



The Delaware Department of Natural Resources and Environmental Control's Whole Basin Management strategy focuses on protecting Delaware's environment by managing it by drainage areas. Using the state's four major drainage basins as the main management units, the Department brings together the expertise from all divisions — Air and Waste Management, Fish and Wildlife, Parks and Recreation, Soil and Water Conservation, Office of the Secretary, and Water Resources — to better assess, monitor, and protect the health of Delaware's environment.

The basis for this integrated approach comes from the realization that virtually every activity that takes place in the environment impacts multiple resources or land-use activities. Thus, managing the complex natural world we call "the environment" requires us to examine the many resources from multiple perspectives.

This report focuses on the Chesapeake Bay Basin, one of Delaware's four major drainage basins. The other three basins that have been assessed through the Department's Whole Basin Management Program include the Piedmont Basin in northern New Castle County, the Delaware Bay and Estuary drainage in eastern New Castle, Kent, and Sussex counties, and the Inland Bays in southeastern Sussex County.

We encourage you to learn more about Delaware's environment and natural resources and share with us your ideas and concerns about the environmental issues in your watershed. We look forward to your input and cooperation as we work to improve and protect the health of Delaware's environment.



If you have any comments that you would like to share regarding this report, please contact DNREC's Public Affairs Office, (302) 739-9902. This publication is available on the Internet. Visit DNREC's web page at www.dnrec.state.de.us.

Easy Reference Phone Numbers



Environment Hotlines

Citizen Complaints (In State).....	1-800-622-8802
Illegal Hunting/	
Fishing Activities	1-800-523-3336

Office of the Secretary

Secretary's Office	739-9000
Coastal Zone Act Administration	739-9909
Land Use Planning.....	739-9909
Compliance Assistance.....	739-9909
Public Affairs Office.....	739-9902
Human Resources	739-9901
Whole Basin Management.....	739-9000
Ecological Restoration.....	739-9000

Division of Air & Waste Management

Director's Office	739-9400
Air Quality Management Section	739-9402
New Castle	323-4542
Solid & Hazardous Waste Branch	739-9403
Tank Management Branch.....	395-2500
Site Investigation & Restoration Branch.....	395-2600
Environmental Response Branch.....	739-9404
Environmental Protection Officers.....	739-9401

Division of Fish & Wildlife

Director's Office	739-9910
Fisheries Section	739-9914
Wildlife Section	739-9912
Enforcement Section	739-9913
Mosquito Control Section	739-9917

Division of Parks & Recreation

Director's Office	739-9200
Planning, Preservation & Development	739-9235
Operation and Maintenance	739-9220
Cultural and Recreational Services	739-9191

Division of Soil & Water Conservation

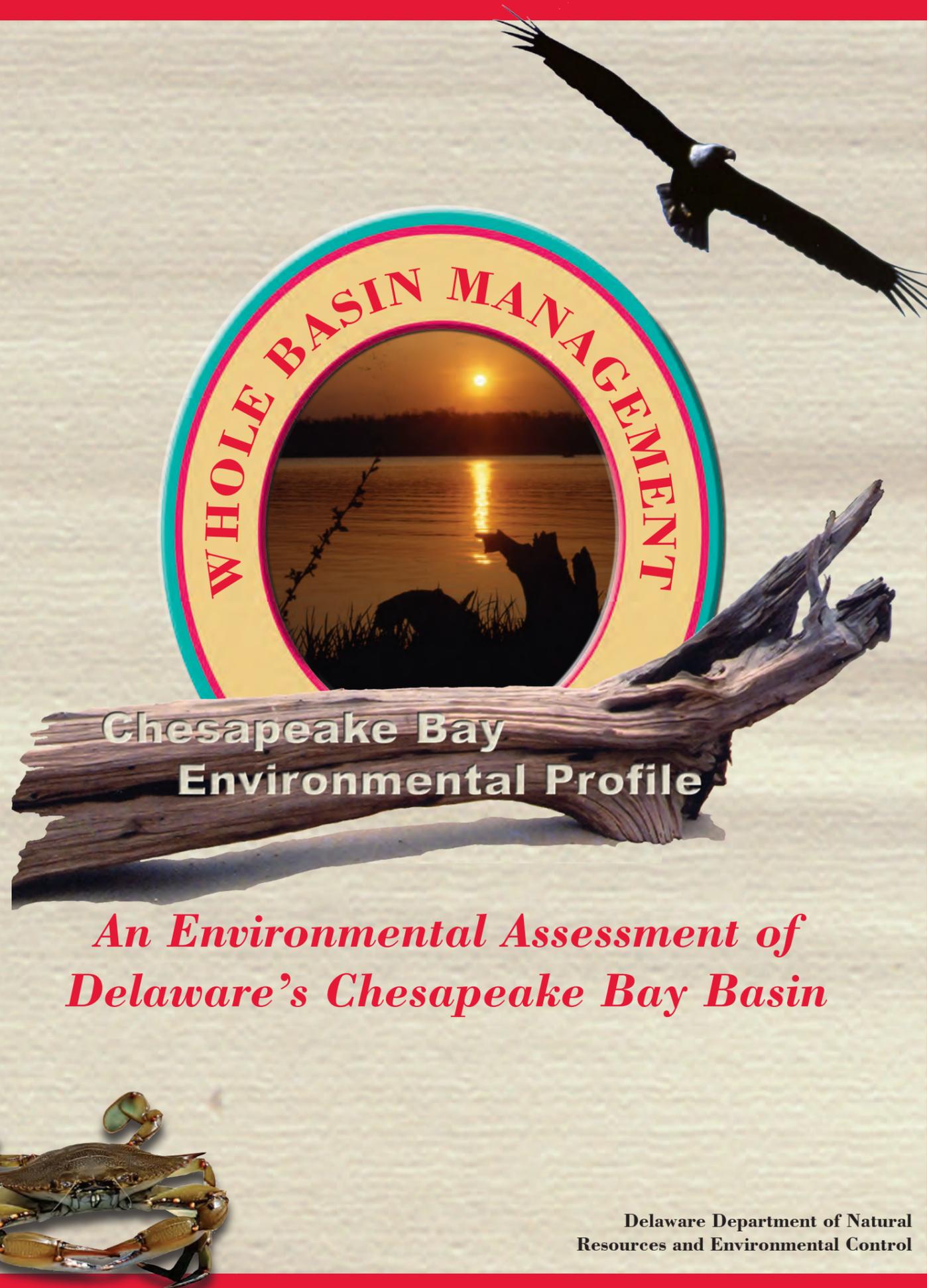
Director's Office	739-9921
Shoreline & Waterway	
Management Section	739-9921
Drainage Section	856-5488
Delaware Coastal Management Program.....	739-9283
Conservation District Operations.....	739-9921

