

# *Delaware Coast ~ A ~ Syst*



An Environmental  
Risk-Assessment  
Guide for Protecting  
Coastal Water Quality

## Purpose of Delaware Coast-A-Syst

Coast-A-Syst, the Coastal Homestead Assessment System, is a program that helps you protect the quality of surface and groundwater near your home and throughout your community.

Common practices in every home—large and 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. Simple changes in your household routine can reduce pollution and protect the health of your family and the environment. Delaware Coast-A-Syst was adapted from South Carolina Coast-A-Syst and materials produced by the national Farm-A-Syst/Home-A-Syst program.

## About this Document

Delaware 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 will help you accomplish three important objectives:

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

## For More Information

For more information about this Document  
or the Delaware Coast-A-Syst please contact:

Delaware Coastal Programs  
Division of Soil and Water Conservation  
Department of Natural Resources & Environmental Control  
89 Kings Highway  
Dover, DE 19901  
302/739-3451

# Environmental Stewardship for Homeowners

Delaware  
Coast  
-a-  
syst

***Edited and Prepared by:***

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Dover, Delaware

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Many were consulted during the development of this document including:

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Delaware Department of Natural Resources and Environmental Control

- Division of Soil and Water Conservation
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- Office of the Secretary

Delaware SeaGrant

University of Delaware Cooperative Extension

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# Introduction

## What Is Delaware 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. Delaware 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 Coast-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 Delaware'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 Delaware 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.

## 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 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.

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.



## CHAPTER 1

# Site Assessment: Protecting Coastal Water Quality Around Your Home

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, river, 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.

### ***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.

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.

Remember—this assessment is a starting point. It is meant to encourage you to complete some, or all, of the other 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.

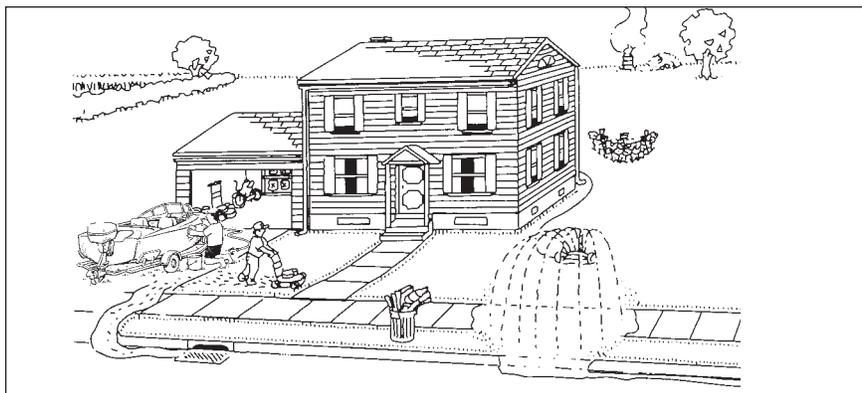


Figure 1.1. Activities in the watershed affect coastal water quality

## ***Why is the environmental health of the coast so important in Delaware?***

With a shoreline of approximately 260 miles, Delaware is obviously a marine-oriented state. In fact, no part of the state is more than 8 miles from tidal waters. Delaware's coast has played an important role in the history, culture, and economy of the state. Today, Delaware's coastal resources also provide jobs and recreation for residents and visitors as well as critical habitat for wildlife species.

Delaware's Atlantic coastline consists of a series of barrier beaches and dunes from Cape Henlopen to Fenwick Island, open only by one large inlet at the Indian River Bay. Several coastal towns, which become small cities during the summer, dot the shoreline. More than 5 million people visit this area each year and spend millions of dollars during their visits. The developmental pressure in this region is intense, putting additional stress on the coastal environment with second homes, shopping outlet malls, and all the necessary supporting infrastructure.

The Delaware Bay and Inland Bays have all the qualities of a mid-Atlantic estuary—strong riverine influences near its headwaters and strong oceanic influences where it meets the Atlantic. Development pressures are not as intense, but are growing. From Lewes to Smyrna and Woodland Beach, large marsh areas dominate the region, with associated narrow beaches and scattered summer home colonies. Large migratory populations of shorebirds in the spring and waterfowl in the fall populate Delaware Bay. Watermen harvest blue crabs, oysters, and fish in these coastal waters throughout most of the year. Recently, the National Audubon Society and the American Bird Conservancy designated Delaware's coastal zone an Important Bird Area because it has some extraordinarily valuable bird habitats that deserve protection.

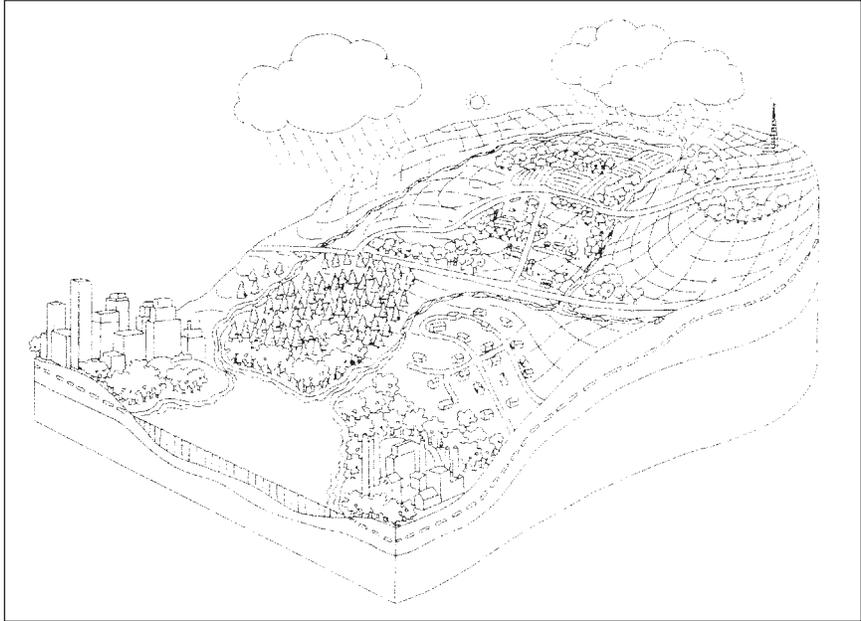
Delaware's many natural and coastal resources are crucial to the state's aesthetic and economic well-being.

- Nearly 25 miles of sandy beaches border the Atlantic Ocean, and 12 miles of those are in the state parks.
- At least 33 species of waterfowl, 19 species of raptors, 160 species of songbirds, and 45 species of mammals inhabit the state; Delaware's waters are home to at least 284 species of freshwater and saltwater fish.
- Estuarine and coastal wetlands provide habitat for marine and terrestrial life, trap sediment, filter pollutants, recharge groundwater, and prevent erosion.
- Delaware Bay provides habitat for the world's largest population of spawning horseshoe crabs.
- Other natural resources include sand and gravel deposits, natural gas deposits that have the potential to serve as natural gas supplies, and resources with the potential to generate low-temperature geothermic energy.
- Ports along the Delaware River and its tributaries handle about 117.7 million tons of imports and 75.4 million tons of exports each year. The Delaware Bay handles about 85 percent of the east coast's oil imports and serves six major refineries.

These facts point out the primary social, cultural, economic, and environmental importance of Delaware'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.



*Figure 1.2. Activities in the watershed affect water quality*

A watershed is like a bathtub. The watershed outlet—the mouth of a pond, lake, reservoir or river—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).

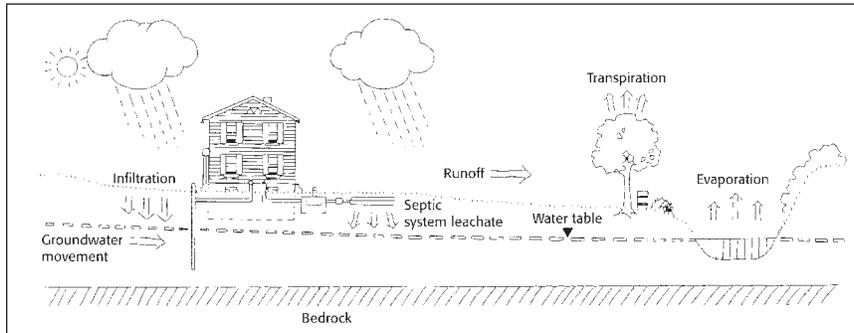


Figure 1.3. In the hydrologic cycle, water falls to earth as rainfall or snow. Water returns to the atmosphere through evaporation from wet surfaces and from plant leaves.

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 threats to water quality, however; wildlife that congregates along lakeshores, such as geese and other waterfowl, can contribute to water quality problems. To protect your water, all of these factors need to be considered.

## Part 1.1—Physical Characteristics of Your Homesite

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 can change. Assessment 1.1 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, or contact your local Soil and Water Conservation District office or Cooperative Extension agent to learn more about your soil.

### ***How does soil type affect groundwater?***

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.

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 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.

### ***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 three feet deep present the highest risks for groundwater contamination.

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 to reach bedrock?**

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. 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 1.4). 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.

