Pink flowers; throughout	Apr-May
Osmanthus americana	Wild Olive	Evg	Acid bays and swamps	Apr-May
*Persea borbonia**	Red Bay	Evg	Used for cooking; moist areas	
Planera aquatica	Water Elm	Decid	River floodplains	Mar-Apr

*Prunus caroliniana**	Cherry Laurel	Evg	Cream flowers; throughout	Mar-Apr
Salix caroliniana	Carolina Willow	Decid	Riverbanks, sandbars, wet places	Mar-Apr
*Sassafras albidum**	Sassafras	Decid	Red fall color; throughout	
*Sorbus arbutifolia**	Red Chokeberry	Decid	White flowers; red fruit; moist areas	Mar.-May
Styrax americana	Storax	Decid	Swamp forests, calcareous hammocks	Mar-Apr
*Symplocos tinctoria**	Horse Sugar	Semi-Evg	Cream flowers; sandy areas	Mar.-May
Xanthoxylum americanum	Toothache-tree	Decid	Rich woods, over calcareous rocks; rare	Mar-Apr
*Xanthoxylum clavaherculis**	Hercules Club	Decid	Thorns; sandy areas	

Shrubs: SCIENTIFIC NAME	COMMON NAME	EVERGREEN/ DECIDUOUS	COMMENTS	BLOOM TIME
Amorpha fruticosa	False Indigo	Decid	Streamsides, tidal marshes; purple flower	Apr-Jul
*Baccharis halmifolia**	Salt Myrtle	Evg	Downy plumes; throughout	Sept-Oct
Batis maritima	Saltwort	Evg	Brackish marshes	Jun-Jul
*Bumelia sp. **	Buckhorn	Decid	White flowers; dry areas	Jun-Jul
*Callicarpa americana**	Beauty-berry	Decid	Bright purple berries, pink flowers	Jun-Jul
Calycanthus floridus	Sweet-shrub	Decid	Low, rich woods; aromatic; maroon; rare	Apr-May
*Cephalanthus occidentalis**	Button Bush	Decid	White flowers; wet areas	Jun-Aug
*Clethra alnifolia**	Sweet Pepperbush	Decid	White flowers; fragrant; fresh wet areas	Sept-Oct
*Cyrilla racemiflora**	Titi	Semi-Evg	White flowers; moist areas	May-Jul
Forestiera acuminata	Swamp Privet	Decid	Swamp forests, calcareous sediments; rare	Mar
Forestiera godfreyi	Godfrey's Privet	Decid	Sea islands, shell middens; rare	Feb
Fothergilla gardenii	Witch Alder	Decid	Pocosins, wet savannas; rare	Sept-Oct
Gaylussacia dumosa	Dwarf Huckleberry	Decid	Xeric to mesic acidic woodlands	Mar-Jun
Gaylussacia frondosa	Dangleberry	Decid	Mesic, acidic woodlands, pocosins	Mar-May
*Hypericum hypericoides**	St. Andrews Cross	Semi-Evg	Yellow flowers; dry areas	May-Aug
*Hypericum stans**	St. Peter's-Wort	Semi-Evg	Yellow flowers; dry areas	Jun-Oct
*Ilex cassine**	Dahoon Holly	Evg	Red berries; fresh wet areas	
*Ilex glabra**	Inkberry	Evg	Black berries; moist areas	
*Ilex verticillata**	Winterberry	Decid	Red berries; moist areas	
*Ilex vomitoria**	Yaupon Holly	Evg	Red berries; throughout	
*Itea virginica**	Virginia Sweetspire	Decid	White flowers; red fall color; moist areas	May-Jun
*Leucothoe axillaris**	Leucothoe	Evg_	White flowers; moist areas	Mar-May
Litsea aestivalis	Pondspice	Decid	Depression ponds, Carolina bays; rare	Mar-Apr
Lyonia ligustrina	Southern Maleberry	Decid	Pocosins, seepage bogs, other wet habitats	Apr-Jun
Lyonia lucida	Fetter Bush	Evg	Pink flowers; moist areas	Apr-Jun
Lyonia mariana	Staggerbush	Decid	Pine flatwoods, savannas, pocosin-sandhill	Apr-May
*Myrica cerifera**	Wax Myrtle	Evg	Blue fruit; fragrant; throughout	
*Osmanthus americana**	Wild Olive	Evg	Cream flowers; dry areas	Apr-May
Quercus minima	Dwarf live Oak	Evg	Flatwoods, coastal fringe sandhills	Apr
Quercus pumila	Running Oak	Decid	Flatwood, especially on loamy soil	Mar-Apr
*Rhododendron atlanticum**	Dwarf Azalea	Decid	Pink flowers; moist-dry areas	Apr-May
*Rhododendron canescens**	Wild Azalea	Decid	Pink flowers; fresh wet-dry areas	Mar-May
*Rhus copallina**	Winged Sumac	Decid	Red fall color; dry areas	
*Rosa carolina**	Wild Rose	Decid	Pink flowers; dry areas	May-Jun
*Rosa palustris**	Swamp Rose	Decid	Pink flowers; moist areas	May-Jul
*Sabal minor**	Shrub Palmetto	Evg	Moist areas	
*Sambucus canadensis**	Elderberry	Decid	White flowers; throughout	Apr-Jul

Shrubs: SCIENTIFIC NAME	COMMON NAME	EVERGREEN/ DECIDUOUS	COMMENTS	BLOOM TIME
*Serenoa repens**	Saw Palmetto	Evg	Low areas	
*Vaccinium arboreum**	Sparkleberry	Evg	Black berries; white flowers; dry	Apr-Jun
*Vaccinium corymbosum**	Highbush Blueberry	Decid	Blue berries; white flowers; moist	Feb-May
Vaccinium crassifolium	Creeping Blueberry	Evg	Pine flatwoods, savannas, pocosin-sandhill	Apr-May
Vaccinium elliottii	Mayberry	Decid	Bottomlands, slopes, sandy river terraces	Mar-Apr
Viburnum nudum	Possum Haw	Decid	Bogs, swamps, pocosins	Mar-Apr
*Viburnum rufidulum**	Blue Haw	Decid	White flowers; dry areas	Mar-Apr
*Yucca aloifolia**	Spanish Bayonet	Evg	White flowers; dry sandy areas	Jun-Jul
*Yucca filamentosa**	Bear Grass	Evg	White flowers; dry areas	Apr-Jul

Flowering Perennials: SCIENTIFIC NAME	COMMON NAME	ANNUAL/ PERENNIAL	COMMENTS	BLOOM TIME
Agalinis aphylla	Gerardia	Annual	Savannas, flatwoods, bogs; purple; rare	Sept-Nov
Agalinis linifolia	Gerardia	Perenn	Depressions, bogs, pond margins; purple	Aug-Sept
Agalinis obtusifolia	Gerardia	Perenn	Flatwoods, bogs	Sept-Oct
Agalinis maritima	Gerardia	Perenn	Brackish marshes	Oct-Nov
Agalinis purpurea	Gerardia	Perenn	Flatwoods, stream banks, disturbed areas	Oct-Nov
Agalinis virgata	Gerardia	Ann	Pine savannas; rare	Sept-Oct
*Asclepias tuberosa**	Butterfly Weed	Perenn	Orange flowers; dry areas	May-Aug
Agrimonia incisa	Pineland Agrimony	Perenn	Dry pine and oak woods; rare	Jul-Sept
Agrimonia parviflora	Southern Agrimony	Perenn	Marshes and floodplains; yellow	Jul-Sept
Agrimonia pubsecens	Downy Agrimony	Perenn	Dry to moist woodlands; white	Jul-Sept
Aletris aurea	Yellow Colic-root	Perenn	Bogs, flatwoods, sandhills; yellow	May-Jul
Aletris farinosa	White Colic-root	Perenn	Flatwoods; white	Apr-Jun
Allium canadense	Wild Onion	Perenn	Floodplains; pink	Apr-May
Amianthium muscaetoxicum	Fly-poison	Perenn	Rich woods; white	Jun-Jul
Amsonia tabernaemontana	Texas Star	Perenn	Rich wet woods, floodplains; blue	Mar-Apr
Arisaema triphyllum	Jack-in-the-pulpit	Perenn	Rich wet woods; green/bronze	Mar-Jun
Aristolochia serpentaria	Snake Root	Perenn	Rich woods, flatwoods; white	Jun-Aug
Asclepias pedicellata	Stalked Milkweed	Perenn	Dry pine savannas; greenish cream; rare	Jun-Jul
Asclepias rubra	Red Milkweed	Perenn	Pocosin borders, wet pine savannas; red	Jun-Jul
Asclepias verticillata	Whorled Milkweed	Perenn	Dry longleaf woods, sandhills; white; rare	Jun-Sept
Aster carolinianus	Climbing Aster	Perenn	Marshes, low woodland borders; pink	Sept-Oct
Aster concolor	Eastern Silvery Aster	Perenn	Woodlands, thickets, old fields; blue/violet	Sept-Oct
Aster dumosus	Long-stalked Aster	Perenn	Woodlands, marshes; white or blue	Aug-Oct
Aster laeviflorus	Goblet Aster	Perenn	Wet savannas; white	Sept-Nov
Aster linariifolius	Stiff-leaved Aster	Perenn	Dry woodlands; blue to violet	Sept-Nov
Aster paternus	White-topped Aster	Perenn	Pine-oak-hickory woods; white	Jul-Aug
Aster patens	Common Clasping Aster	Perenn	Dry fertile woodlands; blue	Apr
Aster solidagineus	White-topped Aster	Perenn	Mesic longleaf woods; white	Jun-Jul
Aster squarrosus		Perenn	Mesic pinelands; violet	Oct-Nov
Aster subulatus		Perenn	Brackish marshes; white	Aug-Oct
Aster tortifolius	White-topped Aster	Perenn	Dry longleaf woodland; white	Aug-Oct
Aster undulatus		Perenn	Dry fertile woods; blue	Autumn