Division of Water Resources

Director's Office	739-9950
Environmental Laboratory Section.....	739-9942
Surface Water Discharges Section.....	739-9946
Groundwater Discharges Section.....	739-9947
Water Supply Section.....	739-9945
Watershed Assessment Section	739-4590
Wetlands & Subaqueous Lands Section	739-9943

Other Resources

Nanticoke Watershed Association	410-873-3045
Chesapeake Bay Foundation	410-543-1999



Chesapeake Bay Environmental Profile

An Environmental Assessment of Delaware's Chesapeake Bay Basin

Delaware Department of Natural
Resources and Environmental Control

Introduction

This report is the Department of Natural Resources and Environmental Control's environmental profile of the Chesapeake Bay Basin in Delaware. It is the summary of an extensive environmental assessment and highlights some of the numerous treasures and challenges within the Chesapeake Basin. This information is being used by the Department to establish environmental priorities and to educate the citizens of Delaware and other governmental agencies about significant issues of concern in the **Basin**.

The basis for developing this report comes from the Department's realization that virtually every activity that takes place in the environment impacts numerous resources. For example, improper disposal of hazardous substances or excessive application of fertilizers on land can result in the leaching of these pollutants into the **ground water**. Pollutants of this kind can also enter streams and other surface waters during storms. The consequences can be widespread, causing negative impacts to drinking water supplies, fish or wildlife habitat, and recreational or even commercial fishing.

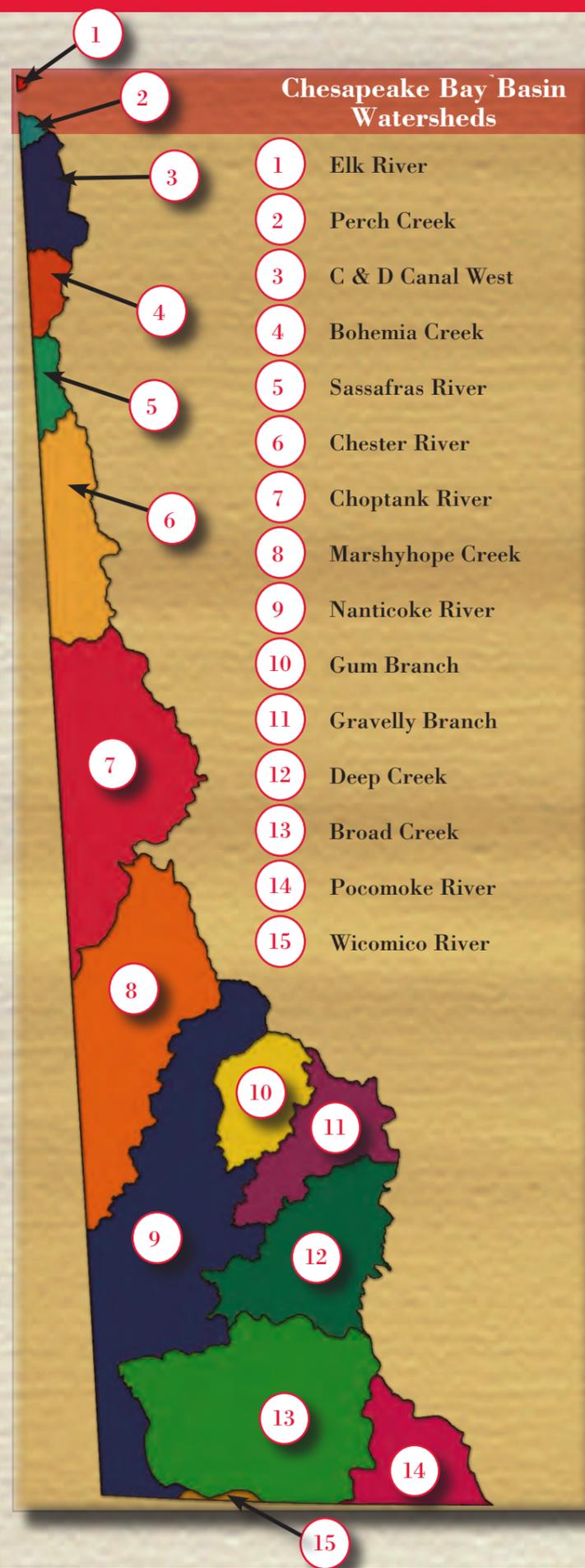
Managing the complex and dynamic natural world we call "the environment" requires close examination of the many resources within it. Understanding and respecting the relationships that exist between the air, land, water, and living resources has prompted the Department to focus on looking at the environment from multiple perspectives. This effort, which we refer to as "Whole Basin Management," involves monitoring, assessing, and managing all of Delaware's biological, chemical, and physical environments within their drainage basins.

Four major drainage basins encompass Delaware: the Piedmont, Chesapeake Bay, Inland Bays/Atlantic Ocean, and Delaware Bay and Estuary. Each basin consists of smaller management units, called **watersheds**, which represent the area drained by a river, stream, or creek. Delaware has 45 watersheds, 15 of which make up the Chesapeake Basin.