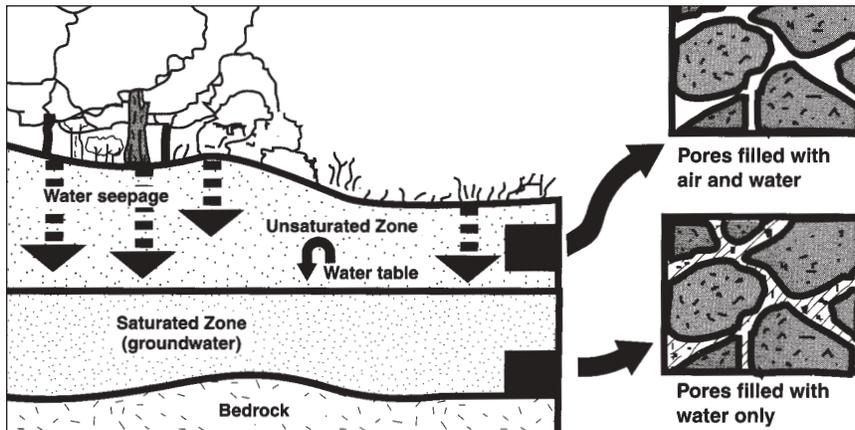


Figure 1.4. The water table is the boundary between saturated and unsaturated soil.

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 ten 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.

## 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 (mid-size particles)	Clay (very tiny particles)	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Soil type and risks to ground-water from infiltration	Clay (very tiny particles)	Silt/loam (mid-size particles)	Sand/gravel (large particles)	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Soil depth	Deep (over 12 feet)	Moderately deep (3-12 feet)	Shallow (less than 3 feet)	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Bedrock	Solid, not permeable or fractured	Solid limestone or sandstone	Fractured bedrock—any kind	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Depth to water table	Over 20 feet	10-20 feet	Less than 10 feet	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Nearness to surface water	Over 100 feet	25-100 feet	Less than 25 feet	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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 Coast-A-Syst chapters.

## 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 Coast-A-Syst chapters. If you involve children as you make your map and conduct the assessment, you will 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. The

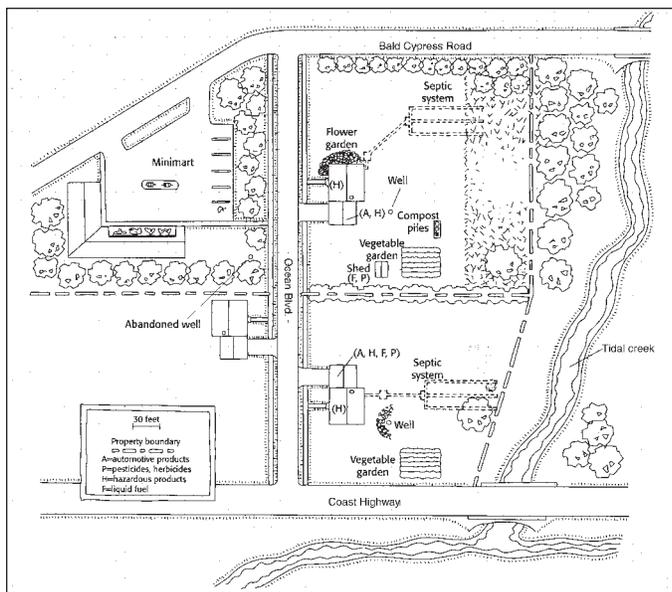


Figure 1.5. An example of a homesite map

### 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 safety of your groundwater. These issues will be discussed in-depth in subsequent chapters.

### 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 the following:

- 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

## Coastal Natural Hazards

While you are taking the time to inspect your property, consider also looking over your home's structure. In coastal Delaware, 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 damages 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, available from your local building official.

For more information about strengthening your home, contact the Institute for Business and Home Safety at <[www.ibhs.org](http://www.ibhs.org)> or 175 Federal Street, Suite 500, Boston, MA 02110-2222, phone: (617) 292-2003.

- 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

### ***Instructions for your homesite map***

Homesite features you should include in your map are:

- Property boundaries
- House and garage
- Outbuildings, sheds
- Septic system and drainfield
- Nearest surface water (wetlands, tidal creeks)
- Water 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. Make up your own code letters or symbols as needed. Examples are:

- F = Fuel tanks for gasoline or heating oil
- A = Automotive products such as motor oil, gasoline, and antifreeze
- P = Pesticides (herbicides, insecticides, fungicides)
- H = Hazardous products like solvents, acids, paints, and 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 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 environ-

ment, 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 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 Coast-A-Syst, or for information about laws and regulations specific to your community, contact your local agency.

## For More Information

### ***Conservation Districts***

New Castle County Conservation District  
2430 Old County Road  
Newark, DE 19702  
(302) 832-3100

Kent County Conservation District  
800 Bay Road  
Dover, DE 19902  
(302) 697-2600

Sussex County Conservation District  
408 North DuPont Highway  
Georgetown, DE 19947  
(302) 856-3990

### ***Cooperative Extension***

New Castle County Cooperative Extension  
910 S. Chapel Street  
Newark, DE 19716  
(302) 831-COOP

Kent County Cooperative Extension  
69 Transportation Circle  
Dover, DE 19901  
(302) 730-4000

Sussex County Cooperative Extension  
Research and Education Center  
16684 County Seat Highway  
Georgetown, DE 19947  
(302) 856-7303

University of Delaware Cooperative Extension  
<http://ag.udel.edu/extension/index.html>

*This material was adapted for Delaware Coast-A-Syst from the Site Assessment chapter of the South Carolina Coast-A-Syst. The 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, SC Sea Grant Extension Program.*