Flowering Perennials: SCIENTIFIC NAME	COMMON NAME	ANNUAL/ PERENNIAL	COMMENTS	BLOOM TIME
Aureolaria pectinata	Yellow Foxglove	Ann	Mesic savannas, sandhills; yellow	May-Sep
Bacopa caroliniana	Blue Hyssop	Perenn	Freshwater marsh, ponds; blue	May-Sept
Bartonia verna	Spring Bartonia	Perenn	Wet savannas, depression ponds	Jan-Mar
Bartonia virginica	Virginia Bartonis	Perenn	Mesic-wet savannas, bogs	Jul-Oct
Bidens bipinnata	Spanish Needles	Perenn	Rich woods, fields, roadsides	Jul-Oct
Bidens mitis		Perenn	Wet savannas, ditches, marshes	Aug-Oct
Boehmeria cylindrica	False Nettle	Perenn	Floodplains, low ground, swamps	Jul-Aug
*Baptisia alba**	False Indigo	Perenn	White flowers	Apr-Sept
*Baptisia tinctoria**	False Indigo	Perenn	Yellow flowers	Apr-Sept
*Bidens laevis**	Beggar Ticks	Perenn	Yellow flowers; fresh wet areas	Sept-Nov
*Canna flaccida**	Golden Canna	Perenn	Yellow flowers; brackish wet areas	May-Jul
Calopogon multiflorus	Multi-flowered Grass Pink Orchid	Perenn	Mesic savannas, flatwoods; pink; very rare	May-Jun
Calopogon pallidus	Pale Grass Pink Orchid	Perenn	Wet savannas; white to pink	May-Jul
Calopogon tuberosus	Common Grass Pink Orchid	Perenn	Wet savannas; pink	Apr-Jul
Cleistes divaricata	Large Spreading Pogonia Orchid	Perenn	Wet savannas; white to pink	May-Jun
*Chrysanthemum leucanthemum**	Ox-eye Daisy	Perenn	White daisy flowers	Apr-Jul
*Coreopsis angustifolia**	Tickseed Coreopsis	Perenn	Yellow flowers; moist areas	Aug-Oct
*Coreopsis falcata**		Perenn	Yellow flowers; moist areas	May-July
*Coreopsis helianthoides**		Perenn	Yellow flowers; moist areas	Sept-Oct
*Coreopsis lanceolata**		Perenn	Yellow flowers; dry areas	Apr-Jun
*Coreopsis major**		Perenn	Yellow flowers; dry areas	Jun-Aug
Epidendron conopseum	Green-fly Orchid	Perenn	On cypress trees in swamps; green	Jul-Oct
Eupatorium album	White-bracted Thoroghwort	Perenn	Dry longleaf woodland; white	Jun-Sept
*Eupatorium coelestinum**	Wild Ageratum	Perenn	Blue flowers; dry or moist	Jul-Oct
Eupatorium leucolepis	Savanna Eupatorium	Perenn	Flatwoods	Aug-Oct
Eupatorium mohrii	Mohr's Eupatorium	Perenn	Wet savannas	Aug-Oct
Eupatorium perfoliatum	Boneset	Perenn	Rich woods; white	Aug-Oct
Eupatorium pilosum	Ragged Eupatorium	Perenn	Wet flatwoods, savannas	Aug-Oct
Eupatorium rotundifolium	Roundleaf Eupatorium	Perenn	Dry-mesic woods; white	Aug-Oct
Eupatorium recurvans	Recurved Eupatorium	Perenn	Depressions; rare	Aug-Oct
Euphorbia corollata	Flowering Spurge	Perenn	Dry longleaf woodland	May-Sept
*Erythrina herbacea**	Coral Bean	Perenn	Red flowers; red seed	Apr-Jul
Habenaria quinqueseta	Long-horned Orchid	Perenn	Pine flatwoods, savannas; white; rare	Aug-Oct
Habenaria repans	Water-spider Orchid	Perenn	Blackwater swamps, streambanks; green	Apr-Nov
*Helianthus angustifolius**	Swamp Sunflower	Perenn	Yellow flowers; fresh wet areas	Jul-frost
*Helianthus strumosus**		Perenn	Yellow flowers	Jul-Sept
Hexalectris spicata	Crested Coralroot Orchid	Perenn	Sea islands, rich upland woods; bronze	Jul-Aug
*Hibiscus moscheutos**	Swamp Rose-mallow	Perenn	White-pink flowers; fresh wet areas	May-Sept
*Iris virginica**	Blue Flag Iris	Perenn	Blue flowers; fresh wetlands	Apr-May
*Kosteletzkya virginica**	Seashore Marsh Mallow	Perenn	Pink flowers; wetlands	Jun-Oct
Lespedeza capitata	Bush-clover	Perenn	Flatwoods; yellow	Aug-Oct
Lespedeza hirta	Silvery Lespedeza	Perenn	Dry longleaf woodland; yellowish white	Aug-Oct
Lespedeza intermedia	Wand Lespedeza	Perenn	Dry longleaf woodland; purplish	Jul-Sept

Flowering Perennials: SCIENTIFIC NAME	COMMON NAME	ANNUAL/ PERENNIAL	COMMENTS	BLOOM TIME
Lespedeza procumbens	Downy Traling Lespedeza	Perenn	Dry longleaf woodland; purplish to roseate	Jul-Sept
Lespedeza repens	Smooth Traling Lespedeza	Perenn	Flatwoods; purplish	Jul-Sept
Lespedeza virginica	Virginia Lespedeza	Perenn	Flatwoods; purplish to roseate	Jul-Sept
*Liatris graminifolia**	Blazing Star	Perenn	Lavender flowers; dry areas	Sept-Oct
*Liatris spicata**	Blazing Star	Perenn	Lavender flowers; moist areas	Sept-Oct
Lillium catesbaei	Pine Lilly	Perenn	Wet savannas; orange to red	Sept-Nov
Lillium michauxii	Carolina Lilly	Perenn	Bogs, rich woods; orange to red	Jul-Aug
Listera australis	Southern Twayblade Orchid	Perenn	Rich, moist to wet woods; gold/bronze	Mar-Jul
Malaxis spicata	Florida Adder's Mouth Orchid	Perenn	Calcareous swamps; green; rare	Jul-Aug
Malaxis unifolia	Green Adder's Mouth Orchid	Perenn	Bogs, moist slopes; green	Jun-Aug
*Mitchella repens**	Partridge Berry	Perenn	White flowers; part shade	May-Jun
*Monarda punctata**	Horse Mint	Perenn	Pink flowers; dry	Jul-Sept
*Nuphar luteum**	Yellow Pond Lily	Perenn	Yellow flowers; fresh wetlands	Apr-Oct
*Oenothera biennis**	Evening Primrose	Perenn	Yellow flowers; dry	Jun-Oct
*Oenothera drummondii**	Beach Eve. Primrose	Perenn	Yellow flowers; dry	Mar-Nov
*Oenothera humifusa**	Dunes Eve. Primrose	Perenn	Yellow flowers; dry areas	May-frost
*Oenothera speciosa**	Evening Primrose	Perenn	Pink flowers; dry areas	Apr-Jul
*Opuntia compressa**	Prickly Pear Cactus	Perenn	Yellow flowers; dry areas	Apr-Jun
Parnassia caroliniana	Grass-of-Parnassus	Perenn	Savannas; white; rare	Nov
Pedicularis canadensis	Eastern Lousewort	Perenn	Rich woods and savannas; white	Apr-May
*Phlox carolina**		Perenn	Lavender, pink or white flowers	May-Jul
Plantago sparsiflora	Pineland Plantain	Perenn	High calcium savannas; green; rare	Apr-Oct
Platenthera ciliaris	Yellow-fringed Orchid	Perenn	Wet savannas; yellow	Jul-Sept
Platenthera cristata	Crested-fringed Orchid	Perenn	Mesic to wet savannas; yellow	Jun-Sept
Platenthera flava	Southern Rein Orchid	Perenn	Swamp forests, shaded wet places; green	Mar-Sept
Platenthera integra	Golden Fringless Orchid	Perenn	Savannas; yellow	Jul-Sept
Platenthera nivea	Snowy Orchid	Perenn	Wet savannas; white	May-Sept
Pogonia ophioglossoides	Rose Pogonia Orchid	Perenn	Pocosin borders, wet savannas; pink	May-Jun
Polygala cymosa	Tall Pinebarren Milkwort	Perenn	Wet depressions; yellow	May-Jul
Polygala ramosa	Short Pinebarren Milkwort	Perenn	Wet savannas; yellow	Jun-Sept
Polygala grandiflora	Showy Milkwort	Perenn	Dry longleaf woodland; pink	May-Jul
Polygala lutea	Orange Milkwort	Perenn	Mesic to wet savannas; orange	Apr-Oct
*Pontederia cordata**	Pickerelweed	Perenn	Wetlands; blue-purple flowers	Mar-Oct
Ponthieva racemosa	Shadow Witch Orchid	Perenn	Bottomlands, moist ravines; green	Sept-Oct
Prenanthes alba	White Lettuce	Perenn	Dry rich woods; pink to purple	Aug-frost
Prenanthes autumnalis	Slender Rattlesnake-root	Perenn	Savannas, wet flatwoods; pink	Sept-frost
Prenanthes serpentaria	Lion's Foot	Perenn	Moist, rich woods	Aug-Oct
Pteroglossaspis ecristata	Spiked Medusa Orchid	Perenn	Mesic savannas and flatwoods	Jun-Sept
Rhexia alifanus	Common Meadow-beauty	Perenn	Flatwoods, savannas; purple	May-Sept
Rhexia aristosa	Awned Meadow-beauty	Perenn	Depressions; purple; rare	Jun-Sept
Rhexia lutea	Yellow Meadow-beauty	Perenn	Wet savannas; yellow	Apr-Jul
Rhexia nashii	Hairy Meadow-beauty	Perenn	Wet savannas	May-Oct
Rhexia mariana	Swollen Meadow-beauty	Perenn	Dry-moist woods, ditches; purple to white	May-Oct
Rhexia virginica	Virginia Meadow-beauty	Perenn	Wet savannas, cypress depressions; rose	May-Oct

Flowering Perennials: SCIENTIFIC NAME	COMMON NAME	ANNUAL/ PERENNIAL	COMMENTS	BLOOM TIME
*Rudbeckia fulgida**	Black-eyed Susan	Perenn	Yellow flowers; spreading; moist	Aug-Oct
*Rudbeckia hirta**	Black-eyed Susan	Perenn	Yellow flowers; dry areas	May-Jul
Sabatia campanulata	Slender Marsh-pink	Perenn	Wet savannas; pink	Jun-Aug
Sabatia difformis		Perenn	Wet savannas, bogs, pocosins; white	May-Sept
Sabatia stellaris	Annual Sea-Pink	Perenn	Marshes, dunes	Jul-Oct
*Salvia coccinea**	Scarlet Sage	Perenn	Red flowers	Feb-Nov
*Salvia lyrata**	Lyre-leaved Sage	Perenn	Blue flowers; dry areas	May-frost
Sanguinaria canadensis	Bloodroot	Perenn	Rich woods; white	Mar-Apr
Sarracenia flava	Trumpet Pitcher Plant	Perenn	Wet savannas, seepage bogs; yellow	Mar-Apr
Sarracenia rubra	Red Pitcher Plant	Perenn	Pocosin borders, seepage bogs; purple	Apr-May
Sarracenia minor	Hooded Pitcher Plant	Perenn	Savannas, wet flatwoods; yellow	Apr-May
*Saururus cernuus**	Lizard's Tail	Perenn	Off-white flowers; fresh wetlands	Apr-Jul
Schwalbea americana	Chaffseed	Perenn	Flatwoods; bronze/golden; rare	May-Jun
Solidago elliottii	Elliott's Goldenrod	Perenn	Savannas, moist flatwoods; yellow	Oct-Nov
Solidago fistulosa	Hairy Pinewoods Goldenrod	Perenn	Wet flatwoods; yellow	Sept-Oct
Solidago odora	Licorice Goldenrod	Perenn	Dry longleaf woodland	Sept-Nov
Solidago nemoralis	Southern Gray Goldenrod	Perenn	Old fields	Aug-Oct
Solidago petiolaris		Perenn	Dry flatwoods	Sept-Nov
*Solidago rugosa**	Rough Goldenrod	Perenn	Yellow flowers; moist areas	Aug-Nov
*Solidago sempervirens**	Seaside Goldenrod	Perenn	Yellow flowers; moist or dry areas	Aug-Nov
Solidago tortifolia	Leafy Pinewoods Goldenrod	Perenn	Mesic woodlands	Sept-Oct
Spiranthes cernua	Nodding Ladies Tresses Orchid	Perenn	Bogs, swamps, ditches; white	Jul-Nov
Spiranthes laciniata	Lace-lip Ladies Tresses Orchid	Perenn	Pond cypress savannas, white; rare	May-Aug
Spiranthes praecox	Grass-leaved Ladies Tresses Orchid	Perenn	Savannas; white	Mar-Jul
Spiranthes vernalis	Spring Ladies Tresses Orchid	Perenn	Savannas, marshes, fields; white	Mar-Jul
Tipularia discolor	Cranefly Orchid	Perenn	Mesic to dry forests; bronze/gold	Jul-Sept
*Tradescantia virginiana**	Spiderwort	Perenn	Blue flowers; moist or dry areas	Apr-Jul
Triphora trianthophora	Three Birds Orchid	Perenn	Humid forests, swamps; green/gold; rare	Jul-Sept
*Verbena scabra**	Verbena	Perenn	Pink flowers; brackish margins	May-Oct
*Verbena canadensis**	Pink Verbena	Perenn	Pink flower; low dry areas	Mar-May