The Chesapeake Basin in Delaware encompasses a 769-square-mile area of land in western New Castle, Kent, and Sussex counties. The basin is named for the water body that rivers and creeks in the western part of the state drain to - the Chesapeake Bay. Delaware's portion of the Chesapeake Basin consists of headwater areas - the uppermost reach of a river or stream and the area where a waterway originates.

The Chesapeake Bay is the nation's largest estuary, a body of water where fresh and saltwater mix. These nutrient-rich waters provide a fertile and ever-changing environment that supports a large and extremely diverse array of plants and animals. This great diversity is the basis for the Chesapeake's worldwide reputation as a nursery for life, and it is therefore central to our mission to maintain that healthy diversity.

The Chesapeake Bay is one of four basins being assessed by the Department's Whole Basin Management Program. The primary objectives of the process are to protect the environment, improve



community outreach and education, maximize wise use of the resource, and promote environmental education and stewardship. As part of this process, we will be asking you and your neighbors to express your ideas, concerns, and opinions about the basin in which you reside.

This publication is a summary of the assessment report for the 15 watersheds that make up the Chesapeake Basin. The pages that follow contain information on the following topics:

- ◆ Watershed Hydrology
- ◆ Land Use and Population
- ◆ Contaminants
- ◆ Water Quality
- ◆ Living Resources
- ◆ Efforts Under Way
- ◆ What You Can Do
- ◆ Additional Actions
- ◆ Impaired Waters

As you read this document, we encourage you to think about the problems or issues in the Chesapeake Basin that concern you and actions we can take to protect and improve our environment. You'll find some suggestions in the back of this document about things we can all do to help.

If we continue to be responsible stewards of the environment, we will create an environmental legacy that we can be proud to pass on to future generations. We must remember that we are simply borrowing the land and water from our children. Our goal is to leave them with the same treasures our ancestors left us to enjoy.

For more information about the Assessment Report of Delaware's Chesapeake Basin, please contact:

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*Department of Natural Resources
and Environmental Control*

302-739-9000

Watershed Hydrology

Water is Delaware's most valuable natural resource. It is critical to our existence, provides habitat for wildlife, and makes possible numerous recreational opportunities. Water is constantly recycling and changing its state through the processes of evaporation, condensation, and precipitation, commonly referred to as the *water cycle*.

The water in our streams and ponds is warmed by the sun's rays, causing it to evaporate and enter the atmosphere as a gas. As these water molecules collect in the atmosphere, the humidity increases until the air mass can no longer hold any more moisture. At this point, the water vapor condenses and falls back to the Earth in the form of snow, rain, sleet, or hail. Some of this precipitation is filtered through the soil and ends up as ground water. If more precipitation falls than the soil can absorb, it becomes runoff. Both ground water and runoff eventually reach a stream, bay, or other water body, and the water cycle begins all over again.

Ground water is the sole source of drinking water throughout the Chesapeake Basin. Millions of gallons of ground water are withdrawn from the Basin's *aquifers* on a daily basis. Ground-water quality in the Chesapeake Basin is highly variable. Much of the water in unconfined aquifers has been impacted by human activity at the surface.

Surface water bodies, such as rivers, lakes, bays, and oceans are the most visible expressions of water in the water cycle. These reservoirs act as "barometers" for measuring the health of the water in the cycle. For example, diverse aquatic habitats and fish populations are representative of a healthy water body. An excess of nutrients can lead to a reduction in the diversity and populations of these living resources. The rivers and creeks of the Chesapeake Basin provide important habitat for migrating birds, finfish, and shellfish. However, these waters are being pressured by development along the shorelines.

Riparian Buffers

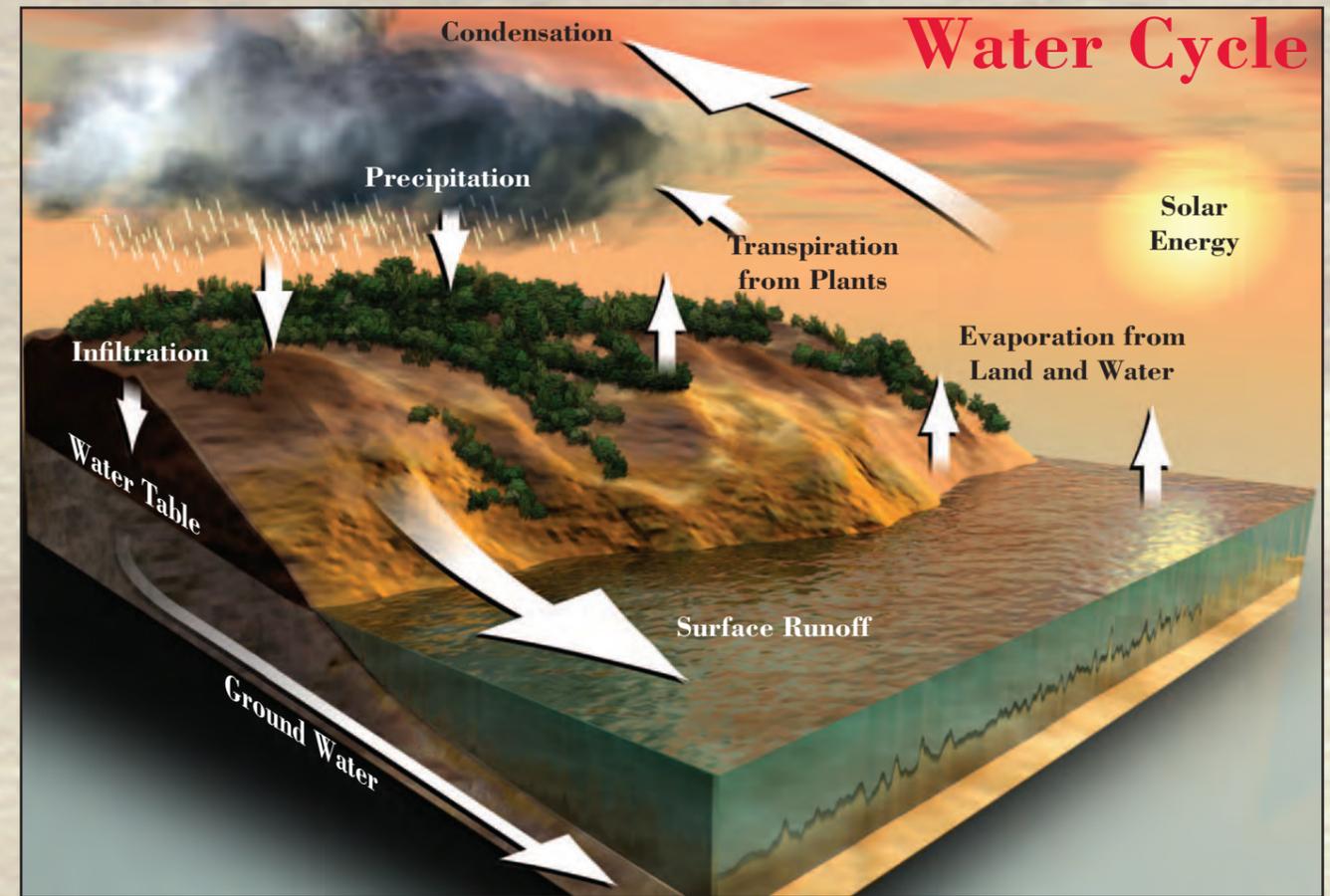
Forests protect watersheds, provide opportunities for recreation and settings for aesthetic enjoyment, serve as habitat for wildlife, and produce wood and other forest products. The forests of Delaware contribute greatly to the quality of life of the residents, making the State a better place in which to live.