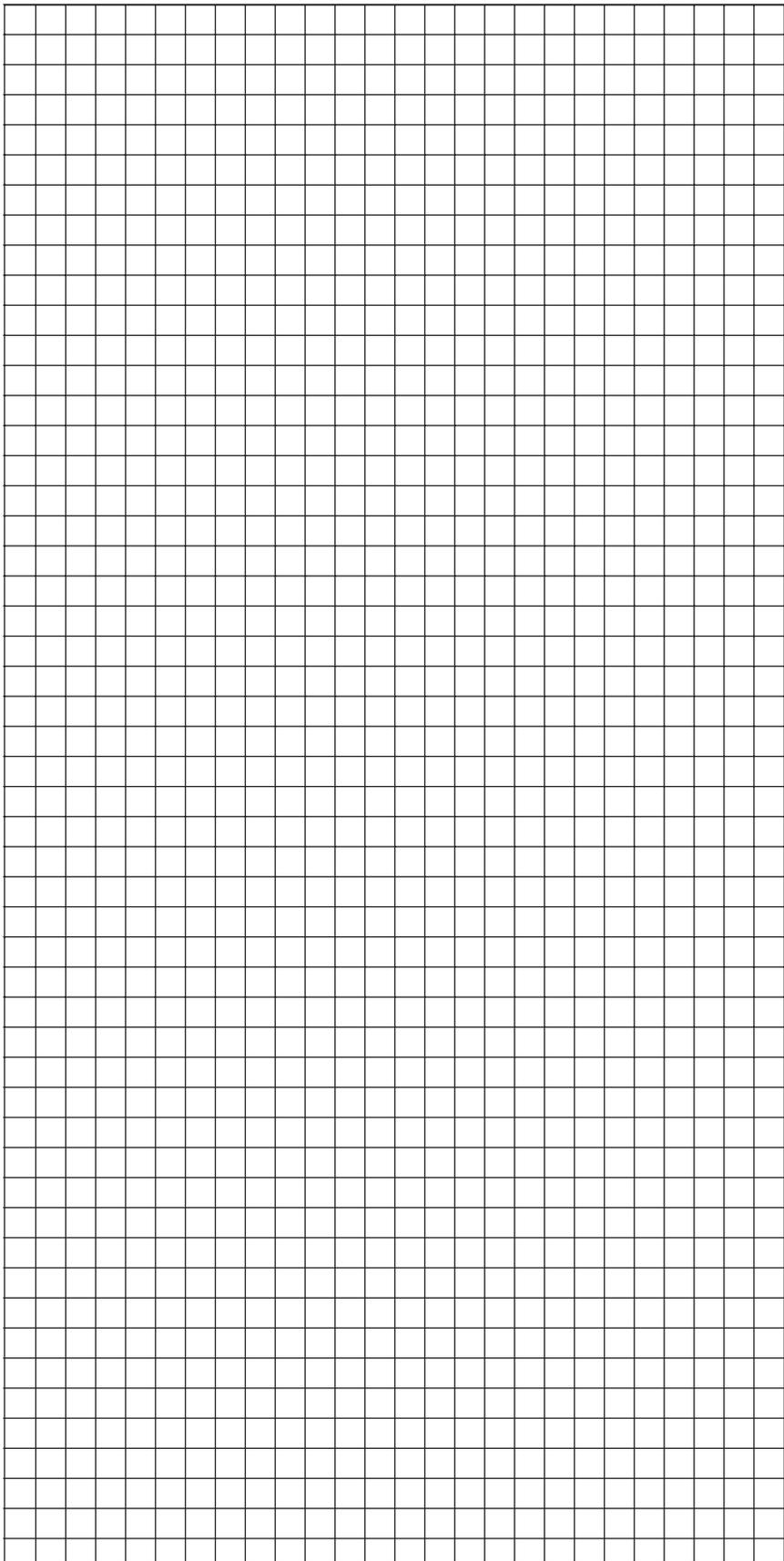


Figure 1.6. Blank graph paper for your homesite map



## CHAPTER 2

# The Clear Choice: Managing Stormwater On Your Property

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

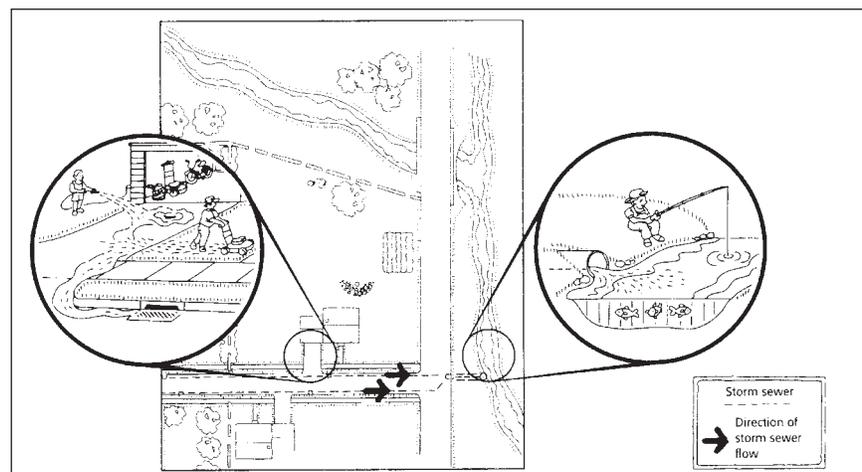
1. Reducing Pollutants in Runoff. Pollutants can include pesticides and chemicals, automotive wastes, grass clippings and yard waste, and pet and animal wastes.
2. Landscaping and Site Management to Control Runoff. Some ways to help control runoff are preventing soil erosion, landscaping, providing proper 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 “down-stream.” 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).



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

The bottom line is that polluted stormwater degrades Delaware's coastal environment. Sediment clouds water and smothers habitat 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.

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.

Table 2.1 Common Sources of Stormwater Pollutants

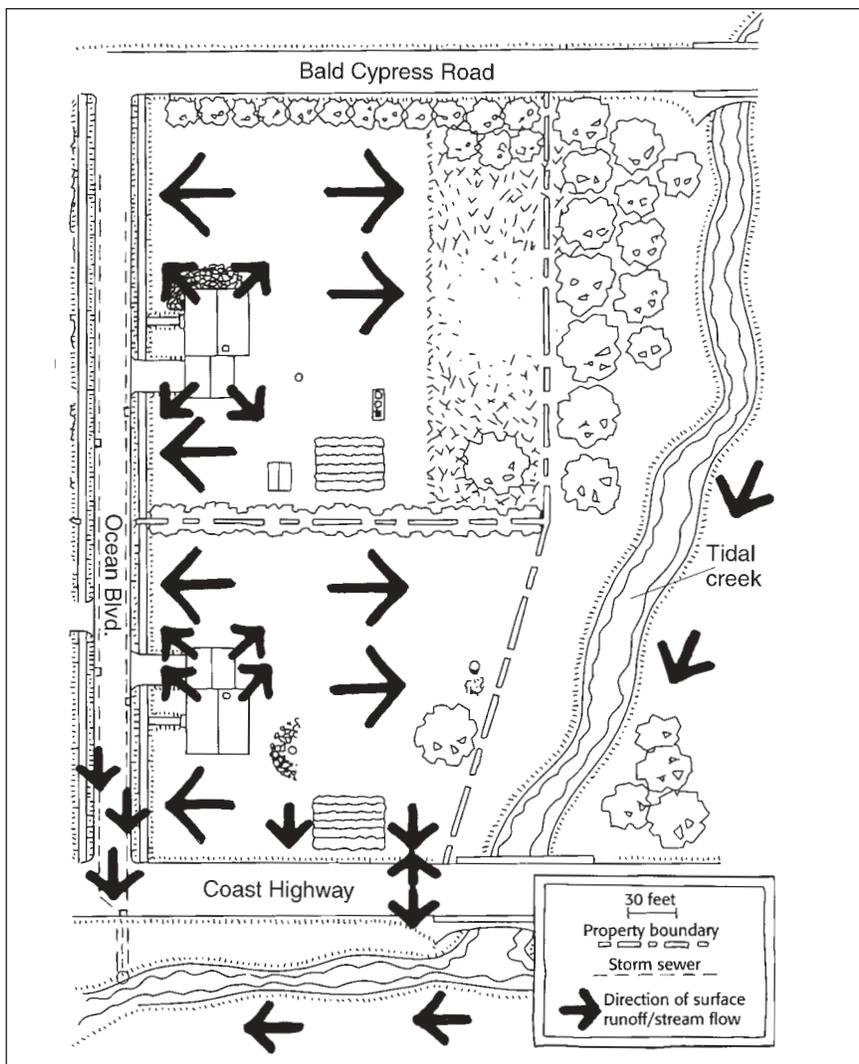
POLLUTANT	COMMON SOURCES	REASON FOR CONCERN
Sediment	Construction sites; bare spots in lawns and gardens; wastewater from washing cars and boats on driveways or parking lots; unprotected and eroding stream banks	Loss or destruction of habitat for fish and plants. Potential navigation hindrances.
Pathogens	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.
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.
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.

## 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, go outside with 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)



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 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 twenty-four hours. 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

### ***Don't Dump! Flows To River***

*This important message is being stenciled onto nearby storm drains. 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.*

## Coastal Natural Hazards

Delaware's most prevalent natural hazards are Nor'easters, hurricanes and inland flooding. Severe flooding not only affects water quality, it can also substantially damage your home and its contents.

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. 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%.

the growth of algae and aquatic plants if they enter streams and lakes. More importantly, animal droppings are also a source of disease organisms. (dog waste, for example, can contain Salmonella, and Giardia; pathogens that will 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 they are doing when they squat over—carry a bag and PICK IT UP!

No solution is perfect, but here are three choices:

1. Flush it down the toilet—The water from your toilet goes to either a sewage treatment plant or a septic system that remove 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 body. 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.

### ***Are yard and garden wastes kept out of storm water?***

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 many homes. 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.

## Assessment 2.1-Reducing Pollutants in Runoff

Use Assessment Table 2.1 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Storage of harmful chemicals	Chemicals are stored in water-proof containers in a garage, shed, or other area that is protected from stormwater.	Chemicals are stored in water-proof containers but within reach of stormwater.	Chemicals are stored in non-waterproof containers outdoors or within reach of stormwater.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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 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?**

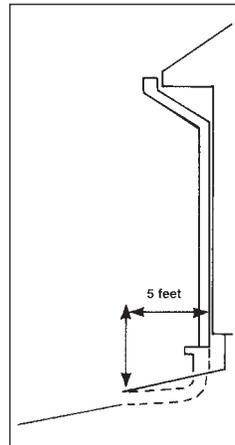
Areas of bare soil often exist in vegetable and flower gardens, on newly seeded lawns, and around construction projects. Even on the shallow sloping coastal plain, water from can remove large amounts of soil and carry it to estuarine wetlands, rivers, and lakes. Planting grass or other ground cover, such a vegetated buffer, is the best 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, Master Gardeners, Natural Resources Conservation Service, or soil and water conservation district offices.

### **The need for riparian buffers in Delaware**

Rapid population growth and suburban sprawl in Delaware 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 buffers of vegetation along tidal creeks and rivers can provide numerous benefits for overall watershed and stream health, while also protecting water quality.

A riparian buffer is simply the land next to a river, tidal creek, or estuary. In its natural state, the land 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.

Benefits of a vegetated buffer:

- 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.

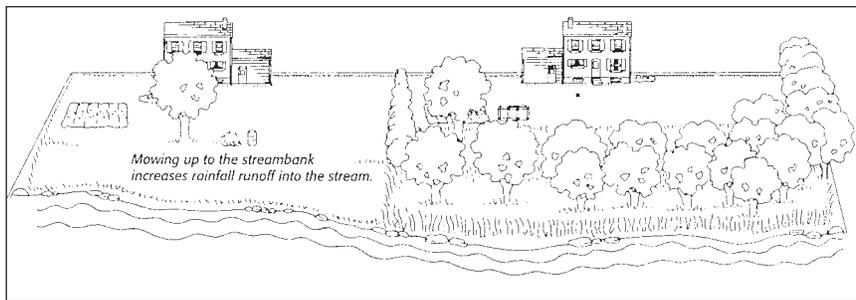


Figure 2.4 To help prevent erosion, leave a buffer strip of thick vegetation along coastal creeks, rivers, and estuaries

## 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Landscaping and bufferstrips	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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

### Responding to risks

Your goal is to lower your risks associated with stormwater leaving your property. In the action checklist 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. 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.

### Harmful Algal Blooms

*Algae are microscopic, single-celled 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 species 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.*

*In recent years, 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 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.

You should take precautions around water bodies if you see large numbers of dying or dead fish. Remember, most fish kills are caused by factors other than toxic algae. In the unlikely event that you see large numbers of dead or dying fish, avoid direct water contact and notify the Department of Natural Resources and Environmental Control at (302) 739-5072.

For information about HABs in Delaware, contact the Department of Natural Resources and Environmental Control.