Grasses, etc: SCIENTIFIC NAME	COMMON NAME	ANNUAL/ PERENNIAL	COMMENTS	BLOOM TIME
Agrostis altissima	Coastal Bog Bentgrass	Perenn	Wet savannas; rare	
Amphicarpum muhlenbergianum	Goobergrass	Perenn	Limesink depressions	
Amphicarpum purshii	Goobergrass	Perenn	Pocosin borders	
Andropgon capillipes var 1.	White Bluestem (wet)	Perenn	Cypress savannas, lime depressions	
Andropgon capillipes var 2.	White Bluestem (dry)	Perenn	Dry to mesic flatwoods	
Andropogon gerardii	Big Bluestem	Perenn	Mesic longleaf woodlands	
Andropogon glaucopsis	Chalky Bluestem	Perenn	Wet savannas and flatwoods	

Grasses, etc: SCIENTIFIC NAME	COMMON NAME	ANNUAL/ PERENNIAL	COMMENTS	BLOOM TIME
*Andropogon glomeratus**	Bushy Broomsedge	Perenn	Large plumes; moist areas	Aug-Oct
*Andropogon virginicus**	Broomsedge	Perenn	Gold fall color; throughout	Sept-Oct
Anthaenantia rufa	Purple Silkyscale	Perenn	Wet savanna; rare	
Anthaenantia villosa	Green Silkyscale	Perenn	Dry longleaf woodland	
Aristida lanosa	Wollysheath Three-awn Grass	Perenn	Dry longleaf woodland	
Aristida spicifomis	Bottlebrush Three-awn Grass	Perenn	Wet savannas; rare	
Aristida purpurascens	Arrowfeather	Perenn	Dry longleaf woodland	
Aristida stricta/beyriciana	Carolina Wiregrass	Perenn	Sandy longleaf sites	
Aristida virgata	Three-awn Grass	Perenn	Flatwoods, savannas	
*Arundinaria gigantea**	Switch Cane	Perenn	Wet or dry; part shade to shade	Apr-Jul
Axonopus furcatus	Big Carpetgrass	Perenn	Wet sandy woods, lawns, other disturbed habitats	
Calamovilfa brevipilis	Pinebarren Sandreed	Perenn	Wet savannas; rare	
*Calamagrostis cinnoides**	Reed Grass	Perenn	Wet areas	Jul-Oct
Cenchrus tribuloides	Dune Sandspur	Perenn	Dunes, sandy fields and roadsides	
Chasmanthium laxum	Slender Spikegrass	Perenn	Flatwoods, savannas, shaded wet woods	
Chasmanthium latifolium	River Oats	Perenn	Riverbanks, bottomland forests	
Chasmanthium sessiliflorum	Longleaf Spikegrass	Perenn	Dry to moist oak-hickory woods	
Coelorachis rugosa	Wrinkled Jointgrass	Perenn	Limesink depressions, wet savannas; rare	
Ctenium aromaticum	Toothache Grass	Perenn	Wet to mesic savannas	
Danthonia spicata	Poverty Oat Grass	Perenn	Dry woodlands	
Dichanthelium sp.	Witch Grasses	Perenn	Wide variety of habitats	
*Dichromena latifolia**	Whitetop Sedge	Perenn	Wet to moist; white bracts	May-Sept
Eragrostis refracta	Lovegrass	Perenn	Disturbances in flatwoods, savannas	
Digitaria filiformis	Crabgrass	Perenn	Disturbances in sandhills	
Distichlis spicata	Seashore Saltgrass	Perenn	Coastal marshes	
Festuca paradoxa	Nodding Fescue	Perenn	Wet soils over limestone	
Glyceria striata	Fowl Mannagrass	Perenn	Low rich woods, swamp forests	
Leersia hexandra	Southern Cutgrass	Perenn	Clay-based Carolina bays, lime depressions	
Leersia oryzoides	Rice Cutgrass	Perenn	Marshes, riverbanks	
Melica mutica	Two-flowered Melic	Perenn	Low rich woods	
Muhlenbergia capillaris	Hairgrass	Perenn	Dry longleaf woodland	
Muhlenbergia expansa	Savanna Hairgrass	Perenn	Wet pine savanna	
*Muhlenbergia filipes**	Sweetgrass	Perenn	Pink plumes; dry-wet	Oct-Nov
Oplismenus setarius	Woods Grass	Perenn	Maritime forests, shell middens	
*Panicum amarum**	Bitter Seabeach Grass	Perenn	Sand dune areas	Oct
Panicum anceps	Beaked Panic Grass	Perenn	Disturbed flatwoods	
Panicum hemitomum	Maidencane	Perenn	Marshes, lakeshores	
Panicum rigidulum	Redtop Panic Grass	Perenn	Depressions	
Panicum tenerum	Southeastern Panic Grass	Perenn	Limesink ponds	
Panicum verrucosum	Warty Panic Grass	Perenn	Disturbed savannas	
*Panicum virgatum**	Switch Grass	Perenn	Pink-purple plumes; wet areas	Jun-Oct
Paspalum laeve	Brownseed Paspalum	Perenn	Mesic longleaf woods	
Paspalum praecox	Early Crown Grass	Perenn	Pine savannas	
Paspalum setaceum	Paspalum	Perenn	Dry woods; most common variety	

Grasses, etc: SCIENTIFIC NAME	COMMON NAME	ANNUAL/ PERENNIAL	COMMENTS	BLOOM TIME
Piptochaetium avenaceum	Eastern Needlegrass	Perenn	Longleaf, oak-hickory woodlands	
Rhynchospora sp.	Beaksedges	Perenn	Mostly wet areas, sinks, bogs, seeps	
Saccharum alopecuroideum	Silver Plumegrass	Perenn	Fields, woodland borders	
Saccharum coarctatum	Brown Plumegrass	Perenn	Clay-based Carolina bays, depressions	
Saccharum giganteum	Sugarcane Plumegrass	Perenn	Marshes, wet savannas	
Schizachyrium scoparium	Little Bluestem	Perenn	Moist to dry woodlands and savannas	
*Setaria geniculata**	Foxtail Grass	Perenn	Graceful; dry areas	May-Oct
*Setaria viridis**	Green Bristlegrass	Ann	Dry areas	Jul-Oct
*Sorghastrum sp.**	Indian Grass	Perenn	Tall, graceful; dry areas	Sept-Oct
Spartina alterniflora	Smooth Cordgrass	Perenn	Salt marshes	
Spartina cynosuroides	Giant Cordgrass	Perenn	Brackish marshes	
*Spartina patens**	Salt Hay	Perenn	Narrow blades; spreading; moist	Jun-Sept
Sphenopholis filiformis	Slender Wedgegrass	Perenn	Savannas	
Sphenopholis obtusata	Prarie Wedegrass	Perenn	Savanna-swamp ecotones and moist disturbed sites	
Sporobolus clandestinus	Rough Dropseed	Perenn	Rich dry woods, longleaf-oak-hickory	
Sporobolus curtisii	Curtis' Dropseed	Perenn	Moist savannas; rare	
Sporobolus junceus	Sandhills Dropseed	Perenn	Dry sandhills; rare in outer Coastal Plain	
Sporobolus pinetorum	Carolina Dropseed	Perenn	Wet savannas; rare	
Sporobolus teretifolius	Wireleaf Dropseed	Perenn	Wet savannas; rare	
Tridens ambiguus	Pineland Triodia	Perenn	Wet savannas	
Tridens carolinianus	Carolina Fluffgrass	Perenn	Dry longleaf woodland	
Tridens chapmanii	Chapman's Triodia	Perenn	Dry longleaf-oak-hickory woodland; rare	
Tridens flavus	Red Top	Perenn	Oak-hickory woods, roadsides	
Tridens strictus	Spike Triodia	Perenn	Wet pine savannas; rare	
Triplasis americana	Southern Sandgrass	Perenn	Sandy woods	
Triplasis purpurea	Purple Sandgrass	Ann	Sandy woods and dunes	
*Uniola paniculata**	Sea Oats	Perenn	Sand dune areas; oat-like seeds	Jun-Sept
Zizania aquatica	Northern Wild Rice	Perenn	Tidal marshes	

Vines: SCIENTIFIC NAME	COMMON NAME	EVERGREEN/ DECIDUOUS	COMMENTS	BLOOM TIME
Ampelopsis arborea	Pepper-vine	Decid	Maritime forests, floodplains; green	Jun-Oct
*Anisostichus capreolata**	Cross Vine	Semi-Evg	Red/orange flowers	Apr-May
*Apios americana**		Herb	Purple flowers; moist areas	Jun-Aug
Berchemia scandens	Supplejack	Decid	Bottomland forests, swamps; green	Apr-May
*Campsis radicans**	Trumpet Vine	Decid	Orange flowers	Jun-Jul
*Clematis crispa**	Leather Flower	Herb	Moist areas; white flowers	Apr-Aug
*Clematis reticulata**		Herb	Dry areas; white flowers	May-Aug
*Gelsemium sempervirens**	Yellow Jessamine	Evg	Fragrant, yellow flowers	Mar-May
*Lonicera sempervirens**	Coral Honeysuckle	Evg	Red flowers; red fruit	Mar-Jul
*Parthenocissus quinquefolia**	Virginia Creeper	Decid	Red fall color	
*Passiflora incarnata**	Passion Flower	Decid	Lavender flowers	May-Jul