Of the states along the Atlantic seaboard, Delaware is the least forested. Remarkably, forests still cover nearly 30 percent of the State, despite Delaware's agricultural history and the rapid conversion of forested lands to residential and other urban uses. Of the three counties in Delaware,

Sussex has experienced the largest loss.

Within a watershed, generally the stream channel and adjacent land areas can be divided into three zones: aquatic, riparian, and upland. The aquatic zone includes the stream and the area of the streambed that is normally underwater.

The *riparian* zone lies between the aquatic and upland zone and is an area of transitional vegetation influenced by its nearness to water. Upland areas adjoin the



Human activities can have a significant impact on the water cycle. When forests and other vegetation are removed and roads and buildings constructed, less precipitation can infiltrate the soil, and runoff increases.

riparian zone and are usually characterized by vegetation and soils different from those in the riparian zone.

duced as the woody roots increase the resistance of streambanks and shorelines to *erosion* caused by high water flows.

Many trees in Delaware grow along streams and serve as riparian buffers that protect and improve water quality and provide corridors used by wildlife. Research has shown that a buffer strip of trees between a stream and cropland provides an extensive list of benefits to both man and the environment. Because of their unique position between land and water, riparian forest buffers of sufficient width intercept sediment, nutrients, pesticides, and other materials in surface-water runoff, referred to as *non-point source pollution*, and reduce nutrients and other pollutants in shallow subsurface water flow. Woody vegetation in riparian buffers provides food and shelter for wildlife, helps lower water temperatures by shading the water-body, and slows out-of-bank flood flows. In addition, the vegetation closest to the stream or water-body provides litter fall and large woody debris important to aquatic organisms. Water *turbidity* is also re-

Conservation efforts at the state and local level are increasingly focused on saving and restoring these riparian buffers to as non-point source pollution, and reduce nutrients and other pollutants in shallow subsurface water flow. Woody vegetation in riparian buffers provides food and shelter for wildlife, helps lower water temperatures by shading the water-body, and slows out-of-bank flood flows. In addition, the vegetation closest to the stream or water-body provides litter fall and large woody debris important to aquatic organisms. Water turbidity is also reduced as the woody roots increase the resistance of streambanks and shorelines to erosion caused by high-water flows.

Conservation efforts at the state and local level are increasingly focused on saving and restoring these riparian buffers.



Forested corridors along streams filter surface runoff reducing the amount of pollutants entering the waterway.

Land Use & Population



The City of Seaford, nestled along the banks of the Nanticoke River, is ever mindful of the need to protect this waterway as pressures from development and recreation continue to increase.

The Chesapeake Basin spans all of Delaware's three counties, with the majority of its land area (65%) in Sussex County (6% and 29% in New Castle and Kent Counties respectively). The landscape of the Chesapeake Basin is largely rural in character. As of 1997, urban land uses made up only 8 percent of the Basin, while agriculture made up 49 percent. Brushland and forest made up about 19 percent of the land area, and water and wetlands made up about 22 percent. Like other areas of the state, agricultural lands were lost between 1992 and 1997, as were brushland and forests and water and wetlands.

While much of the land area within the Chesapeake Basin remains rural, development pressure is increasing in and around the urbanized areas of the Basin in Sussex County. Sussex is Delaware's fastest growing county, with a 38 percent increase in population from 1990 to 2000 (from 113,229 people to 156,638 people). The Delaware Population Consortium projects that the population will continue to grow and will reach 248,638 people

by 2030 (a 58 percent increase from 2000). While most of the population growth and development pressure in Sussex County has occurred (and will likely continue) in eastern Sussex County, the increase in land values along the coast is beginning to spread development pressure westward to areas within the Chesapeake Basin. In fact, the Nanticoke watershed may have more septic systems than the Inland Bays Basin due to Sussex County's septic elimination program in the Inland Bays.