## Stormwater Management

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action.
<i>Sample:</i> Pet wastes left in areas where runoff occurs.	Bury wastes away from gardens, wells, ditches, or areas where children play.	One week from today: April 8
<i>Sample:</i> No vegetated buffer along the creek bank on my property.	Establish buffer of native vegetation by Spring.	Next week: April 3

### **Who to contact for more information about stormwater**

Contact your local Cooperative Extension office and the affiliated Master Gardener groups for information on landscape management. The Division of Soil and Water Conservation in the Department of Natural Resources and Environmental Control office can provide information on nonpoint source pollution and regulations regarding stormwater management regulations for construction projects.

### **Department of Natural Resources and Environmental Control**

Division of Soil and Water Conservation  
89 Kings Highway  
Dover, DE 19901

Sediment and Stormwater Program  
(302) 739-4411

Nonpoint Source Program  
(302) 739-8014

Delaware Coastal Programs  
(302) 739-3451

### **Conservation Districts**

New Castle County Conservation District  
2430 Old County Road  
Newark, DE 19702  
(302) 832-3100

Kent County Conservation District  
800 Bay Road  
Dover, DE 19902  
(302) 697-2600

Sussex County Conservation District  
408 North DuPont Highway  
Georgetown, DE 19947  
(302) 856-3990

## **Cooperative Extension**

New Castle County Cooperative Extension  
910 S. Chapel Street  
Newark, DE 19716  
(302) 831-COOP

Kent County Cooperative Extension  
69 Transportation Circle  
Dover, DE 19901  
(302) 730-4000

Sussex County Cooperative Extension  
Research and Education Center  
16684 County Seat Highway  
Georgetown, DE 19947  
(302) 856-7303

University of Delaware Cooperative Extension  
<http://ag.udel.edu/extension/index.html>

*This material was adapted for Delaware Coast-A-Syst from the Stormwater chapter of the South Carolina Coast-A-Syst. This chapter was originally written by Carl DuPoldt, Environmental Engineer, Natural Resources Conservation Service, Somerset, New Jersey and Carolyn Johnson, Water Quality Education Specialist, University of Wisconsin Cooperative Extension, Milwaukee. Material was adapted for South Carolina Coast-A-Syst by Barbara Speziale, Clemson University Cooperative Extension, Cal Sawyer, SC Sea Grant Extension Program and Colton Bowles, South Carolina Department of Health and Environmental Control. Coastal Hazards information was supplied by Beth Judge, SC Sea Grant Extension Program and buffer information was supplied by Ward Reynolds, SC Office of Ocean and Coastal Resource Management*



## CHAPTER 3

# Well Water: Keeping It Clean

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. The following topics are covered:

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.

## 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 below will help you answer questions in the table.

### 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.

### 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."

## 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 choic-

	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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Soil type	Soil is fine-textured like clay loams or silty clay	Soil is medium-textured like silt or loam.	Soil is coarse-textured like sand, sandy loam, or gravel.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

es 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.

### ***Responding to risks***

Your goal is to lower your risks. Turn to the action checklist 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 3.2, fill out the assessment table to determine risks related to your well's design or condition.

### ***Before you begin construction***

The Delaware Regulations Governing the Construction and Use of Wells was revised effective April 1, 1997. It contains criteria for obtaining a well permit and constructing wells. All wells in Delaware must be constructed by a well driller or well driver licensed with the Delaware Department of Natural Resources and Environmental Control. For more information on well construction in Delaware, contact the Water Supply Section, Division of Water Resources, Department of Natural Resources and Environmental Control at (302) 739-4793.

### ***How old is your well?***

Well age is an important factor in predicting the likelihood of contamination. Wells constructed more than fifty 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 thirty to forty 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.

### ***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 3.5). 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. 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 visually 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 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.

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 should 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. Exact distances the casing should extend above the ground surface can be found in State Regulations.

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 mg Chlorine/L, should remain in the well for a minimum of 4 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.

### ***How long since your well was inspected?***

Well equipment doesn't last forever. Every ten to fifteen 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.

## 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 20-50 years old.	Well is more than 50 years old.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Well type	Drilled well.	Driven-point (sand-point) well.	Dug well.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Casing depth	Casing extends 50 or more feet below the land surface.	Casing extends 20-50 feet below the land surface.	Casing extends less than 20 feet below the land surface.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Well inspection	Well was inspected within the last 10 years.	Well was inspected 10-20 years ago.	Well was inspected over 20 years ago or don't know when well was last inspected.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

### Responding to risks

Your goal is to lower your risks. Turn to the action checklist on 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.

Some of the naturally occurring contaminants in water are listed in Figure 3.5.

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 Manganese	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

CONTAMINANT	DESCRIPTION	RECOMMENDED LIMITS
Nitrates& 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 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.

The way in which you take the water sample, and the container that you use may affect the accuracy of the analysis (Figures 3.6).

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.

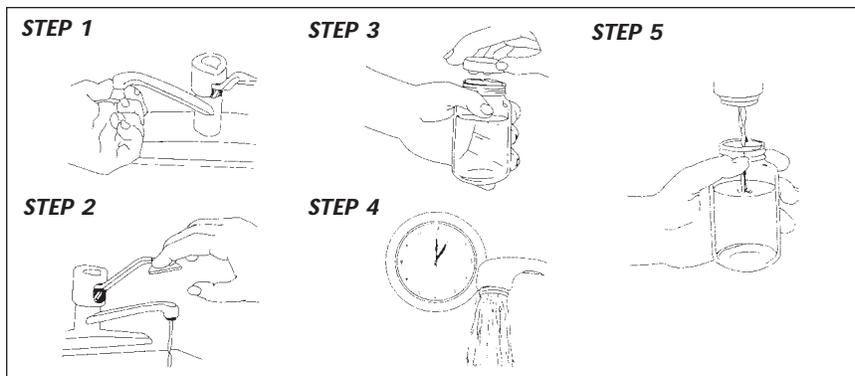


Figure 3.6. General procedure for collecting water samples for mineral analysis.  
**STEP 1:** Remove the aerator from an indoor, leak-free cold water faucet. If testing for bacteria, flame the end of the faucet with a lighter. (Note: Flaming may discolor chrome or gold-finished faucets.)  
**STEP 2:** 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 laboratory 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

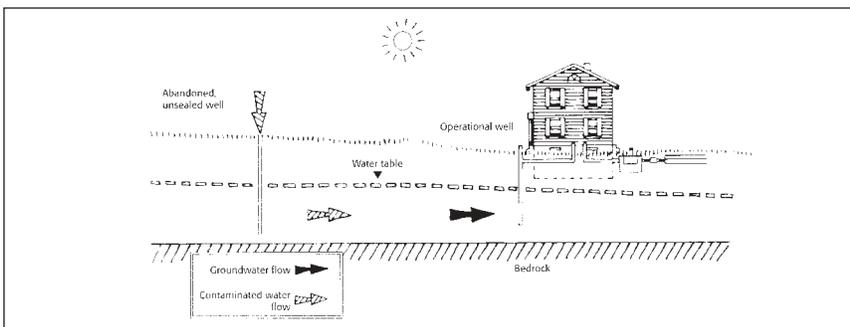
### ***What contaminants should you look for?***

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<sub>3</sub>-N) or 45 mg/L of nitrate (NO<sub>3</sub>). 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 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 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.

### ***Are there any unused and abandoned wells on your property?***

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.

## 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

### Responding to risks

Your goal is to lower your risks. Turn to the action checklist on page ## to record the medium- and high- risk practices you identified. Use the information above 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. For each risk, write down the improvements that you plan to make. Use recommendations from this chapter and from resources elsewhere. 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

### ***Well construction and maintenance***

Delaware Department of Natural Resources and Environmental Control  
Division of Water Resources  
Water Supply Section  
89 Kings Highway  
Dover, DE 19901  
(302) 739-4793

*Private Water Systems Handbook*, MWPS-14. A 72-page publication available from the Northeast Regional Agricultural Engineering Service (NRAES). See page 116 for ordering information.

### ***Water Quality***

US EPA publications:

*Lead in Your Drinking Water*, EPA810-F-93-001

US EPA Office of Ground Water and Drinking Water  
<http://www.epa.gov/ogwdw>

### ***Well Water/Drinking Water Testing***

Testing kits can be obtained from the Delaware Division of Public Health's Office of Drinking Water.

New Castle County

Office of Environmental Health  
2055 Limestone Rd, Suite 300  
Wilmington, DE  
(302) 995-8650

Appoquinimink State Service Center  
214 N. Broad Street  
Middletown, DE  
(302) 378-5200

Kent County

James W. Williams State Service Center  
805 River Rd  
Dover, DE  
(302) 739-5305

Delaware Public Health Laboratory  
30 Sunnyside Road  
Smyrna, DE 19977  
(302) 653-2870

Sussex County

Georgetown State Service Center  
546 S. Bedford St  
Georgetown, DE  
(302) 856-5496

### ***Groundwater, soil type, and geology***

Contact your state or U.S. Geological Survey.

## ***Drinking water quality standards***

Call the U.S. Environmental Protection Agency'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 material was adapted for Delaware Coast-A-Syst from the Drinking Water chapter of the South Carolina Coast-A-Syst. 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, SC Sea Grant Extension Program.*



## CHAPTER 4

# Household Wastewater: Managing Your Home Septic System

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. And yet 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 Natural Resources and Environmental Control, has regulatory authority governing the permitting, construction, and use of septic systems in Delaware. Local laws, however, may impose more stringent or additional requirements. Contact the Division of Water Resources, Department of Natural Resources and Environmental Control a for advice or assistance.