Ferns: SCIENTIFIC NAME	COMMON NAME	EVERGREEN/ DECIDUOUS	COMMENTS	BLOOM TIME
*Adiantum capillus-veneris**	Venus' Hair Fern	Decid	Shady calcareous slopes	
Asplenium heteroresiliens	Carolina Spleenwort	Decid	Rich woods; rare	Apr-Oct
Asplenium playneuront	Maritime Ebony Spleenwort	Decid	Rich woods	Apr-Oct
Asplenium resiliens	Blackstem Spleenwort	Decid	Rich woods; rare	Apr-Oct
*Athyrium asplenoides**	Southern Lady Fern	Decid	Shade; moist areas	
Azolla caroliniana	Mosquito Fern	Decid	Aquatic	Jun-Sept
Botrychium biternatum	Southern Grape Fern	Evg	Swamps	Aug-Oct
Botrychium dissectum	Common Grape Fern	Evg	Rich woods, bottomlands	Aug-Oct
Botrychium virginianum	Rattlesnake Fern	Decid	Rich woods	Apr-Jun
*Dryopteris ludoviciana**	Southern Sheild Fern	Decid	Moist areas	Jun-Sept
Onoclea sensibilis	Sensitive Fern	Decid	Marshes, wet places	May-Jun
Ophioglossum crotalophorides	Bulbous Adder's-tongue	Decid	Moist ditches, grassy roadsides; rare	Mar-Sept
Ophioglossum pycnostichum	Southern Adder's-tongue	Decid	Bottomland forests	Mar-Jul
*Osmunda cinnamomea**	Cinnamon Fern	Decid	Moist areas	
*Osmunda regalis**	Royal Fern	Decid	Moist areas	
Phegopteris hexagonoptera	Broad Beech Fern	Decid	Mesic forests	Apr-Aug
Pleopeltis polypodioides	Resurrection Fern	Evg	Tree limbs, especially live oak	Jun-Oct
*Polystichum acrostichoides**	Christmas Fern	Evg	Shade; moist areas	
Pteridium aquilinum	Bracken	Decid	Moist-dry pinelands	Jul-Sept
Thelypteris kunthii	Wide-spread Maiden Fern	Decid	Calcareous areas	May-Aug
Thelypteris palustris	Marsh Fern	Decid	Marshes, bottomland forests	Jun-Sept

On the Water: Caring for Your Boat and Dock

Chapter 7

Recreational boating provides relaxation and enjoyment for thousands of South Carolina residents. With so many enthusiasts enjoying our shoreline, rivers and lakes, boat and personal watercraft owners play a major role in water quality along the coast. By understanding the potential impacts of boating practices, you can ensure that the coastal waters we all depend on will not be damaged.

This chapter examines boating-related activities and what you can do to minimize possible harm to the environment. The following topics will be covered:

- Boat cleaning and maintenance
- Spill prevention and waste disposal
- Dock construction and maintenance

Figure 7.1. Good boating practices safeguard coastal water resources for all citizens.

By completing this chapter, you'll learn to identify, evaluate and reduce the pollution risks your boating practices may cause.

What are the environmental concerns?

Boating- and marine-related activities can have a profound effect on local environmental quality. In 1999, there were more than 434,000 boats registered in South Carolina. While individual boats usually release only small amounts of pollutants, when multiplied by thousands of boaters, docks and marinas, these pollutants can cause measurable water quality problems in lakes, rivers and other coastal waters.

Products used to wash boat hulls and decks often contain toxic ingredients such as chlorine, phosphates and ammonia. Likewise, wood preservatives, stains, antifouling paints and strippers are used regularly without regard to potential environmental hazards. Individuals often clean or repair their boats in driveways, streets and parking lots where there is no drainage control and contaminated discharge enters stormdrains, which typically lead directly to local surface water bodies.

Another problem occurs when exotic plant and animal life such as hydrilla, water hyacinth or zebra mussels become attached to boats and trailers and are accidentally introduced into waterways. Once established, exotics can spread quickly and are difficult and expensive to control.

Figure 7.2. Recreational boating is an enjoyable activity for many coastal residents.

These uninvited guests degrade water quality and fish and wildlife habitat by outcompeting valued native species and by blocking out light needed by underwater plants.

Discarded trash in the water is not only unsightly; it can kill and injure aquatic life. Federal law prohibits boats from discharging plastics, or garbage that contains plastics, into any waters. Nevertheless, this type of debris commonly finds its way into our coastal waters at alarming levels.

The physical alteration of shoreline, wetlands and aquatic habitat during the construction of a private dock can be considerable. If docks are improperly sited or built, there can be significant erosion problems as a result of lost or destroyed vegetation. In addition, the pilings and decking are often made of lumber that is

treated with pesticides and other preservatives. While this wood material is largely safe if treated properly, it should still be handled and disposed of with caution.

Part 7.1 Boat Cleaning and Maintenance

Most boat owners want a clean and healthy environment in which to enjoy the full recreational potential of South Carolina's coastal waters. Preventing pollution can be as simple as using good maintenance practices and less caustic or toxic products.

Look over the topics below, and read those that will help you better understand your boating practices and habits. Fill out the cleaning and maintenance assessment on page 106 to see if any of your routines pose environmental risks and may need improvement.

Washing the Hull and Deck

Many of the products that we use every day in our homes are perfectly safe in that environment. On our boats however, where cleaners can be discharged directly into the water without any treatment, the same products can be lethal to marine life.

Grease-cutting detergents, scouring powders and bleaches clean very well, but these products are toxic to marine organisms and threaten water quality. Fortunately, there are many alternative products and practices designed specifically for boaters that are less harmful.

To lessen the impact of cleaning your boat, scrub and rinse the deck and hull with fresh water after every trip. Remember, the safest cleaning product available is good, old-fashioned elbow grease! Use a non-abrasive sponge and don't give that sea salt a chance to build up and corrode important components.

If fresh water won't do the job, then take advantage of alternative cleansers (Table 7.1). Don't use products that contain ammonia, sodium, chlorinated solvents, petroleum distillates or lye.

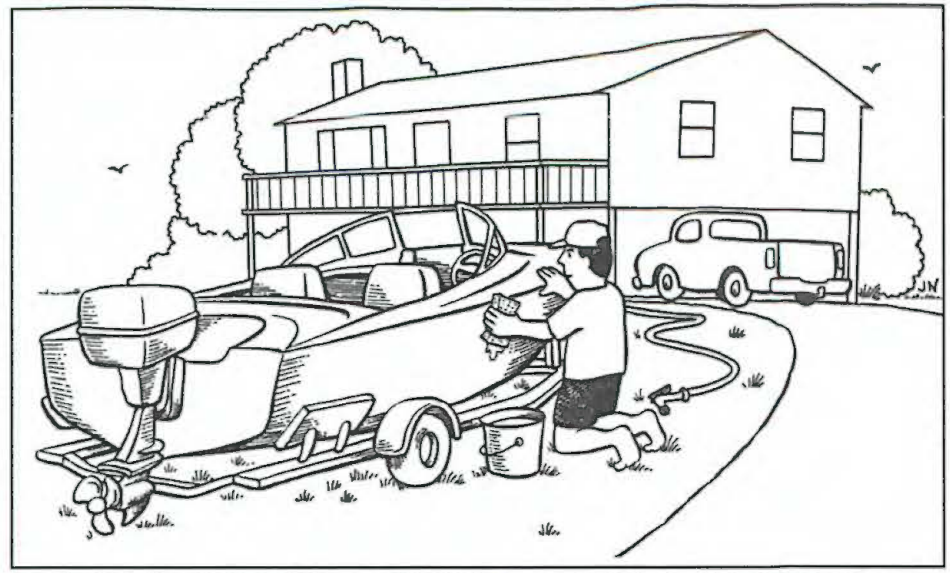

Figure 7.3. If you must clean your boat at home, park the boat in the yard so excess water will seep into the ground instead of running off your property into a stormdrain.

Use these cleaning agents conservatively rather than dousing the deck with soap. Apply small amounts with a cloth and wipe it up rather than hosing it off after each application. When you need a hose, use a squeeze nozzle that shuts off when released to conserve water and minimize runoff.

Always think about where you are going to clean your boat. Is it wise to clean it off beside the boat ramp? How about in your driveway or the street? Don't forget that runoff in both cases will find its way directly into a nearby surface water body. If possible, park your trailer in the grass or other permeable area where excess water will have a chance to seep into the ground and be filtered by the soil.

Targeting Aquatic Nuisance Species

Exotic plants and animals are an increasing problem in South Carolina waters. In 1999, there were 11 coastal water bodies listed as aquatic plant problem areas by the South Carolina Department of Natural Resources (DNR). Each year the state spends hundreds of thousands of dollars to control the spread of noxious weeds such as hydrilla and water hyacinth. As you can see, recreational boaters have both environmental and financial reasons to take preventative action.

The first step in the prevention of spreading nuisance species is to develop an attitude of concern. Second, accept the fact that your activities are a potential means of transportation, and third, adhere to the recommendations outlined here and to those of DNR.

Table 7.1 Alternatives to Toxic Products for Cleaning Your Boat

Instead of ...	*Try this...*
Bleach	Borax or hydrogen peroxide
Detergent and Soap	Vegetable- or citrus-based soaps; plenty of elbow grease
Scouring Powder	Baking soda
Floor Cleaner	1 cup of white vinegar in 2 gallons of water
Window Cleaner	1 cup white vinegar in 1 quart of warm water, rinse and squeegee
General Cleanser	Baking soda and vinegar; lemon juice combined with borax paste
Head Cleaner	Pour in baking soda and use a brush
Shower Cleaner	Wet surface, sprinkle on baking soda, and scrub with a scouring brush
Aluminum Cleaner	2 tablespoons cream of tarter in 1 quart of hot water
Brass Cleaner	Worcestershire sauce or paste made of equal parts salt, vinegar and water; rinse thoroughly
Copper Cleaner	Lemon juice and salt
Chrome Cleaner and Polish	Apple cider vinegar to clean; bay oil to polish
Fiberglass Stain Remover	Baking soda toothpaste
Drain Opener	Use boiling water and plumbers snake or disassemble; toxic substances should not be used in through-hull drain
Mildew Remover	Paste using equal parts of either lemon juice and salt or vinegar and salt
Wood Polish	Almond or olive oil (interior wood only)

Taken from "Managing Boat Wastes," University of Hawaii Sea Grant College Program

- Inspect your boat, trailer and boating equipment (anchors, centerboards, rollers, axles) and remove any plants and animals that are visible before leaving any water body.

- Drain water from the motor, livewell, bilge and transom wells immediately after you pull the boat out.

- Empty your bait bucket onto dry ground before leaving the landing. Never release live bait into a water body or release aquatic animals from one water body into another.

- Wash and dry your boat, tackle, downriggers, trailer and other boating equipment to kill harmful species that were not visible at the boat launch. This can be done on your way home or once you have returned home. Some aquatic nuisance species can survive more than two weeks out of the water, so it is important to ...

  - Rinse your boat thoroughly with fresh water after each trip; or dry your boat and equipment for at least five days, before transporting to another water body.

  - Learn what these organisms look like (at least those you can see). If you suspect a new infestation of an exotic plant or animal, report it to DNR.

  - Consult DNR for recommendations and permits before you try to control or eradicate an exotic "pest."

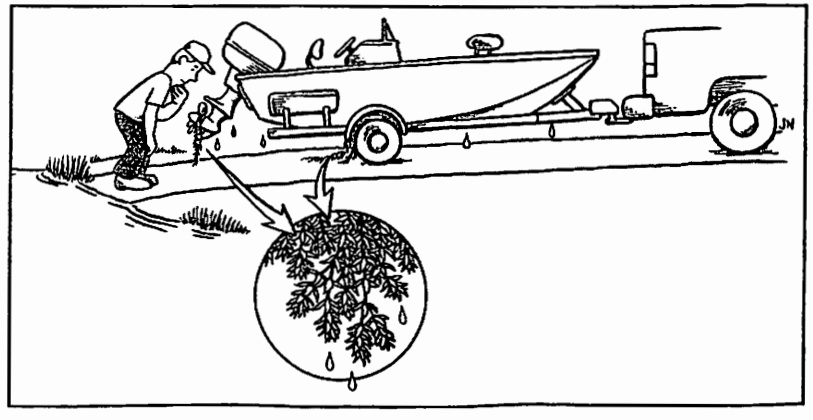

Figure 7.4. Always inspect your boat and trailer for plant fragments or animals that may be attached, and remove them immediately.