Land use decisions are made at the County and municipal levels and governed by local zoning and subdivision ordinances. State laws require the counties and municipalities develop and update comprehensive plans to lay out a vision for growth. New Castle and Kent Counties adopted updated comprehensive plans in March 2002; Sussex County adopted its comprehensive plan update in December 2002. Bridgeville, Seaford, Blades, and Georgetown have recently adopted updated comprehensive plans, and other towns in the basin are in the process of developing plans. In addition,

Livable Delaware

Livable Delaware is a positive, proactive strategy that seeks to curb sprawl and direct growth to areas where the state, counties and local governments are most prepared for it in terms of infrastructure investment and thoughtful planning. It builds on the foundation laid by the Strategies for State Policies and Spending, which were adopted in 1999.

Delaware's population is projected to grow by more than 200,000 people between now and 2030. The state of Delaware has a stake in how and where growth occurs. Unlike most other states, Delaware provides most services and infrastructure throughout the state - social services, prisons, roads and transit, the largest police force in the state, about 70 percent of school funding, 50 percent of library construction funding, and 60 percent of paramedic funding.

Governor Minner believes that state government's responsibility is to provide these services and infrastructure efficiently, not haphazardly. Sprawl wastes taxpayers' money.

A 2001 Centers for Disease Control Study defines sprawl as "uncontrolled, poorly planned, low-density and single-use community growth." Besides wasting taxpayers' money, sprawl damages our quality of life in Delaware.

How?

- ◆ *Contributes to the loss of about 3,500 acres of farmland a year (Delaware Department of Agriculture)*
- ◆ *Aggravates traffic congestion and air pollution*
- ◆ *Lengthens response times for emergency responders*
- ◆ *Destroys natural habitat and contributes to ground-water depletion and pollution*
- ◆ *Contributes to flooding and drought problems because of the growth in impervious surfaces (buildings, roads, parking lots)*
- ◆ *Contributes to a sedentary and unhealthy lifestyle (2001 Centers for Disease Control study)*

the State adopted the *State Strategies for Policies and Spending* in December 1999 to set out its vision for growth. Livable Delaware builds on the *State Strategies* and encourages growth in and around existing urban areas where infrastructure is readily available.

Under the county comprehensive plans and the *State Strategies*, there are several areas within the Chesapeake Basin which have been identified as growth areas. These include the municipal and surrounding areas of Greenwood, Bridgeville, Seaford, Blades, Laurel and Delmar. In addition, a portion of the Georgetown, Ellendale, and Harrington growth areas lie within the basin.

Within these growth areas, development is encouraged, so as to spare the rural areas of the state from sprawling, unplanned development. While urbanized growth areas present environmental challenges, the long-term environmental benefits of focused growth are positive. Development in and around the municipal areas provides opportunities for hook-up to central sewer and water, reducing the water quality impacts associated with the

proliferation of septic systems. Bicycle and pedestrian accessibility of employment and community services reduces automobile emissions. With the availability of new technology and environmental data, provisions can be made in the growth areas for the protection of wetlands, buffers, open space, and other natural features that protect the quality of the environment and support quality of life for residents. Guidance should be given to the county and municipal governments within the basin to help them develop ordinances that encourage or require natural resource protections that are compatible with urban growth.

Projected Wastewater Flow Average Daily Flow (GPD)

Sewer District	2005	2020
Greenwood	161,000	236,000
Bridgeville	259,000	320,000
Seaford	1,274,000	1,790,000
Blades	385,000	991,000
Laurel	776,000	1,103,000
Delmar	686,000	1,051,000

Contaminants

There are two broad categories of contaminants: nutrients and chemicals. Nutrients include nitrogen, phosphorous, and pathogens. Chemicals are divided into classes, which include petroleum, solvents, organics, pesticides and herbicides, PCBs, heavy metals, and other inorganics. Contaminants may enter the environment from a variety of sources, such as large industries, small businesses, mobile sources, agricultural operations, residential areas, and biological sources, as well as from the air outside the Basin. Because the Chesapeake Basin in Delaware is the headwaters of the Basin, contamination from water outside the Basin is not an issue, with the exception of tidal waterways, such as the Chesapeake and Delaware Canal and the Nanticoke River.

Nutrients

Nutrient enrichment of water is a natural process, spanning thousands of years, and resulting from natural erosion and the breakdown of organic material. However, soil erosion, domestic waste disposal, and runoff can greatly increase the rate and amount of nutrients reaching waterways. Too many nutrients in the water can create a situation called **eutrophication**. Eutrophication is defined as an excess of nutrients (namely nitrogen and phosphorous) in the water, which causes accelerated growth of algae and plankton, depletion of dissolved oxygen, increased turbidity, and a general degradation of water quality. Dissolved oxygen is vital for fish and other aquatic life. Eutrophication is one of the most serious problems facing the Chesapeake Bay today. Agricultural runoff, urban runoff, and municipal and industrial point source discharges are the primary sources of nutrients.

Agriculture is Delaware's number one industry, with poultry the primary agricultural product. Sussex County is the number one broiler-producing county in the nation. Within Sussex County, the Indian River, Nanticoke River, and Broad Creek watersheds are meccas of poultry production. The Broad Creek watershed has the greatest density of poultry per acre than any other watershed in the State. Consequently, the Nanticoke River and Broad Creek have a surplus of manure. Both waterways are rated high in susceptibility to **non-point source** water pollution.

Manure can be a valuable agricultural by-product if managed properly. However, applying manure in excess or at the wrong time to agricultural fields may release nutrients into the air or water. Instead of nourishing crops, the nutrients become pollutants. The major concern is that excess nitrogen can leach through the soil and into the ground-water. Waste management and alternative uses for poultry litter need to grow with the industry. A good example of this is the Perdue AgriRecycle plant which went into operation in 2001. This plant converts chicken manure into pellets which are used as fertilizer in other parts of the country. Over 15,000 tons of manure is processed each year and moved off of the Delmarva peninsula. The Delaware Nutrient Management Commission, through their Nutrient Relocation Program, provides assistance to transport excess poultry litter, to areas that can utilize the additional nutrients throughout Delaware, Maryland, New Jersey and Pennsylvania. Since 2001, the program has relocated over 200,928 tons of manure (figure includes 44,000 tons exported by Perdue's AgriRecycle pellet-fertilizer plant).