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 both environmental, human health, and economic reasons. In addition to degrading natural resources, a failed system can cost thousands of dollars to replace.

### 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 water-tight septic tank buried in the ground and a drainfield that can 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.

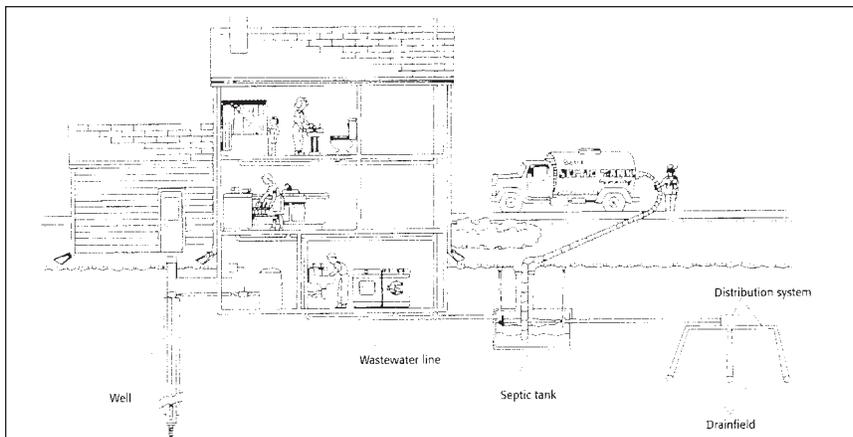


Figure 4.1. Household wastewater carries dirt, soap, food, grease, and bodily wastes “down the drain” and out of your house to an on-site septic or municipal wastewater treatment system

### **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. Fiberglass and polyethylene tanks are also used. The tank must be water-tight 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 to 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 func-

tioning, 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.

### **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 4.2). 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.

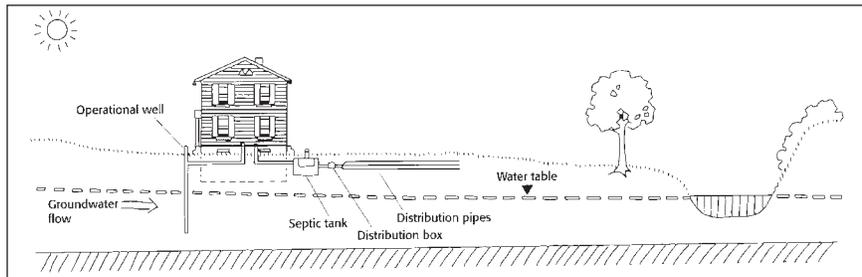


Figure 4.2. Cross-section of a septic system showing tank and distribution arrangement.

### **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 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.

## 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.

Delaware state law requires a comprehensive soil and site evaluation to determine the suitability of the soils and the topography of the lot. A Permit to Construct must be obtained from Department of Natural Resources and Environmental Control 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?
- 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?
- 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 State of Delaware Regulations 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 conduct a thorough evaluation of the property and determine its capacity to support a 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.

***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 \$1,000-10,000 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, over 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.

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 Delaware communities.

For more information about long-term and short-term erosion in your area, contact the Shoreline and Waterway Section, Division of Soil and Water Conservation, Department of Natural Resources and Environmental Control at (302) 739-4411.

## 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 permit application packet from Department of Natural Resources and Environmental Control and ask about any other required permits (such as local planning and zoning office) 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 and existing house, driveway, pool, other buildings, septic system, and well. Include distances from proposed buildings to road and property lines.
- 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.

## 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 2 days' worth of wastewater. (Two days is long enough to allow solids to settle out by gravity.)

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 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.

## Assessment 4.1—Septic System Planning

Use Assessment Table 4.1 below 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Installation	I had a licensed septic system contractor install my system.	I had an unlicensed person install my system.	I installed my septic system.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Separation distance	Drainfield is located further 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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. 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 more. 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.

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. 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 you're the Department of Natural Resources and Environmental Control or a licensed septic tank contractor whenever you experience problems with your system, or if there are any signs of system failure.
- 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 re-suspend 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 the Department of Natural Resources and Environmental Control 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 (refer back to the section on the septic tank). 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.

## **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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
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 cars park over it or 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, or you allow water to pond over it, or you allow trees and shrubs to grow over or near it.)	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

	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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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 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.

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action.
<i>Sample:</i> I've never had my inspection 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

Delaware Department of Natural Resources and Environmental Control  
 Division of Water Resources  
 89 Kings Highway  
 Dover, DE 19901  
 (302) 739-4762

### **Publications**

*Simply Septics Brochure.* Delaware Department of Natural Resources and Environmental Control (302)739-4762

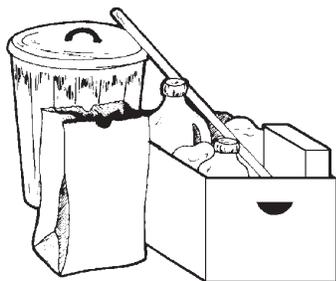
[http://www.dnrec.state.de.us/water2000/sections/watershed/ws/2004\\_03\\_simply\\_septics\\_files/frame.htm](http://www.dnrec.state.de.us/water2000/sections/watershed/ws/2004_03_simply_septics_files/frame.htm)

*A Homeowner's Guide to Septic Systems.* United States Environmental Protection Agency

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## CHAPTER 5

# Understand the Risks: Managing Hazardous Household Products



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).



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

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?

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.

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 box below 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:

- the type of chemicals in the product
- how much of the chemical you are exposed to
- 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.

**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 That Could Be Hazardous If Improperly Managed**

#### **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

## ***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 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, stream, or any other body of water
  - Washing chemicals off the driveway with a hose
  - Pouring pesticides or non-water-soluble 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 are provided at the conclusion of this chapter

## **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 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 could be hazardous. Health problems can be avoided 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 and or environmental 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.



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

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 the Solid and Hazardous Waste Management Branch at (302) 739-3689.

### **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 sidebar. For

### **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.*

### **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 Poison Information Center (Wilmington) phone number is 1-800-722-7112. Keep this number close to your phone.*

#### **Accidental Spills—**

*For information about spills of hazardous products, contact the Delaware Department of Natural Resources and Environmental Control at 1-880-662-8802 or the National Response Center at 1-800-424-8802.*

#### **Harmful Exposure—**

*To report products that have caused you harm, contact the U.S. Consumer Products Safety Commission at 1-800-638-2772.*

### 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.

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 the “Recipes for a Healthy House” on page (??). If you choose to make your own household products, be sure to consider these precautions:

- 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 the container with the contents and date. Never store homemade products in old containers from commercial products.

### 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.

## 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

### Responding to risks

Your goal is to lower your health risks and reduce potential harm to the environment. Turn to the action checklist 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.

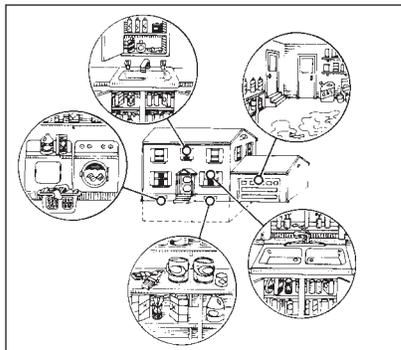


Figure 5.3 Hazardous products may be stored throughout a household.

### 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.

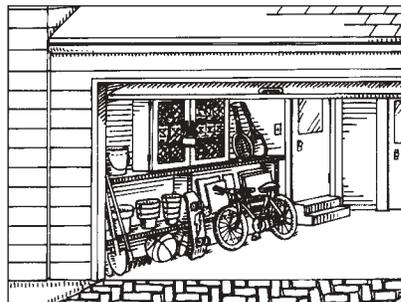


Figure 5.4 Hazardous products should be stored in a locked cabinet or other location inaccessible to children and above potential flood levels.

## 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 1-800-358-9616. 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.

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?

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 other hazardous products to prevent dangerous chemical reactions. Reactions occur when corrosives leak from their containers and drip or flow to 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.

## Assessment 5.2—Safe Storage

Use Assessment 5.2 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).	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

### **Responding to risks**

Your goal is to lower your health risks and reduce potential harm to the environment. Turn to the Action Checklist 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 Delaware, hazardous wastes from individual households are not yet regulated by law; however, specific wastes are encouraged not to be disposed of in your a municipal solid waste landfill. These items 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 the Delaware Solid Waste Authority's (DSWA), Household Hazardous Waste Collection sites or recycled at Recycle Delaware Igloo locations.. Contact the DSWA's Citizens Response Line at 1-800-404-7080 for more information regarding this program.

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 may be able to use small quantities of paint or cleaning products.

Part 5.3 provides tips for disposal of certain hazardous product categories. The disposal guides listed under For More Information 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.



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. Other household hazardous waste may be taken to the DSWA's Household Hazardous Waste Collection Day.

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

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. The DSWA which collects 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. 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 U.S. Environmental Protection Agency (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.

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.

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.