Sensible Boat Sanding and Painting

Sanding and painting can be messy tasks, and if certain precautions are not taken, these chores can also create an environmental mess.

You may want to consider using a licensed boatyard or contractor to undertake the types of repair that include paints, varnishes and epoxies. These commercial facilities are equipped to control air emissions while painting, collect and treat debris from hull cleaning, and recycle or properly dispose of all types of hazardous wastes. In other words, they take the headache of repair away from you!

If you are a die-hard do-it-yourselfer, or for small to moderate projects, there are several precautions you should take to keep toxics and debris out of coastal waters.

First, ***always plan for maintenance so that it's done all at once when your boat is out of the water.*** Save difficult jobs until the winter, when most of us haul boats out for at least a month or two.

Before you start sanding or painting, cover the area between the boat and the ground with a plastic sheet or tarp to catch debris. This simple practice will collect much or all of the fine particles that result from your maintenance practices. In addition, if you are painting your boat yourself, wear appropriate protective clothing such as a hat, gloves and safety glasses. Invest in a high-quality respirator, not a dust mask. If you can smell and taste a solvent, stop what you're doing and take a break.

Never sand in a heavy breeze when the particles could become airborne and inhaled or deposited directly into water. Use sanding equipment with a dust containment bag, sweeping up residual sanding dust and disposing of it in the trash.

Marine paints come in two basic forms: water-based and oil-based. Water-based paints are generally considered less dangerous than oil-based paints, which contain cancer-causing solvents that, if inhaled, ingested, or absorbed through the skin, can affect your health.

When painting your deck or hull ...

- Buy only enough paint for the job. Mix your paint on land, avoiding spills and drips.
- Use pans or containment trays to catch drips and spills.
- Seal containers tightly when not in use and store in a cool, dry location that is not accessible to children.
- Re-use paints, varnishes and solvents whenever possible. Toxic products must be disposed at a hazardous waste collection facility (See Chapter 5, page 69).
- Donate leftover paints to fellow boaters.

Most bottom paints are considered pesticides, and a S.C. Certified Pesticide Applicator's License is required to purchase the products. Check with your local marine supply store or call your local Extension office if you have any questions.

Exterior Wood and Trim

Wooden parts and gear have been part of boating in South Carolina for hundreds of years. Even though many boats are now manufactured using aluminum or fiberglass, there are still companies that routinely construct boats with wooden components.

To minimize the use and harmful impacts of varnishes, consider having covers made for exposed wooden parts such as teak railings or hatches. While the initial investment may seem costly, you will save money on routine wood refinishing. You can also feel good about supporting a local marine business and protecting the environment!

Many people love the look of bleached teak decks and trim. However, wood cleaners used to restore the bleached look are mostly acid-based products that are very hazardous to the

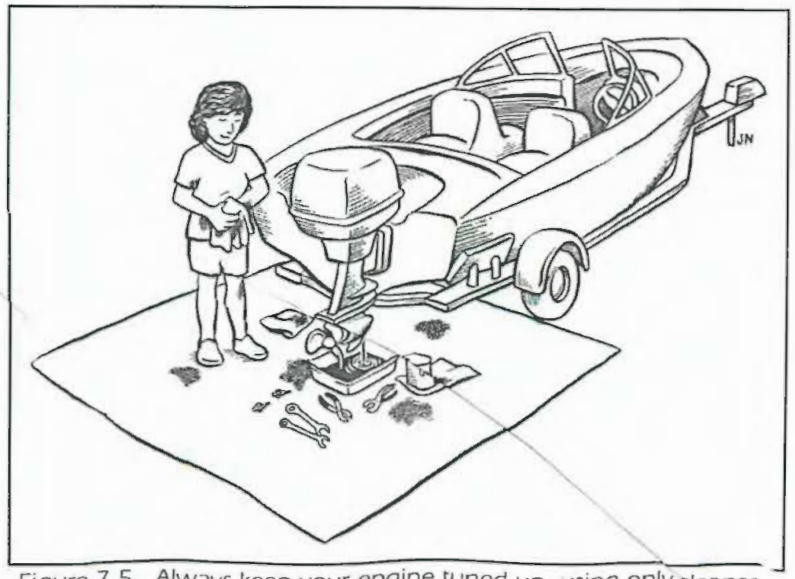

Figure 7.5. Always keep your engine tuned up, using only cleaner-burning TC-W3 oil. Capture and recycle any used foot oil.

aquatic environment. In addition, regular application of wood cleaners can wear away the grain and damage seam compounds.

Here are some alternatives to bleaching wood:

- Allow wood to fade to gray. Rinse with fresh or salt water occasionally to remove excess dirt and grime.
- Use teak cleaners and soaps sparingly, avoiding solvents or varnishes.
- If you oil your teak trim, minimize or eliminate caustic cleaners before applying the oil.
- If you must use cleaners or solvents, apply with a cloth or sponge rather than more abrasive steel or copper wool.

Engine Maintenance

Maintaining your outboard or inboard engine can pose some special problems, mostly due to the materials involved, such as oil, grease, transmission fluid and antifreeze. ***Oil can be a particular problem, since a single quart, when spilled, can pollute an area of up to 2 acres, equivalent to nearly three football fields of water surface.***

Performing routine maintenance will improve boat and engine operation while protecting the environment. The basic rule to follow is keep your engine well-tuned. It will use fuel more efficiently, reduce fuel consumption and last longer. It will also discharge fewer pollutants into South Carolina waters.

Tips for Routine Engine Maintenance

- Follow the manufacturer's recommended maintenance schedule.
- When changing your oil, wipe up spills immediately and be extremely careful to catch all used oil in a container for onshore recycling.
- For inboard engines, place a bilge "pillow" (an oil-absorbing sponge available at many marine stores) in your bilge to remove oil from your bilge water. Then the oil won't be pumped overboard by your bilge pump.
- For outboards, use the premium TC-W3 oil recommended by your engine's manufacturer. Premium TC-W3 oils contain more detergents and burn cleaner than the older Type TC-W2 oils.
- If your engine does not have oil injection of any sort, carefully measure the oil you mix with your gasoline. Remember that too much oil in the gasoline means inefficient burning. Too little oil can cause significant engine damage.
- Prepare engines properly for winter storage. Good care at the end of the season can keep your outboard running well. Consider using a good professional service to winterize your engine or learn to do the job yourself.
- Inspect your rubber fuel lines regularly. The alcohol content of unleaded fuels has a tendency to deteriorate fuel line hoses, sometimes in a matter of months. Should signs of deterioration be evident (dry, cracked, or soft and mushy spots) replace them immediately with any hose marked "USCHG type A." The Coast Guard has approved an alcohol-resistant fuel line hose, identified as SAEJ1527, now commonly in use.
- Do not use bilge-cleaning chemicals, which merely disperse the oil in bilge water.
- Use enzyme-based bilge cleaners, which are nonpolluting and also very effective. Drain old antifreeze into a container for onshore recycling. When you recycle, be sure you don't mix propylene glycol and ethylene glycol types of antifreeze. Where possible, use less toxic propylene glycol, rather than traditional ethylene glycol antifreeze. Make sure you check the manufacturer's specifications to see if propylene glycol can be used in your engine. In either case, it is illegal to dump antifreeze into South Carolina waters. Consider installing an in-line fuel/air separator on each tank. These devices prevent fuel from escaping out the vent holes but let air in.

From "Your Boat and the Bay,"
Chesapeake Bay Foundation, 1999

Risk Assessment 7.1 Boat Cleaning and Maintenance

Use the table below to rate your risks related to the boat cleaning and maintenance practices you use. For each question, check your risk level in the right-hand column. Some choices may not be exactly like your situation, so choose the response that fits best. Refer to Part 7.1 above if you need more information to complete this table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Cleaning products	I use only water to clean my hull and deck. I rinse the boat after every trip and use a lot of elbow grease instead of harsh cleansers.	I use only marine detergents or alternative cleaners to clean my hull and deck.	I use whatever cleaning agent is handy, regardless of whether it is meant for use in the marine environment. I never rinse my boat.	❑ Low ❑ Medium ❑ High
Cleaning location	I take my boat to a self-service car wash after each trip so my runoff will be collected and treated or recycled.	I pull my boat trailer into the yard when I wash it off so most of the runoff will percolate into the soil.	I wash my boat in the street or in my driveway where my runoff will likely find its way into a nearby surface water body.	❑ Low ❑ Medium ❑ High
Hull maintenance	I take my boat to a licensed boatyard when the hull needs painting or scraping.	I take on small or moderate painting and scraping jobs at my house. I use a tarp under the boat to catch debris and wear protective clothing. I use a containment bag and properly dispose of or recycle waste.	I never follow label instructions and take no precautions — even when recommended. I don't use drip pans or recycle leftover products.	❑ Low ❑ Medium ❑ High
Nuisance species	After each boating trip, I always check the hull, engine and trailer for vegetation that may have become attached. I never take my boat from one water body to another in the same week.	If I see any plants hanging off my boat or trailer, I'll remove them. Occasionally I use my boat in different water bodies, but I always let it dry out for several days.	I never check my boat or trailer for plant fragments. There are times I will trailer my boat from one water body to another in the day.	❑ Low ❑ Medium ❑ High
	I always check my live well and bilge water for the presence of exotic species, completely emptying and rinsing the basin after each trip. I never transfer live bait from one location to another.	I always empty the live well after each trip, but I do not rinse it out.	I never check my live well for the presence of nuisance species. I frequently transfer live bait from one location to another.	❑ Low ❑ Medium ❑ High
Wood and trim maintenance	I use covers for my exposed wooden components. I enjoy the look of weathered wood and use only salt water to rinse away the dirt and grime.	I use wood cleaners and soaps sparingly, avoiding solvents and varnishes. If I must use a cleaner I apply with a sponge or soft cloth.	I frequently use harsh wood cleaners and varnishes. I also use steel wool to prepare the wood surface for application. I rinse my tools in the water after I finish.	❑ Low ❑ Medium ❑ High
Engine maintenance	I always keep my engine finely tuned. I use only cleaner-burning TC-W3 oil mixed to the correct ratio. I always capture and recycle my used oil.	I tune up my engine every couple of years. I use whatever oil is on sale, recycling when it's convenient.	I never tune up my engine. I use the cheapest oil available. I mix my oil to burn rich because I've been told that will make my engine last longer.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your boat cleaning and maintenance risks and reduce potential harm to the environment. Turn to the Action Checklist on page 115 to record the medium- and high-risk practices you identified. Use the recommendations in Part 7.1 to help you plan actions to reduce your risks.

Part 7.2 Spill Prevention and Waste Disposal

Large oil spills, such as the wreck of the Exxon Valdez in Alaska, receive most of the public's attention. However, according to recent studies, these large spills account for only 10 percent of all the oil that ends up in the water each year. The other 90 percent comes from polluted urban runoff and other nonpoint sources, such as improperly disposed used oil, bilge water, outboard motors and careless fueling habits.

Likewise, disposal of waste is a serious issue. Human sewage discharged from boats can contain disease-causing organisms that harm marine animals and plants. Plastics and trash are often mistaken for food by marine life resulting in starvation or poisoning.