Excess poultry litter to be relocated to areas that are in need of additional nutrients for crop production.



Chemicals must be properly stored to ensure that they are not released into the environment.

The Chesapeake Basin has one of the highest percentages (95 percent) of land area served by **septic systems** as compared to other areas in the state. Many of the parcels are strip developments along rural roadways. Due to moderate to poorly-drained soil conditions, there are limitations for on-site septic disposal. Research in the Nanticoke watershed indicates that a notable amount of nitrogen loading may be originating from septic systems. As the soil types and water-table depths in the Nanticoke watershed are similar to the rest of the Chesapeake Basin, similar nutrient loads can be expected throughout the Basin.

Pathogens are disease-causing bacteria and viruses. There are many sources of pathogens. Sources of greatest concern are raw or inadequately treated sewage. The potential daily pathogen output from one person's untreated sewage can equal that of treated sewage from hundreds to possibly thousands of people, depending on the level of treatment. Wildlife and animal operations can also be significant sources of pathogens. High levels of bacteria pose a serious risk of illness to shellfish consumers, swimmers, and others who come in contact with contaminated waters.

Twice a month, numerous sites within the Chesapeake Basin are tested for bacteria. Delaware uses a standard of 70 total coliform bacteria per

100 ml; and fewer than 10 percent of the samples don't exceed 330 total coliform per 100 ml. All data from four stations in the Nanticoke Watershed are in excess of the 70 total coliform/100 ml shellfish harvest standard. Wading sample data collected from one station in the Trap Pond swimming area have led to the closing of Trap Pond for swimming over the last several years.

Chemicals

Chemical contamination from industrial sources and the potential threat of this contamination is not widespread in the Chesapeake Basin. The highest concentration of these sites occurs within, and immediately surrounding, the towns located in Sussex County. Leaking underground storage tanks make up a majority of the sites with known contamination. Petroleum hydrocarbons are the chemical contaminants most often found at these sites, which can cause contamination of nearby drinking wells.

A large number of chemical contaminants are present in the Chesapeake Basin. Chemical releases in the Chesapeake Basin have been documented at landfills, some **hazardous waste** generators, Superfund sites, underground storage tank sites, and salvage yards. All of these sites are under various stages of investigation and remediation.

Water Quality



Photo by NOAA

The Chesapeake Basin is particularly favorable for agricultural production because the soils respond well to management, the temperate climate provides a fairly long growing season, and the rainfall is well distributed. Currently, agriculture makes up 50 percent of the land use, forestry makes up 39 percent, and other land uses/urban development makes up the other 11 percent.



Agriculture

Agricultural activities (primarily the wide spread application of fertilizers) and the onsite wastewater discharge associated with residential and commercial development have significantly impacted ground-water quality over much of the Basin. Because of its common occurrence, nitrate is often used as an indicator of impacted ground water.

Pesticide use is widespread throughout the Chesapeake Basin. Herbicides (atrazine, cyanazine, metolachlor, and simazine) are readily detected in shallow unconfined ground water beneath sandy soils with low organic matter. Atrazine is the most frequently detected herbicide and occurs at the highest concentrations. More than 95 percent of the herbicides detected are at concentrations generally at or near the 0.1 microgram per liter laboratory detection limit. In most cases, this limit is substantially below the drinking water standards set by the EPA.

Most farmers in the Chesapeake Basin now voluntarily use *Best Management Practices* to limit their application of nitrates and pesticides on farmland in order to protect water quality. These practices aid farmers in retaining nutrients by identifying the appropriate times, conditions, and quantities for fertilizer application.

Septic Systems

The Chesapeake Basin has one of the highest percentages (95 percent) of land area served by septic systems. Thousands of recorded, but currently undeveloped, lots will eventually add to the number of septic systems. Most of these undeveloped lots are stripped from farm-field frontages along county roadways and waterways. Overall, the Basin has moderate to severe limitations for onsite septic disposal due to the moderate to poorly-drained soil conditions.

Current septic regulations deny the placement of standard (gravity and elevated sand mounds) and/or alternatively designed low-pressure pipe

septic systems on soils where the seasonal high water table is within 20 inches of the soil surface. As an option for those property owners, septic regulations allow for alternatively designed systems on a case-by-case basis. These alternative septic systems utilize technologies that pre-treat the effluent to a specific level, usually to levels below 10 parts per million (ppm) of nitrate-nitrogen. Total and fecal coliform levels are also significantly reduced within these pretreatment units. (Coliform bacteria are a by-product of both human and animal waste.) The soil must still dispose of the effluent. The cost of these pretreatment units has dropped significantly so more people can afford them, however some soils are too wet even for these new systems.

Standard home septic systems trap sewage solids in a tank and disperse the remainder under ground. Although some nitrogen will escape a septic system that is working correctly, a septic tank must be emptied regularly to maintain maximum performance and prevent unnecessary leaking. Septic systems have a direct impact on ground water, the primary source of drinking water for residents of the Chesapeake Basin. At the back of this book you'll find more detailed information about maintaining your septic system.

A number of water quality issues have arisen in the Chesapeake Basin over the past several years, from how to address habitat loss to concerns about toxic outbreaks of *Pfiesteria*, which is believed to be caused in part by excess nutrients. Changes in environmental quality have led to fish kills, loss of desirable submerged aquatic vegetation, (SAV), and declines in desirable finfish and shellfish habitat.

Delaware continues to experience serious water pollution and public health problems. The focus of water quality management has expanded, therefore, from point source discharges to nonpoint source problems such as urban and agricultural runoff, erosion, and sedimentation. Unaddressed, these problems lead to poor habitat conditions for fish and other aquatic life, diminished enjoyment of water-related recreation, and conditions that can create illness for people. Additional research and assessment efforts will be necessary to better understand how this complex aquatic system responds to pollutants.