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

### 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 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 community 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!)	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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!)	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Antifreeze; waste motor oil	I recycle antifreeze and used 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 used oil always in the same place, near a well or waterway. (NOTE: This is illegal!)	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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!)	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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. I dump all my leftovers directly into a waterway. (NOTE: This is illegal!)	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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 non-chemical options.	I do not handle pesticides as directed on the label.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

### **Responding to risks**

Your goal is to lower your risks. Turn to the Action Checklist below 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. 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.
<i>Sample:</i> Cabinet with antifreeze and paint stripper is not child-proof.	Buy a lock and install it on cabinet.	One week from today: November 28
<i>Sample:</i> 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

## For More Information

### **Hazardous Household Products**

If you are not sure whether a particular household waste is hazardous or if you need other information, contact the Solid and Hazardous Waste Management Branch at (302) 739-3689.

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:

Solid and Hazardous Waste Management Branch  
89 Kings Highway  
Dover, Delaware 19901

Or the:  
Delaware Solid Waste Authority (DSWA)  
Citizen's Response Line at 1-800-404-7080

### **Pesticides**

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, that 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 or contact the Delaware Department of Agriculture, Pesticide Management Program at (302) 698-4500.

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 contact WEF, Public Information Department, 601 Wythe Street, Alexandria, VA 22314-1994; phone (800) 666-0206 or (703) 684-2452.

### **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			
Used 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)			
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			

CATEGORY/ PRODUCT	Is it properly stored?	Is information about proper disposal needed?	Are there special precautions to keep in mind?
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			
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 this inventory, you are more familiar with hazardous products 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?

*This material was adapted for Delaware Coast-A-Syst from the Household Hazardous Products Chapter of the South Carolina Coast-A-Syst. 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. 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 chart on the potential 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.*



## CHAPTER 6

# Home Landscape Management

Gardening has always been a favorite pastime for homeowners in coastal Delaware. 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.

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

Topics covered include:

- Landscape planning
- Vegetative buffers
- Soil testing
- Fertilizer and pesticide usage
- Lawn type and maintenance
- 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.

### ***What are the environmental concerns?***

Your home landscape, which includes the natural settings of your home and property, might be the last places 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 ten 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!

Problems may occur when individuals, along with commercial development, move into relatively untouched, natural areas and impose traditional landscape management practices. This usually involves the clearing of all natural habitats along both natural and manmade waterways

or lakes. These natural buffers have provided for 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 pesticides. Consider the hard work required returning unsightly, eroded areas back to 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 product. 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 native plant material and the natural features of the site. The process of planning your landscape should be well thought out before the initial clearing begins on your site. Planning early will allow you to save native plant species and work with the natural flow of the area to eliminate potential problem areas.

### 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 natives that can benefit your design. Soil erosion will also become a problem here 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, able to tolerate wet soils if the area is poorly drained, and will mature to a height that you want. 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 our state.

Once plant selection is made according to your master plan, site preparation can be an even more 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 at this point would be a good idea to acquire some important data.

### ***Site preparation***

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 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. Buffers can increase property values, reduce erosion, minimize polluted runoff, expand natural habitat, maintain scenic beauty, and help to clean the air.

### ***What are vegetated riparian buffers?***

The term “riparian” refers to areas of land along a stream, river, marsh or shoreline. The purposes of establishing a riparian buffer are to:

- Reduce erosion and stabilize stream banks
- Encourage infiltration of stormwater runoff
- Control sedimentation
- Reduce the effects of flood and drought
- Provides forest areas to shade streams and encourage desirable aquatic species
- Offers scenic value and recreational opportunity
- Restores and maintains the chemical, physical and biological integrity of water sources
- Minimizes public investment in waterway restoration, stormwater management, and other public water resource endeavors

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.

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 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 vegetated riparian buffers***

For vegetated buffers to provide important protection from environmental pollution, they must be designed properly. Buffers along water bodies are easy to establish and maintain if provided for at the outset of

construction. Native vegetation should be used because they are naturally adapted to withstand local water, climate, soil, and pest conditions. For the creation of new buffer areas, native plants that establish rapidly and are suitable for flood zone conditions should be used. 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. The ability of a buffer to provide multiple benefits is also closely linked with its width - wider buffers will provide more benefits.

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 people travelling on the water.

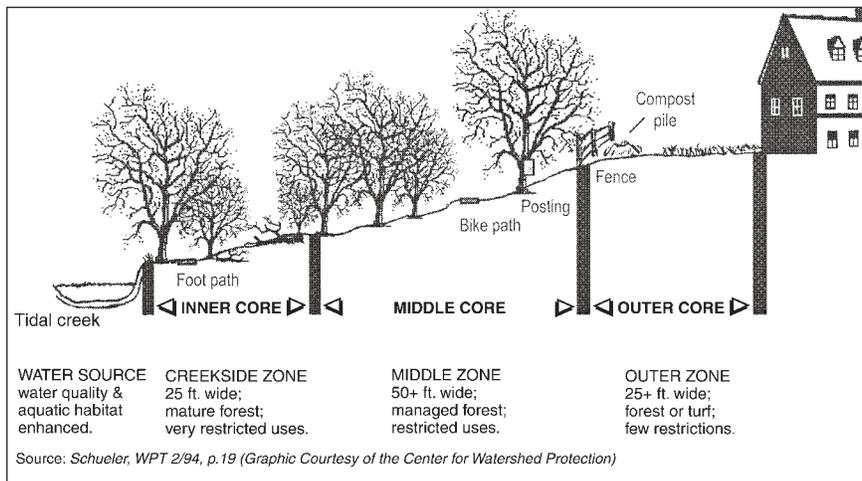


Figure 6.1 Riparian buffer zones

### 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 (area protected 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 choices of plant material will increase. Also be mindful that you should not stray from the overall recommendation to use only native vegetation.

Tips on planning an effective windbreak:

- The optimum solid space or foliage density for a windbreak is about 60%. 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.
- For smaller landscapes, a well-maintained hedge, wider at the base, would serve as an effective windbreak

Windbreaks consist of any type barrier that is designed and placed for the specific purpose of slowing down the speed and redirect 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.

Several examples of windbreak materials may 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.

## 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

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Plant selection	You use only native vegetation in your home landscaping.	You try to use native vegetation where possible, but sometimes an attractive ornamental just looks so good, even though it will require occasional fertilizers and pesticides.	You never plant native vegetation and know that means you must use more water, pesticides, and fertilizers.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Vegetated buffers	You have an uncut vegetated buffer along the water at your home. The buffer is made up of entirely native vegetation.	You have a buffer along the water at your home. Half of the buffer is woody vegetation, but the other half is manicured lawn, which requires high maintenance.	You have no vegetated buffer at your home along the water.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Vegetated buffers	You have a wide, uncut vegetated buffer of greater than 100 feet along the water. You maintain different zones of trees, shrubs, and lawn.	You have a fairly wide buffer of around 50 feet along the water. You do not maintain different zones of vegetation.	You have no vegetated buffer at your home along the water.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

## 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 along Delaware'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 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 panicum. Once these species have been established, others follow as their seeds are carried to the new environment.

For more information about dunes and beach grass, contact the Shoreline and Waterway Section, Division of Soil and Water Conservation, Department of Natural Resources and Environmental Control at (302) 739-4411.

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.

### ***Responding to risks***

Your goal is to lower your risks related to home landscaping practices in the coastal zone. Turn to the action checklist 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 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.

### ***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 twenty-four hours. Be sure to keep children and pets away from treated lawns for at least twenty-four 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 and fishmeal, and other soil amendments also should be applied based on the needs of your lawn.

### ***Maintain the proper soil pH***

Acidity and alkalinity of a soil is expressed as the soil pH. The pH will affect your lawn's and ability to absorb fertilizers and other nutrients in the soil. 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 benefit the both 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. The soil test will also provide information about the fertility levels of your soil.

### ***Apply 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% slow release N. When using fer-

tilizers developed especially for shrubs, such as polycoated, resin coated or 100% slow release, following the manufacture'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 1/4 the application rate for these grasses. For example, if you have a 12 - 4 - 8 fertilizer, apply 2 1/2 pounds per 1,000 sq. ft. to your centipede or carpetgrass lawn. For an established lawn, the following fertilizer ratios, analyses and rates are recommended during the growing season:

FERTILIZER RATIO N-P-K	FERTILIZER ANALYSIS	APPLICATION RATE (lbs/1000 ft <sup>2</sup> )
3-1-2	12-4-8	8
	15-5-10	6
	18-6-12	6
	21-7-14	4
4-1-2	16-4-8	6
	20-5-10	5
1-0-1	15-0-15	6
	18-0-18	5

***Fertilize your lawn with the proper amount of fertilizer at the right time.***

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 procedure:

- 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 slowly available over a long period of time, say several months, which result 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 below.

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

### ***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. 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 insure 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, loss of money and repeated applications of the product that 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, 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.

## BE CAREFUL!!!

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

- 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<sup>2</sup>.