Fueling Your Boat

Most recreational boaters fuel their boats on the back of their trailers at a local gas station. Since there is no surface water under the boat and there are safeguards in place to minimize the impacts of small spills, the risk of environmental damage is minor.

In the water however, filling the fuel tank often means waiting for the gas to spurt out the overflow vent. It doesn't take a genius to figure out where that extra fuel is going.

Following a few simple steps will go a long way toward eliminating this common problem:

- Never leave the fuel nozzle unattended. While fueling your boat, never leave the hose unattended.
- Don't overfill your tank. Know your tank's capacity and learn to gauge the amount of fuel you need.
- Fill slowly. Many marine filling stations are not equipped with nozzles that automatically shut off with backpressure. By slowing down, you can prevent that accidental spill and still top off your tanks.
- Keep absorbent pads handy when fueling. Wipe up any accidental spills immediately, whether they occur at the vent outlet or the nozzle. Dispose of the soiled rags properly by giving them to the marina operator or placing them in a sealed container.
- Consider installing an in-line fuel/air separator. The devices are cheap — about $75 — and they prevent the fuel from escaping out the vent hole, while letting the air in.

To report the spill of oil, gas or other hazardous materials into the water, call the U. S. Coast Guard at (800) 424-8802. You can also call the Department of Health and Environmental Control (DHEC) at (843) 740-1590 to report a spill.

Bilge Water

Nearly all boaters have encountered an oily sheen in their bilge water. Oil leaks from numerous lubricated parts of an engine and mixes with water entering the bilge.

How do we dispose of this polluted water? The best advice involves prevention. As covered in the previous maintenance section, fix those small leaks that allow oil to drip into the bilge. Take a few minutes before you change the oil to ensure the proper capture and cleanup of all the fluids. Always keep an aluminum or plastic tray in the bilge as a containment device.

Once oil has seeped into the bilge, use oil-absorbent pads to capture the surface oil before pumping the water over. If too much is leaking to be contained by absorbent pads, consider the use of a bilge pumpout service. Check the phone book or contact a local marina for the service nearest you.

Under no circumstances should you ever add liquid detergents to bilge water. These chemicals only disperse the oil and can foul bilge pumps and absorbent pads. In addition, the U.S. Coast Guard can fine you for up to $25,000 for those few squirts of soap if you pump the treated water overboard.

Disposal of waste is a serious issue. Human sewage discharged from boats can contain disease-causing organisms that harm marine animals and plants.

Head Sewage

Probably no issue draws the attention of regulatory agencies and environmental groups to boaters more quickly than the illegal dumping of raw sewage. The untreated sewage discharge from a single weekend boater can put the same amount of bacterial pollution into the water as does sewage from 10,000 people whose waste has passed through a municipal treatment facility.

Coastal boaters should attempt to achieve zero discharge of all sewage into recreational waters. While on the boat, human waste should be contained in a U.S. Coast Guard-approved marine sanitation device (MSD). Upon returning to shore, portable toilets should be emptied into approved shoreside waste handling facilities, and MSDs should be discharged into approved pumpout stations.

Whether you know it or not, each of us is already helping to promote proper sewage discharge. Every time you purchase motorboat fuel and fishing equipment, part of the money is contributed to a fund set aside by the Sportfish Restoration Act and the United States Clean Vessel Act. This fund provides states, including South Carolina, money for the construction, renovation, operation and maintenance of pump-out stations and waste reception facilities for boaters. Be proud of your role!

Plastics and Trash

Today, most folks would not consider throwing their trash — plastic, nets, fishing line, six-pack rings, styrofoam and so forth — overboard. Yet every year, tons of debris makes its way into our coastal waters. In 1996, during the annual Beach Sweep/River Sweep cleanup, volunteers removed over 70 tons of trash from South Carolina waterways in a single day!

Plus-One Boating

Practice Plus-One Boating

What you bring out, take back ... Plus One

One piece of litter, one piece of debris, every time.
If it floats, net it. If it blows out, go back and get it.
Unload your litter with your catch.

That's all there is to it — just plain common sense on the water. Imagine the difference we boaters, fishermen, sailors and hunters could make if we all practiced Plus-One boating. For more information on the Plus-One program (including boxes, decals and patches), contact the S.C. Sea Grant Consortium at (843) 727-2078 or the S.C. Department of Natural Resources at (843) 762 5000.

Often unintentionally, boaters contribute to the problem. Empty ice bags and six-pack rings are blown out of the boat. Fishing line is too tangled to save so it gets tossed into the water. Cigarette butts are often not even considered trash, and casually flicked overboard.

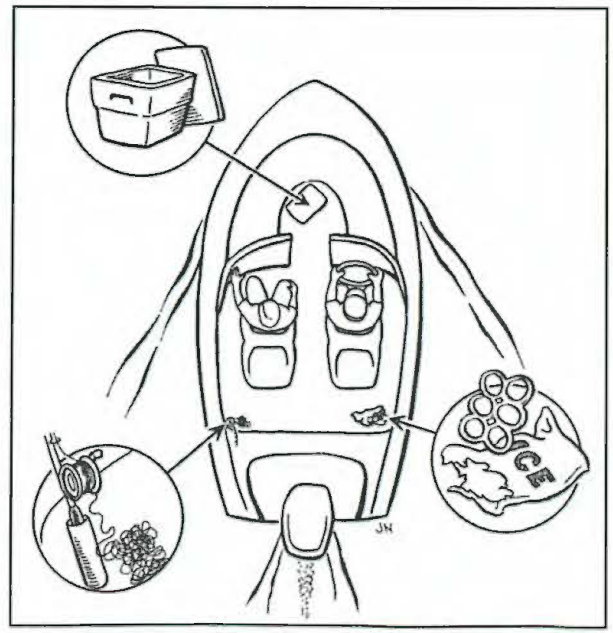

Figure 7.6. Items that are not properly secured can be accidentally blown overboard.

The following recommendations are pretty straightforward:

- Be careful. Accidents and spills happen even when you have the best of intentions.
- Leave as much plastic ashore as is reasonably possible. That way there is no chance of it falling overboard.
- Carry a trash bag. If you put all of your trash in one place, it's easy to contain and dispose of when you get back to shore.
- Recycle where possible. Deposit your glass, aluminum, plastic and newspapers in appropriately marked containers at marinas or other recycling centers.

What else can I do to help?

- Practice Plus-One boating every time you are out on the water (see box, above). Equip your boat with a long-handled net and a trash bag, and put them to use — every time.
- Organize a one-day cleanup of your local waters. Encourage parricipation from your

fishing group, civic group or even local boy/girl scout troops.

- Build and install a Plus-One Boating box — a trash bag dispenser with a message at you marina or boat landing.
- Increase awareness of the Plus-One program by proudly displaying Plus-One decals on your boat and wearing Plus-One patches on your hat or jacket.

Fish Wastes

When you've had a great day out catching fish, do you ever give any though to where and how you clean them? You should!

The amount of fish waste (heads, scales and guts) disposed into an enclosed basin, like a small tidal creek or close to a marina, can exceed what would exist naturally in the water. In small quantities, this fish waste is fed upon by such scavenging organisms as crabs or catfish, and is not a problem.

However, in large amounts where water circulation is restricted, decomposition of this fish waste can significantly affect the water quality by lowering the dissolved oxygen levels and even spreading disease among native fish populations. This can be a problem in marinas or near boat landings where fish are cleaned and water is not flushed adequately.

Cleaning and gutting fish at a fish-cleaning station with trash receptacles and wastewater hookups easily solves any potential problems. If one of these stations is not convenient, bag your fish waste and throw it away with your other household garbage.

Clam and Oyster Shell Disposal

Clam and oyster roasts have long been an important part of coastal living in South Carolina. But what do you do with the shells once the roast is over? For years individuals have discarded spent shells back into the creeks for improvement of shellfish habitat or used them for fill in driveways and ornamental concrete. However, with importation of shellfish from other regions of the United States to South Carolina, the potential for disease transmission to native shellfish areas has increased.

There are two general recommendations for disposal or recycling of clam and oyster shells. Many individuals use clam and oyster shells to fill driveways, enhance landscaping and in construction for tabby use. When recycling shells in this way, remember that clam and oyster shells have sharp edges and can cause cut tires over time. Homeowners need to consider these possible concerns when making use of clam and oyster shells.

DHEC and DNR have initiated a recycling program for used shells that will improve shellfish and fisheries habitat. By far the best cultch, or material for attachment of oysters, are recycled shells. Researchers have determined that oyster reefs are integral parts of the marine environment and extremely important fish habitat. Around the Chesapeake Bay for example, residents have begun growing oysters not for consumption but specifically for habitat enhancement.

In the past few years there has been a shortage of clam and oyster shells for cultch use, and the commercial oyster industry is required to place 50 U.S. bushels per acre to improve oyster production and fisheries habitat in the state of South Carolina. Commercial shellfisherman actually receive double credit if they deposit shells on any of the 56 state grounds in South Carolina. State grounds are areas where both commercial and recreational shellfisherman can harvest shellfish. The state maintains the public shellfish grounds that are utilized for recreational harvest only.

DNR is developing a program to stockpile clam and oyster shell for use in specific areas of the state. Contact the shellfish coordinator at (843) 762-5028 about the stockpiling of clam and oyster shells. Shells need to be kept out of the water for a period of one year to reduce the potential of introducing shellfish diseases into state waters. If an individual has large quantities of shell for recycling and placing as cultch in public shellfish grounds, DNR will actually come and collect the shells. Shellfish recycling is now an important part of the state shellfish program, and instead of placing them in the driveway, individuals may wish to help recycle shell to help produce more oysters and also to improve dramatically the fisheries habitat of the state of South Carolina.

Risk Assessment 7.2 Spill Prevention and Waste Disposal

Use the table below to rate your risks related to how you prevent spills and dispose of your marine-related wastes. For each question, check your risk level in the right-hand column. Some choices may not be exactly like your situation, so choose the response that fits best. Refer to Part 7.2 above if you need more information.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Fueling	I always fill my gas tank at the local filling station, never refueling while on the water. I have a "whistle" installed in the line to warn me when my tank is getting full. I never leave the nozzle unattended.	I try not to overfill the gas tank, but when I do, I clean up spills using absorbent pads. I seldom use marina gas stations.	I always try to get as much gas in my boat as possible, whether I am at a marina or at my local station. When the gas comes shooting out my vent, I know I've got enough.	❑ Low ❑ Medium ❑ High
Bilge water	I maintain my engine very carefully, always checking hoses and connections for any sign of a leak. If I see an oil sheen in my bilge, I use a commercial pumpout service to clean it out.	When I see oil in my bilge, I stop the pump and use the absorbent pads I keep on board to soak it up. I dispose of these used pads at a local recycling center.	If I notice an oily sheen in my bilge, I use the pump to get it overboard. I don't keep absorbent pads on board, but I do use a liquid detergent to eliminate oil in the bilge if I see any.	❑ Low ❑ Medium ❑ High
Head sewage	I never discharge any sewage into the water. I always use pumpout facilities, which are provided at many local marinas. I ensure that my MSD is functioning properly before each outing.	I only discharge treated sewage into coastal waters, and only when my holding tank is full. I use a pumpout station when it's convenient.	I discharge my sewage at the end of each outing before returning to the dock or ramp. I don't like using pumpoutstations because they are costly and dirty.	❑ Low ❑ Medium ❑ High
Fish waste	I only clean fish at designated fish-cleaning stations, with trash cans and wastewater treatment. If a station is not around, I bag the waste and throw it away at home.		I always clean my fish at the boat ramp, disposing of the waste in the water.	❑ Low ❑ High

Responding to Risks

Your goal is to lower your spill and waste risks and reduce potential harm to the environment. Turn to the action checklist on page 115 to record the medium- and high-risk practices you identified. Use the recommendations in Part 7.2 to help you plan actions to reduce your risks.