The Nanticoke River has been designated as having Exceptional Recreational and Ecologic Significance (ERES) by the Federal Government

Living Resources

Despite the low elevations and generally simple topography throughout the Basin, a wide assortment of habitat types harbor a diverse flora and fauna.



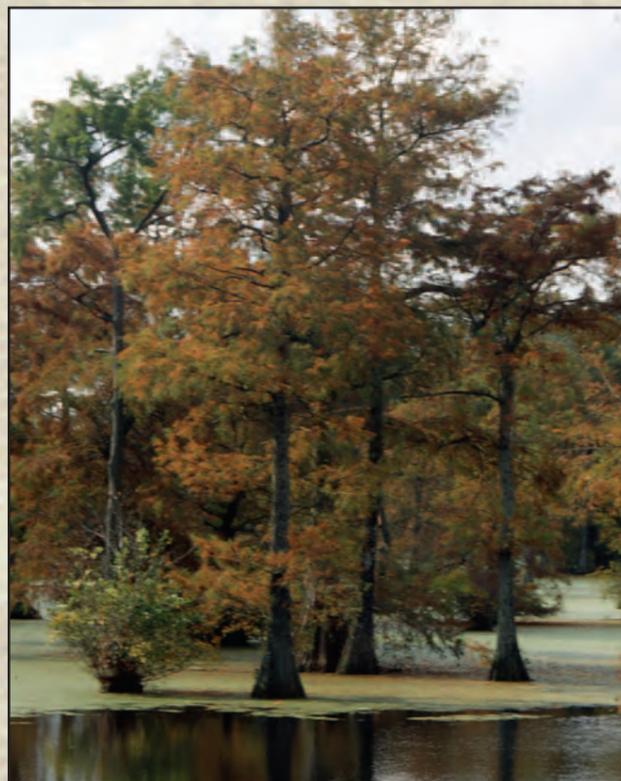
Many acres of pristine woodlands are in the Basin.

Forest Communities

In general, the northernmost forests in the Chesapeake Basin are comprised of a mixture of hardwoods, dominated primarily by oaks, beech, tulip poplar, and hickories on the drier sites. The predominate tree species in a wide variety of wetland habitats include box elder, sycamore, sweet gum, slippery elm, red maple, tulip poplar, ash, pin oak, and sometimes river birch and black willow. The farther south one travels in the Chesapeake Basin, a transition in forest species begins, but nowhere is this more dramatic than as one enters Sussex County. Here, the deciduous hardwood-dominated forest gives way to an evergreen forest with a distinctive southern feel. This is the Oak-Pine Forest Region.

The oldest trees in the State are found in this Basin, where one forested wetland contains specimens estimated at 500 years old. Although the age of these magnificent trees is unusual in Delaware, and indeed in the entire Chesapeake watershed, many of these trees are just reaching middle age.

The bald cypress is a rare species in the State of Delaware. This tree species has a relatively limited distribution and is found in only four watersheds in the state, two of which are in the Chesapeake Basin (the Broad Creek and Pocomoke). The tree has a low number of natural occurrences within Delaware, where it reaches the northernmost limit of its North American range. The James Branch, which drains into Broad Creek, contains the most extensive and finest examples of bald cypress wetlands in the State.



A stand of Bald Cypress in the Chesapeake Basin.

Atlantic white cedar is a wide ranging but uncommon tree species found in a narrow, interrupted belt scattered along the Atlantic coast from Maine to Florida, then west along the Gulf Coast to Mississippi. Significant populations of Atlantic white cedar are in the Chesapeake Basin, in the Nanticoke watershed and its associated tributaries. Several small populations exist in the Great Cypress Swamp in the Pocomoke drainage. Atlantic white cedar wetlands in Delaware and throughout their range are considered likely places for both state and globally rare species.

Wildlife

The white-tailed deer is native to the Chesapeake Basin and has adapted and thrived in the human-altered habitat. However, damage to agricultural crops has become a concern in Delaware. Since 1992, the deer harvest within the Basin had increased approximately 53 percent, far exceeding the overall statewide increase of 36 percent, yet the white-tailed deer appears to remain in high num-



Ospreys are opportunistic nesters.

bers in the Basin.

Both the beaver and the wild turkey were exterminated from Delaware in the mid 1800s and reintroduced much later. Both populations are increasing in the Chesapeake Basin. Wild turkeys are very adaptable and will use a variety of habitats from mature forests to open agricultural fields.

The northern bobwhite quail is not faring so well. This species is dependent on grassland habitats which is no longer a prominent feature of agricultural lands, due to the loss of hedgerows and the efficiency of large farm equipment. The decline in Chesapeake Basin quail populations appears to follow the state trend. However, the Chesapeake Basin has great potential for providing quail habitat protection and restoration. Several incentive programs have been initiated to improve conditions for wildlife.

Hopefully these types of efforts will help the northern bobwhite quail return to healthy numbers.



Red-Shouldered Hawk

Bird species such as the Kentucky warbler, Louisiana water thrush, and yellow-throated vireo are migratory neotropical species that breed in the forests of the Choptank watershed, but are rare elsewhere in the State. The cerulean warbler is also dependent on mature deciduous floodplain forests and surrounding upland forests for reproductive success. Formerly present along the Choptank River, this species was not sighted during the last survey. Habitat reduction may have eliminated this species from the Choptank environs. It is now known to be breeding in fewer than six sites throughout Delaware and is faring poorly throughout its global range.

Other bird species such as the barred owl, red-shouldered hawk, and pileated woodpecker are important forest predators that have disappeared from most of Delaware's woodlands. These species require extensive tracts of mature floodplain forests to ensure successful reproduction. The populations of these birds and many others are in decline in Delaware because of fragmentation and elimination of the surrounding upland forests.