- Calculate how many gallons/acre or /1000ft<sup>2</sup> you sprayed:

$$\frac{1 \text{ gal sprayed}}{\text{acres or } 1000 \text{ ft}^2 \text{ sprayed}} = \text{gal/acre or /1000 ft}^2$$

## 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	You test your soil for pH and nutrients annually. Fertilizer and lime are used only as recommended.	You do not test your soil. Fertilizer and lime are used according to label instructions when it's convenient.	You do not test your soil. Fertilizer and/or lime are used in large amounts with no regard for approaching weather changes.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Selecting fertilizers	You only use slow-release fertilizer on a sloping lawn near a waterbody or storm drain.	You use fast-release fertilizer according to soil test results on a sloping, dense lawn near a waterbody or storm drain.	You use fast-release fertilizer on a thin, sparsely covered lawn near a waterbody or storm drain.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Fertilizer storage	You 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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 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 two 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 the right height is important; lawns cut too short invite weeds to invade. Use the following table 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.

“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.

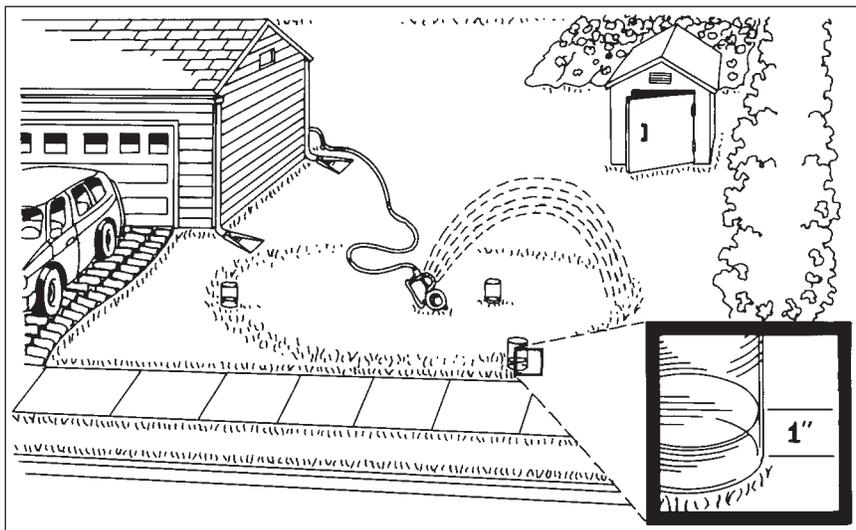
In places with dry climates, there are many plants that are drought-tolerant. Consider using drought-resistant turfgrass species like bermudagrass. Perennial flowers conserve water because their roots grow deeper than annual plants and require little or no watering once established. A shallow mulch (about 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 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 .

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.



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

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 deeply to develop grass with deep extensive root systems. 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 7 days. Therefore, our lawns require about 1 inch of water every 5 to 7 days. This will vary depending on soil type, turfgrass growth and rainfall. Sandier soils will require more frequent irrigation than do heavy soils. Apply one-half inch of water on coarse, sandy soil and one 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 4 hours in one spot. If water runs off the lawn before 1 inch is applied, turn the sprinkler off, let the water soak in for about an hour, and then continue watering. Use footprinting or the screwdriver test to determine when your lawn needs water.

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 exhibit 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 beautiful 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, for instance, 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 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 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 you may encounter in your landscape***

There are many beneficial insects that reside in our landscapes. Some are very obvious and others hidden. You might not think of some as beneficial at all. Following is a small list of "beneficial insects" you can identify around your garden. Find a good identification book with color pictures of both adult and larval form of beneficial insects and protect them when you see them.

- |                        |                       |                        |
|------------------------|-----------------------|------------------------|
| <i>Spiders</i>         | <i>Ground beetles</i> | <i>Bees</i>            |
| <i>Lady Beetles</i>    | <i>Lacewings</i>      | <i>Hover Flies</i>     |
| <i>Predatory mites</i> | <i>Ants</i>           | <i>Predacious Bugs</i> |
| <i>Centipedes</i>      | <i>Wasps</i>          |                        |

## 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Mowing Height	Mow the lawn frequently, removing no more than 1/3 of the height at each mowing.	Mow the lawn once every two weeks.	Mow the lawn when you have the time.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Pesticides	Nonchemical or low-toxicity methods are used to control pests.	Chemicals are used according to label instructions.	Chemicals are used without regard to label instructions or conditions.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
	Pest is identified and its life cycle is understood before choosing control methods. Decide if control is warranted.	A pesticide to control pests is used, according to label instructions, when you see the pests.	A pesticide is used to control pests when you see them. You use a little more than is recommended on the label.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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 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 pest 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 clipping 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 a high-nitrogen source, 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) in 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.

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 50 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. The maximum dimension to allow air to the center of the pile is 5 feet x 5 feet x any length.

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.

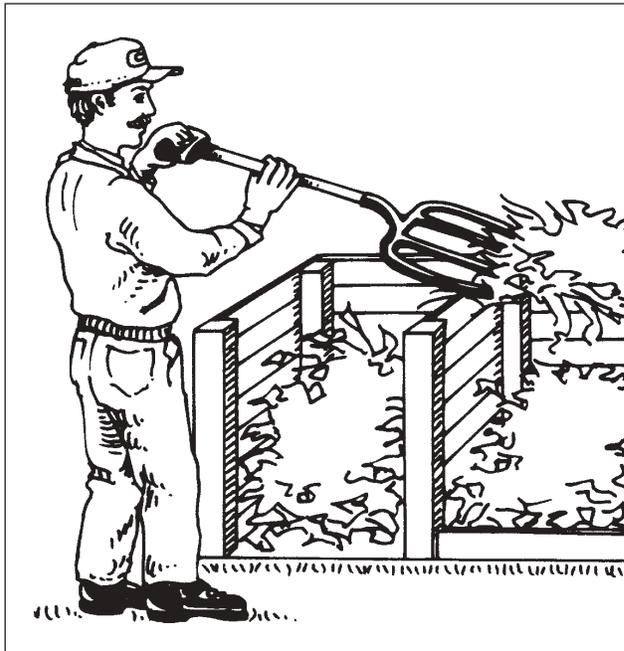


Figure 6.4 compost piles will remain relatively odor-free if they are turned and aerated regularly.

At the second turning (after about another week), the material should be a uniform coffee-brown color and moist. The relatively undecomposed outer layer 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.

### Composting with Worms

*The process of worm composting involves worms digesting food waste leaving behind high-quality castings called "vermicompost". Worms work most efficiently at a temperature between 50° and 70°F. This makes worm composting ideal for some type of semi-heated area indoors or out. If your 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, some times 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.*

*Vermicomposting does 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, 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.

During the first few weeks of composting, the pile should reach a peak 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 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. 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.

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.

#### **MATERIALS THAT SHOULD AND SHOULD NOT BE ADDED TO A COMPOST PILE**

<b>Yes</b>	
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

<b>No</b>	
Butter	Mayonnaise
Bones	Meat
Cat manure	Milk
Cheese	Oils
Chicken	Peanut butter
Dog manure	Salad dressing

## 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
Composting	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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Compost pile location	The compost pile is more than 50 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Composting	The compost pile only contains 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

### Responding to risks

Your goal is to lower your risks. Complete the action checklist below 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

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action.
<i>Sample:</i> Fertilizers applied but soil	Submit soil samples to Clemson extension office for testing.	One week from today: March 15
<i>Sample:</i> 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

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.

## For More Information

### **Coastal Dunes**

Shoreline and Waterway Section, Division of Soil and Water Conservation, Department of Natural Resources and Environmental Control. (302) 739-4411.

### **Riparian Buffers**

*Delaware's Riparian Buffers – building a line of defense to protect our state's waters.* 2000. Delaware Coastal Programs, Division of Soil and Water Conservation, Department of Natural Resources and Environmental Control. (302) 739-3451.

### **Native Plants**

*The Flora of Delaware: An Annotated Checklist.* (2001) by William A. McAvoy and Karen A. Bennett. Delaware Natural Heritage Program, Division of Fish and Wildlife, Department of Natural Resources and Environmental Control. (302) 653-2880.

### **Soil Testing**

*Soil testing kits can be purchased at any of the three UD Cooperative Extension Offices listed below, or directly from the University of Delaware Soil Testing Program.*

New Castle County Cooperative Extension  
910 S. Chapel Street  
Newark, DE 19716  
(302) 831-2667

Kent County Cooperative Extension  
69 Transportation Circle  
Dover, DE 19901  
(302) 730-4000

Sussex County Cooperative Extension  
Research and Education Center  
16648 County Seat Highway  
Georgetown, DE 19947  
(302) 856-7303

University of Delaware Soil Testing Program  
152 Townsend Hall  
531 S. College Avenue  
Newark, DE 19717  
(302) 831-1392

*This material was adapted for Delaware Coast-A-Syst from the Home Landscaping Chapter of the South Carolina Coast-A-Syst. This chapter was originally developed by K. Marc Tefteau, 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. 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, SC Office of Ocean and Coastal Resource Management. Special recognition goes to Karl Ohlandt for the initial development of the native coastal plant list. Additional native plant information was supplied by John A. Brubaker, Medical University of South Carolina, Department of Pharmacology and Jeff S. Glitzenstein, Tall Timbers Research Station.*



## CHAPTER 7

# On the Water: Caring for Your Boat and Dock

Recreational boating provides relaxation and enjoyment for thousands of Delaware residents. 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.

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



This chapter examines boating-related activities and what you can do to minimize possible harm to the environment. Topics covered include:

- boat cleaning and maintenance
- spill prevention and waste disposal
- dock construction and maintenance

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 2001, there were over 47,486 boats registered in Delaware. While individual boats usually release only small amounts of pollutants, when multiplied by thousands of boaters, docks, and marinas, they 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 storm-drains, 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. 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. Yet, this type of debris commonly finds its way into our coastal waters at alarming levels.