Part 7.3 Dock Construction and Maintenance

One of the many advantages to living on the coast is quick and easy access to water. Those who enjoy boating and other water-related recreational opportunities, and also own waterfront property, often want a dock or boat slip to improve this access.

If you are going to build a dock, or plan to repair the one you already own, there are choices you will make that affect the environment. Are you going to use a marine contractor or do the work yourself? What kind of wood will be used for the pilings and decking? Have you made considerations for potential erosion problems?

Getting the Proper Permits

Before any dock construction can begin by either you or a contractor, a permit must be acquired from the Office of Ocean and Coastal Resource Management (OCRM). Contact OCRM offices in Beaufort, Charleston or Myrtle Beach and pick up a Permit Application Packet (OCRM field office locations are listed on page 118).

The permit application is a straightforward document explaining the requirements and information that must be submitted to OCRM. In most cases an administrative fee is required as part of the permitting process. The fees range from $50 for noncommercial activities such as a private dock, to $1000 for marina applications. The applications are placed on public notice for either 15 or 30 days, depending on the activity, allowing OCRM staff to thoroughly address the proposal as well as other agencies and members of the public to review and comment on the project. Issued OCRM permits are good for a five-year period during which the authorized activity must be completed.

Choosing a Marine Contractor

Choosing your marine contractor can be more important than any other contractor you may need. Why? Because the marine construction industry is largely unregulated. There are no building codes for marine contractors. Nobody checks the work of the contractor during or after construction to make sure it meets quality standards.

Go look at the work of any marine contractor you consider for your project and "ask around" about their reputation. Call the Better Business Bureau to see if there are any complaints registered against the company. If the contractor obtained the permit for you, ask to see a copy before construction begins. If there were permit problems, you would be held partially liable for any damages that might occur.

Also, make sure the contractor specifies what type of wood will be used for each of the dock components. Are they going to use regular or marine-grade pressure treated lumber? What is the pile length and how will they be seated? What are the dimensions of the decking lumber? Will they use galvanized nails or lag screws? The contractor you select should spell out all of this detail and more.

What Type of Material Will You Use?

To ensure structural soundness and long service life for coastal docks, wood should be protected from attack by insects or microorganisms and by decay from fungi. This is especially important in South Carolina because of the hot and humid climate. Pressure treatment offers a long-lasting and generally environmentally safe alternative.

In pressure treatment, chemical preservatives are forced deep into the cellular structure of the wood in a closed cylinder under pressure. This process enables the preserved wood to maintain a chemical barrier against insects and decay for long periods of time. The fact that preservatives are bound so effectively into the lumber means less is available to seep or leach into water.

There are three basic types of wood preservatives: waterborne, oilborne and creosote. Only the waterborne chemicals are generally used in pressure-treated wood products intended for residential uses. These products are generally available at your neighborhood home improvement centers. Chromated copper arsenate (CCA) is the most commonly used waterborne preservative.

Oilborne preservatives, such as creosote, are now used primarily for commercial applications, such as timbers for railroad ties, bridges and wood used in marine structures such as bulkheads and seawalls.

Pressure-treated wood has not been listed as hazardous waste. While it is acceptable in South Carolina to send treated wood to a landfill space, look into options for recycling. In many cases, the wood can be reused in its original form or used in secondary applications such as fence posts, landscaping or other projects. Treated wood should not be burned in fireplaces, stoves or other nonpermitted units because toxic residue may be produced as part of the smoke or ashes.

Board dimensions are also very important. 2" x 8" boards are much stronger than 2" x 6" boards when used for stringers. Make sure you know the dimensions and treatment levels for the boards to be used on your project.

Table 7.2. Pressure-treated Wood Application and Retention Table for CCA

Retention (lbs/ft3)	Product Application
0.25	Above Ground
0.40	Ground Contact
0.60	Permanent Wood Foundation
2.50	Salt Water

Alternatives to Wood

Recycled plastic lumber is gaining popularity among marine contractors and environmentally conscious homeowners. Plastic lumber is more expensive than regular or marine grade pressure-treated lumber, but it is virtually maintenance-free and many companies provide a lifetime warranty on the materials.

Plastic lumber means you'll never have to worry about the effects of water or moisture damage. It is impervious to marine borer worms, insects, water and chemicals. It is solid, nonporous, and will not leach any chemicals into the water. Another positive point is that most of this type of lumber is made from 100-percent recycled plastic material. Your purchase and use of these products closes the recycling loop!

Working with plastic lumber is the same as regular lumber and requires only standard wood-working tools and fasteners. Several floating and even fixed docks can be shipped completely or in kit form with all the hardware you need.

Talk with your marine contractor or do some research yourself to find the best deals.

Repairing and Maintaining Your Dock

To many people who own or take care of docks along the coast of South Carolina, it seems like repair and maintenance is an annual chore. Although pressure-treated wood resists insects and decay, it's still vulnerable to moisture and the sun's rays.

While nailing loose deck boards, replacing rusted or worn framing bolts and fasteners, and inspecting electrical or water lines are all necessary practices, we are going to focus on the maintenance of the wood itself.

Before you go out and purchase any cleaning products, ***remember that a hard bristle brush with a long handle (to save your back), a bucket of salt water and an afternoon of elbow grease will often clean your dock as well or better than commercial products.*** In addition, you have the added benefit of knowing that if you tipped your bucket over, no harmful chemicals would spill into the water around your dock!

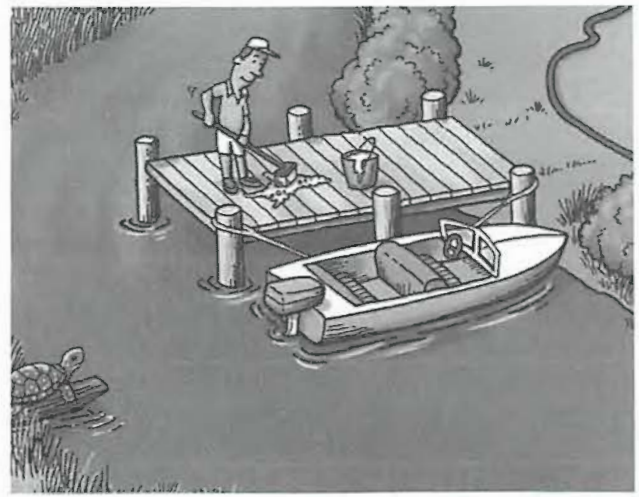

Figure 7.7. Proper care and maintenance of your dock will ensure long years of enjoyment and clean water quality.

There are a wide variety of products available to help you maintain the structural integrity and look of your dock's wood. New wood treatment protects brand-new lumber from sun and rain, deck cleaner can help with dirty and graying docks, and a clear wood preservative will revive the beauty of your weathered dock while protecting against the elements.

Before you use any of these products, ALWAYS read the label before you begin. Many oil-based wood maintenance products are very harmful to water quality if they are spilled or applied improperly.

The following tips will help you properly apply wood-care products to your dock:

- Remove all loose dirt and debris before you apply wood-care products.
- Try to work on a day with light or no wind.
- Always use a tarp or ground cloth under your project to help prevent drips and spills.
- Use a brush or roller when applying the sealer to minimize dripping. Don't use a sprayer because the excess will find its way into the water around your dock.
- Use as little of the product as it takes to completely cover the decking, avoiding drips.
- Rinse and clean tools in the yard, well away from any surface water.

Coastal Natural Hazards

A hurricane or nor'easter can severely damage your boat — and you may be held responsible for any damage your boat causes to your neighbor's property! Use this checklist to help you prepare your vessel to withstand the strong winds and waves of a severe storm.

PRELIMINARY ACTIONS

- ❑ Locate moorings in advance and obtain permission from appropriate persons. Ensure that there is enough water for your boat at low tide.
- ❑ Make a practice run to check accessibility, depth and bridges. Locate aids or obstructions to navigation and suitable anchoring places. Remember that drawbridges MAY NOT open during an evacuation!
- ❑ Inform the local marine patrol or police of your secured vessel's identification and location.
- ❑ Check your marina contract — know your responsibilities and liabilities.

EQUIPMENT

- ❑ Make sure you have lines of adequate length (several hundred feet) and size (minimum $^{5}/_{8}$-inch), preferably of nylon (for strength and stretch) available. Line size will vary with the size of your boat.
- ❑ Use chafing gear for all lines to protect them from wear at contact points.
- ❑ Secure fenders of adequate size and strength (old tires are good) to your boat to protect it from other boats, pilings or other floating debris.
- ❑ Have NOAA weather radio and communications equipment available.
- ❑ Have oversize anchors (25 pounds or heavier) and use all methods to improve holding power.
- ❑ Keep fuel tanks full, if possible, during hurricane season.
- ❑ Keep batteries fully charged. Purchase an extra battery, if possible, and keep bilge pumps in working order.

SECURING THE BOAT

- ❑ Prepare a checklist of things needed to secure your boat. Assemble these supplies and store together.
- ❑ Use large trees — alive and with a good root system — to fasten your vessel if necessary. Some trees may be stronger than man-made pilings. Be sure to check the strength of anything you tie to.
- ❑ Remember that tides can reach heights of 10 to 20 feet above normal during a storm, particularly when they back up into waterways. Be sure to consider the possibility when securing lines.
- ❑ Wind direction changes during a hurricane — secure your boat for all directions. Use more than one anchor.
- ❑ Strip boat of all moveable equipment (canvas, sails, cushions) and lash down anything you can't remove.
- ❑ Seal all openings (a/c duct tape works well) to make your vessel as watertight as possible.
- ❑ If you leave your boat on a davit, open the drains before securing.

SECURING THE BOAT ON A TRAILER

- ❑ Place wooden blocks between the frame member and the axle inside each vessel. Let about half the air out of the tires and then fill the boat one-third full of water to help hold it down. The blocks will prevent damage to the springs from the additional weight of the water.
- ❑ Tie your boat and trailer securely to a strong object (telephone pole or large tree) using heavy duty line.

HURRICANE WARNING

- ❑ Leave EARLY for safe harbor. Be sure not to block to passage of other boats that have moorings farther inshore. Cooperate with other skippers in securing their boats and assist them as long as safe and prudent. Follow the directions of police. Remember: There may not be room for your boat at the last minute.
- ❑ Do not stay aboard. Even small hurricanes with sustained winds of 75 MPH have gusts of 110 MPH that would blow anyone off the deck. Rescue efforts are impossible. Even if you live aboard, seek safe shelter on land!

AFTER THE HURRICANE

- ❑ Check for damage to boat and equipment before moving.
- ❑ When proceeding to home port, watch carefully for obstructions and debris in the water. Markers and other navigational aids may be missing.

Risk Assessment 7.3 Dock Construction and Maintenance

Use the table below to rate your risks related to dock construction and maintenance. For each question, check your risk level in the right-hand column. Some choices may not be exactly like your situation, so choose the response that fits best. Refer to Part 7.3 above if you need more information to complete this table.

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Dock construction	I will use a licensed marine contractor to construct my dock. I will examine the plans, specs and permits for their compliance with state regulations.	I will apply for the dock permit myself. I will construct the dock in a location that minimizes erosion.	I will not apply for a dock permit. I will build the dock without regard for localized erosion.	❑ Low ❑ Medium ❑ High
Material	I will insist on the use of recycled plastic lumber.	I will use pressure-treated lumber that has been properly labeled and is free of visible residue.	I will use whatever lumber is the cheapest and most readily available, giving no thought to the chemicals used.	❑ Low ❑ Medium ❑ High
Product selection	I like the look of a weathered dock. When I clean my dock, I use only salt water and some elbow grease!	When I clean or seal my dock, I use commercially available products. I always examine the label for any warnings about potential harm when used around water and purchase only environmentally safe alternatives.	I always use whatever is on sale to clean my dock. I never pay attention to the chemicals inside.	❑ Low ❑ Medium ❑ High
Application	When applying sealer to my dock, I always work on a sunny day with no wind. I use a tarp under my bucket to catch drips and only use a small amount of the sealer.	When I apply sealer, I try to avoid spills and drips. I rinse my equipment out in the lawn, away from the dock.	I always use a sprayer when I apply sealer to my dock, giving little consideration to how windy it is. I use a large amount of sealer. When I finish, I rinse the sprayer out in the creek.	❑ Low ❑ Medium ❑ High

Responding to Risks

Your goal is to lower your dock construction and maintenance risks and reduce potential harm to the environment. Turn to the Action Checklist on the next page to record the medium- and high-risk practices you identified. Use the recommendations in Part 7.3 to help you plan actions to reduce your risks.

Action Checklist

When you finish the assessments, record all medium and high risks in the checklist below. For each risk you identified, write down the improvements you plan to make. Use recommendations from this chapter and other resources to decide on a course of action.

Pick a target date to keep you on schedule for making changes. You don't have to do everything at once, but try to eliminate the most serious risks as soon as you can. Often it helps to start with inexpensive or free actions first.

Boat and Dock Care

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action.
Sample: *Washed and cleaned boat in the driveway.*	*Pull the trailer into the yard and wash the boat in the grass.*	*Next boating trip*
Sample: *Presently do not use absorbent pads in the bilge.*	*Buy absorbent pads and store them in an easily accessible location.*	*One week from today: November 28*

For More Information

The poster, *A Guide to Marine Sewage Disposal Stations in Coastal South Carolina*, is available from your local OCRM office. See page 118 for information on contacting the office nearest you.

Clean Boater: Clean Boating Habits, can be obtained by contacting the Florida Department of Environmental Protection, Office of Environmental Education, 3900 Commonwealth Blvd., MS-30, Tallahassee, FL 32399-3000, or by calling (850) 488-9334.

Get a copy of the *Clean Boating Guide*, by writing to the California Sea Grant Extension Program, University of California - San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0232, or by calling (858) 534-4446.

Managing Boat Wastes: A Guide for Hawaii Boaters, is available to boaters from every port by contacting the University of Hawaii, Sea Grant College Program Communications Office, 2525 Correa Rd., HIG 210, Honolulu, HI 96822, telephone: (808) 956-7031.

For a copy of *Your Boat and the Bay*, contact the Chesapeake Bay Foundation, 162 Prince George St., Annapolis, MD 21402, telephone: (410) 268-8816.

A list of waterbodies and nuisance aquatic plants can be found on the DNR webpage or by contacting the South Carolina Aquatic Nuisance Species Program, Land, Water and Conservation Division, 2221 Devine Street, Suite 222, Columbia, SC 29205, telephone: (803) 734-9100; fax: (803) 734-9200; http://www.dnr.state.sc.us/water/envaff/aquatic/indexb.html

Request a copy of *Frequently Asked Questions About Pressure Treated Wood* from the American Wood Preservers Institute at 2750 Prosperity Ave., Suite 550, Fairfax, VA 22031-4312, telephone (703) 204-0500, or visit their website at http://www.awpi.org.

This chapter was developed cooperatively by Cal Sawyer, Coastal Environmental Quality Specialist, and Jack Whetstone, Aquaculture Specialist, South Carolina Sea Grant Extension Program. Material was adapted from similar publications by the California Sea Grant Extension Program (San Diego) and the Florida Department of Environmental Protection. In addition, the template and format used were developed by the national Farm-A-Syst/Home-A-Syst programs, 303 Hiram Smith Hall, 1545 Observatory Drive, Madison, WI 53706.

Information and Services

Clemson University Cooperative Extension offices are located in each coastal county. Contact your local county Extension agent for assistance and additional information about Coast-A-Syst topics. General water quality publications are available on the Clemson University Cooperative Extension website, http://virtual.clemson.edu/groups/psapublishing/Pages/Water/water.htm. The Extension Water Quality Home Page (http://www.clemson.edu/cleanwaterwater/) describes ongoing water quality projects, research, education and current issues.

County	Address	Telephone	Fax
Beaufort	Box 169, Beaufort, 29901	(843) 525-7118	(843) 525-7243
Berkeley	227 First St., Moncks Corner, 29461	(843) 719-4140	(843) 761-4221
Charleston	259 Meeting St., Charleston, 29401	(843) 722-5940	(843) 722-5944
Colleton	Box 1086, Walterboro, 29488	(843) 549-2596	(843) 549-2597
Dorchester	Box 248, St. George, 29477	(803) 563-3441	(803) 563-0171
Georgetown	Drawer 1100, Georgetown, 29440	(843) 546-4481	(843) 546-2852
Horry	Box 1005, Conway, 29526	(843) 365-6715	(843) 365-6719
Jasper	Box 1089, Ridgeland, 29936	(843) 726-3461	(843) 726-3470

The South Carolina Department of Health and Environmental Control's Office of Environmental Quality Management is involved with the protection of the environment and is organized into program areas concerning solid waste and hazardous waste management, drinking water protection, water pollution control, and air quality control. There are district offices which are strategically located throughout the state and staffed with professionals who work in all EQC program areas.

EQC District	Counties	Address	Phone and Fax
Low Country	Beaufort, Colleton Hampton, Jasper	313 Thirteenth St. Port Royal, SC 29935	Phone: (843) 522-9097 Fax: (843) 522-8463
Trident	Berkeley, Charleston, Dorchester	1362 McMillan Ave., Suite 300 Charleston, SC 29405	Phone: (843) 740-1590 Fax: (843) 740-1595
Waccamaw	Georgetown, Horry, Williamsburg	1705 Oak Street Plaza Myrtle Beach, SC 29577	Phone: (843) 448-1902 Fax: (843) 946-9390

Soil and Water Conservation Districts work with federal (Natural Resources Conservation Service) and state (S.C. Department of Natural Resources) partners to assist local landowners in the application of conservation practices.

County	Address	Telephone	Fax
Beaufort	281 Parris Island Gateway, Beaufort, 29902	(843) 521-0302	(843) 524-8427
Berkeley	223 N. Live Oak Dr., Room A-7, Moncks Corner, 29461	(843) 761-8340	(843) 761-7320
Charleston	2420 Mall Dr., Suite 102, North Charleston, 29418-6520	(843) 727-4671	(843) 727-4541
Colleton	Box 1086, Walterboro, 29488	(843) 549-2596	(843) 549-2597
Dorchester	5809 W. Jim Bilton Blvd., St. George, 29824	(803) 563-3412	(803) 563-3099
Georgetown	1837 N. Fraser St., Georgetown, 29442	(843) 546-7808	(843) 546-2243
Horry	1949 Industral Park Rd., Room 125, Conway, 29936	(843) 365-7645	(843) 365-6650
Jasper	406 Main St., Ridgeland, 29936	(843) 726-8148	(843) 726-5763

South Carolina Office of Ocean and Coastal Resource Management

OCRM Office	Address	Telephone
Beaufort	703 Bladen St. Beaufort, SC 29902	(843) 524-6885
Charleston	1362 McMillan Ave., Suite 400 Charleston, SC 29405	(843) 747-4323
Myrtle Beach	1705 North Oak St., Suite 6 Myrtle Beach, SC 29577	(843) 626-7217

Home A Syst National Office
Farm-A-Syst/ Home-A-Syst
303 Hiram Smith Hall
1545 Observatory Drive
Madison, WI 53706
(608) 262-0024
homeasys@uwex.edu

Soil and Water Testing
County Extension Offices, or
Agricultural Service Laboratory
171 Cherry Road
Clemson, SC 29634
(864) 656-2069
Fax: (864) 656-2069

South Carolina Water Quality Regulations
S.C. Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
(803) 898-4300

South Carolina Health Regulations
For information on sanitation and well separation distances, contact your county health department.

Oil and Chemical Spills or Fish Kills
Toll-free 24-hour number for reporting chemical spills, oil spills or fish kills.
(888) 481-0125

Ingestion or Human Contact with Toxic Materials
Palmetto Poison Control
College of Pharmacy
University of South Carolina
Columbia, SC
(800) 922-1117 or (803) 765-7359

United States Geological Survey
720 Gracern Road
Stephenson Center, Suite 129
Columbia, SC 29210
(803) 750-6100

Pesticide Information
Clemson University
Pesticide Information Program
Department of Entomology
114 Long Hall
Clemson, SC 29634-0365
(864) 656-3113

Master Gardener Program
The South Carolina Master Gardener Program is a volunteer training program administered by the Clemson University Cooperative Extension Service. Introduced in Charleston County in 1981, the Master Gardener program is now offered in 25 counties

The Master Gardener program is divided into two parts: instruction and service. In the first part, participants receive at least 40 hours of intensive, practical horticultural training. A few of the following topics are covered in the program:

- Soils and Plant Nutrition
- Basic Plant Pathology, Physiology and Entomology
- Vegetable Gardening
- Tree and Small Fruit Culture
- Culture of Woody Ornamentals
- Lawn Mangement
- Basic Landscape Design

After successfully completing the classroom portion, which involves regular attendance and passing a final exam, participants receive the title of "Master Gardener." The Master Gardener graduates then volunteer at least 40 hours of service in the Clemson Extension office or in the community. Volunteer activities are coordinated through the local county Extension office.

Master Gardeners share their knowledge and skills in a number of ways: answering horticulture calls at the Extension office; speaking to garden and civic clubs; working with youth or senior groups; and assissting communities with beautification projects.

Many Master Gardeners far exceed the expected 40 hours of service. Many continue in the program beyond the first year, motivated by their

willingness to help others and personal satisfaction derived from participating in this community service program.

If you have the desire, commitment and time to learn and want to put your knowledge and skills to work through volunteer service, then apply for admission to the Master Gardener program. Contact your county Clemson Extension agent to see if a program is offered in your county. For those with internet access, log onto the S.C. Master Gardener website at http://agweb.clemson.edu/Hort/SCMG/MGBrochW.htm to see which counties have active Master Gardener programs.

Notes

Notes

Clemson University Cooperating with U.S. Department of Agriculture, South Carolina Counties, Extension Service, Clemson, South Carolina.
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Public Service Activities