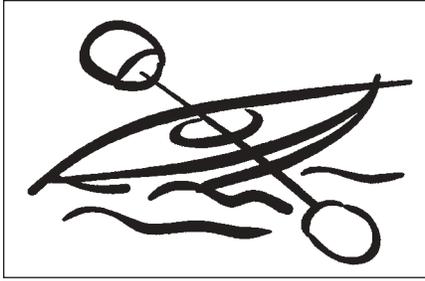


Figure 7.2 *Recreational boating is an enjoyable activity for many coastal residents*

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 nevertheless 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 Delaware'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 to see where you pose the greatest risk 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. Don't use products that contain ammonia, sodium, chlorinated solvents, petroleum distillates, or lye.

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 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.

Table 7.1—Alternatives to Toxic Products for Cleaning Your Boat

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 borax paste	Bicarbonate of 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

### **Targeting aquatic nuisance species**

Exotic plants and animals are an increasing problem in Delaware waters. Each year the state spends hundreds of thousands of dollars to control the spread of noxious weeds such as hydrilla and water hyacinth. In the United States alone, we spend \$137 billion annually in attempting to control invasive species. Needless to say, this places a huge burden on the Division of Fish and Wildlife’s budget. So, 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 below and to those of the DNREC.

- *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 2 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 5 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 DNREC.
- *Consult* the DNREC for recommendations and permits before you try to control or eradicate an exotic “pest.”

Additional information is available through the US Fish and Wildlife Service, who, in cooperation with the US Coast Guard, is presenting a campaign to “Protect Your Waters and Stop Aquatic Hitchhikers”. Their website, ([www.protectyourwaters.net](http://www.protectyourwaters.net)), is an excellent source of news about the latest invasive species issues and facts that recreational users of aquatic systems can use to protect their waterways.

### **Sensible boat sanding and painting**

Sanding and painting can be messy tasks, and if certain precautions are not taken, these chores can also create a mess for the environment.

You may want to consider using a licensed boat yard 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 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.

### **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 SAE1527, 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 non-polluting 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 Delaware 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.

*Your Boat and the Bay*  
Chesapeake Bay Foundation,  
1999

- Re-use paints, varnishes, and solvents whenever possible. Toxic products must be disposed at a hazardous waste collection facility (See Chapter 5).
- Donate leftover paints to fellow boaters.

Most bottom paints are considered pesticides, and a Delaware Certified Pesticide Applicator's license is required to purchase the products. For additional information regarding the regulation and proper management of anti-fouling paints, contact the Delaware Department of Agriculture at (302) 739-4811. Additionally, check with your local marine supply store or call your local Extension office if you have further questions.

### **Exterior wood and trim**

Wooden parts and gear have been part of boating in Delaware 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 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 two 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 Delaware waters.

## 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 product use	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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	
Nuisance species	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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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 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.

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 the extra fuel is going.

Following a few simple steps will go a long way to 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 through.

### **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 clean up 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 US Coast Guard can zap you for up to \$25,000 for those few squirts of soap if you pump the treated water overboard.

### **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 US 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 Delaware, money for the construction, renovation, operation, and maintenance of pump-out stations and waste reception facilities for boaters.

Be proud of your role!

***To report the spill of oil, gas or other hazardous materials into the water, call the U. S. Coast Guard at 1-800-424-8802. Also call the Delaware Department of Natural Resources and Environmental Control at 1-800-662-8802 (in State) or (302) 739-5072.***

### **Plastics and trash**

Today, most folks would not consider throwing their trash-plastic, nets, fishing line, six-pack rings, styrofoam, etc.-overboard. Yet every year, tons of debris makes its way into our coastal waters. In 2002, during the annual Delaware Coastal Cleanup, 1611 volunteers removed over 22,049 pounds of trash including 32,475 cigarettes/cigarette filters from Delaware's Coastline in a single day!

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.

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.

### **Fish wastes**

When you've had a great day out catching fish, do you ever give any thought 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. The least preferable option is to clean your fish while you are still away from the dock or ramp and out in open water.

## **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 re-fueling 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 over-fill 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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 pumpout stations because they are costly and dirty.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> 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 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.



## Delaware Clean Marina Program

The Clean Marina Program is a voluntary, incentive-based program that encourages marina operators and recreational boaters to protect coastal water quality by engaging in environmentally sound operating and maintenance procedures. While Clean Marina programs vary from state to state, all programs offer information, guidance, and technical assistance to marina operators, local governments, and recreational boaters on best management practices that can be used to prevent or reduce pollution. Marinas that participate in the Clean Marina Program are recognized for their environmental stewardship and can be easily identified by the Delaware Clean Marina Logo.

If you have any questions or would like your marina to become a "Clean Marina" please call the University of Delaware Sea Grant Marine Advisory Service at (302) 645-4268

## 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 Delaware Department of Natural Resources and Environmental Control.

### ***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 decay from fungi. This is especially important in Delaware because of the hot and humid climate in the summer. Pressure treatment offers a long lasting and 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: water-borne, oil borne and creosote. Only the water-borne 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 common-

ly used water-borne preservative.

Oil-borne 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.

To date, pressure-treated wood has not been listed as hazardous waste. In Delaware it is acceptable to send treated wood to a landfill space, but look into 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 non-permitted units because toxic residue may be produced as part of the smoke or ashes.

## Table 7.2—Pressure treated wood application and retention table for CCA

Table 7.2 Pressure treated wood application and retention table for CCA

PREVENTION (lbs/ft <sup>3</sup> )	PRODUCT APPLICATION
0.25	Above Ground
0.40	Ground Contact
0.60	Permanent Wood Foundation
2.50	Salt Water

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.

### **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, non-porous, and will not leach any chemicals into the water. Another positive point is that most of this type of lumber is made from 100% 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 in the coastal areas of Delaware, 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.



*Figure 7.3—Proper care and maintenance of your dock will ensure long years of enjoyment and clean water quality*

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!

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 not applied properly.

Some tips for properly applying wood dock care products:

- 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.

## 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High
Product selection	I like the look of a weathered dock. When I clean my dock, I only use salt water and some elbow grease!	When I clean or seal my dock, I use commercially 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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.	<input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> 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 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

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.
<i>Sample:</i> Wash and clean boat in the driveway	Pull the trailer into the yard and wash the boat in the grass	Next boating trip
<i>Sample:</i> 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

Delaware Department of Natural Resources and Environmental Control  
Division of Water Resources  
Wetlands and Subaqueous Lands Section  
89 Kings Highway  
Dover, DE 19901  
(302) 739-4691

*Delaware Clean Marina Program.* University of Delaware SeaGrant Marine Advisory Service (302) 645-4268

*A Guide to Marine Sewage Disposal Stations in Coastal South Carolina,* 1999, Office of Ocean and Coastal Resource Management, poster.

*Clean Boater: Clean Boating Habits,* Florida Department of Environmental Protection, 1998, 22 pp.

*Clean Boating Guide,* California Sea Grant Extension Program (San Diego), August 1995, 35 pp.

*Managing Boat Wastes: A Guide for Hawaii Boaters,* University of Hawaii Sea Grant College Program, 1998, 19 pp.

*Your Boat and the Bay,* Chesapeake Bay Foundation, 1999, 15 pp.

*This material was adapted for Delaware Coast-A-Syst from the Boat and Dock Care Chapter of the South Carolina Coast-A-Syst. This chapter was developed cooperatively by Cal Sawyer, Coastal Environmental Quality Specialist and Dr. 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.*



# Appendices

## Information and Services

Delaware Department of Natural Resources and Environmental Control is comprised of the Office of the Secretary and five divisions: Soil and Water Conservation, Water Resources, Air and Waste Management, Fish and Wildlife, and Parks and Recreation. The department's mission is to protect and manage the state's vital natural resources, protect public health and safety, provide quality outdoor recreation and to serve and educate the citizens of the First State about the wise use, conservation and enhancement of Delaware's Environment.

Delaware Department of Natural Resources and Environmental Control  
89 Kings Highway  
Dover, DE 19901  
<http://www.dnrec.state.de.us/dnrec2000/>

Cooperative Extension offices are located in each county. The University of Delaware Cooperative Extension Home Page (<http://ag.udel.edu/extension/index.html>) describes on-going projects, research, education, and current issues.

New Castle County Cooperative Extension  
910 S. Chapel Street  
Newark, DE 19716  
(302) 831-COOP

Kent County Cooperative Extension  
69 Transportation Circle  
Dover, DE 19901  
(302) 730-4000

Sussex County Cooperative Extension  
Research and Education Center  
16684 County Seat Highway  
Georgetown, DE 19947  
(302) 856-7303

Conservation Districts work with federal (Natural Resources Conservation Service) and state (DE Department of Natural Resources and Environmental Control) partners to assist local landowners in the application of conservation practices.

New Castle County Conservation District  
2430 Old County Road  
Newark, DE 19702  
(302) 832-3100

Kent County Conservation District  
800 Bay Road  
Dover, DE 19902  
(302) 697-2600

Sussex County Conservation District  
408 North DuPont Highway  
Georgetown, DE 19947  
(302) 856-3990