The critical factor to the success or failure of a species could be available breeding or nesting habitat, foraging habitat, or direct competition for habitat with exotic or native invasive species. In many cases, these vital habitats have become isolated, small, or degraded in quality. Even the best habitats are vulnerable or threatened.



The Cerulean Warbler's reproductive success depends on mature deciduous floodplain forests.

Living Resources

Fisheries

The streams and rivers that drain into the Chesapeake Bay support many species of fish harvested for both food and profit. Substantial commercial fishing efforts take place in the Nanticoke River, with American shad, blueback herring, alewife, white catfish, channel catfish, striped bass, and white perch representing the highest percentage of the catch. Despite restrictions, some species have declined. A combination of habitat loss, water-quality degradation, and overfishing has contributed to this decline.

The Nanticoke River was once the third most productive tributary for American shad in the entire Chesapeake drainage. Near the turn of the century, commercial landings in the Delaware portion of the Nanticoke exceeded 200,000 lbs. American shad have suffered a tremendous decline since then. A moratorium on commercial fishing for American shad was adopted in 1980 for Maryland waters, in 1993 for Virginia waters, and in 2000 for Delaware waters, including recreational fishing for shad, with the exception of catch and release. A shad grow

out facility is in operation at the NRG Vienna Power Plant on the Lower Nanticoke in Maryland and another shad hatchery is under construction in Delaware's Nanticoke Wildlife Area, with an expected opening by spring of 2005. Since the year 2000, both American and Hickory shad have been stocked in the main stem of the Nanticoke and some of its tributaries. The local environmental organizations that you can read about near the end of this document are all working toward restoration of the American shad, once central to the culture and the economy of this area. The alewife and blueback herring, which use this drainage for spawning and nursery habitat, have also declined. It is the hope of state agencies and local nonprofit environmental organizations to one day have fish ladders installed in the Nanticoke watershed for both shad and herring and to see this great fishery return.

Several rivers in this Basin have been dammed to create ponds, which in turn impede *anadromous species* (fish that spend part of their life in saltwater and part in freshwater) such as alewife, blueback herring, and American shad, from reaching historic spawning areas. Below is a list of tributaries that drain into the Chesapeake Bay, and Delaware ponds that potentially impede migration.

Impeded Waterways

- ◆ **Nanticoke River**
Collins, Concord (Fleetwood), Craigs, Williams (Hearns)
- ◆ **Broad Creek**
Records (Trap, Raccoon, Trussum, Chipmans), Horseys, Portsville (Tussock)
- ◆ **Choptank River**
Mud Mill

The Department of Natural Resources and Environmental Control is currently evaluating the impact of fish ladders installed since 1995 on several Delaware Bay tributaries. Once evaluations are complete, an anadromous species management plan will be drafted. At that time, recommendations will be made regarding tributaries of the Chesapeake Bay that impede migration of anadromous species.

The American eel is a species of special concern. This species uses the Chesapeake Bay drainage as a nursery and feeding area. Harvested eels never have an opportunity to spawn. There is a black market for elvers (eels less than 6 inches), which are illegally collected and sold in foreign markets. The 6-12 inch juveniles are sold legally as bait and live food in the U.S. and foreign markets. Currently, Delaware has no limit on the number of commercial licenses, no limit on the number of pots allowable per person, and no reporting requirements.

The Nanticoke River system sustains the heaviest fishing pressure of all tidal streams in Delaware. The most sought-after resident freshwater gamefish is the largemouth bass. Many fishing tournaments and man-days of fishing are directed strictly toward this species. The quality of this fishery is largely preserved by the catch-and-release method used by anglers.

Deep Creek and Gravelly Run, tributaries of the Nanticoke River, support extensive Submerged Aquatic Vegetation beds. Shoreline development and the removal of tree and grass buffers cause underwater grasses to die and smother fish eggs within those grasses. Dredging and channelization projects have been proposed for some areas of the Nanticoke watershed, which would severely affect shellfish, plant, and fish species. These kinds of projects need more careful and thorough consideration. Aquatic species can be adversely affected during any life stage.

Accidental or deliberate introduction of *non-native species* can cause major problems to native species, fishing, other forms of water-based recreation, and water quality. There are numerous examples of exotic species in this drainage basin. The Asiatic clam is an exotic species that has altered food chains, decreased diversity, and displaced native mussel species, some of which are rare. The



Striped Bass, commonly called Rockfish

common carp, when it is extremely abundant, can upset the ecological balance in ponds. Zebra mussels are not yet found in Delaware's portion of the Chesapeake Basin, but they are a significant problem throughout the Chesapeake Bay, clogging water systems in large and small boats and out-competing native species for food and habitat. This species is extremely difficult to control so it's important that we prevent them from entering the headwater areas in Delaware. Even some forms of underwater grasses that exist in the Chesapeake Basin are exotic and invasive (like *Hydrilla*). Trussum Pond has had a very severe case of duckweed each summer that contributes to low dissolved oxygen, causing most of the fish to die or move into headwater areas.

Many of Delaware's residents and visitors depend on water for their recreation enjoyment. Fishing, swimming, and boating are popular activities throughout Delaware. Delaware's portion of the Chesapeake Basin includes a dozen publicly-owned ponds and lakes, comprising nearly 700 acres that serve recreational needs. The health of Delaware's waters will affect the recreation potential of these ponds and streams. Delaware's wildlife represents a vital recreational resource base as well. Both hunting and birding depend on the health of the state's natural resources.

In many ways, our living resources reveal more about the state of our environment than any other factor. Our native species are generally the first indicators of change or disruption. They experience first-hand the direct impact of habitat loss, degraded air and water quality, and competition from exotic species.



Atmosphere

The Chesapeake Bay is rich in the nutrients nitrogen and phosphorus. As much as 25% of the total nitrogen entering the bay is estimated to be deposited from the atmosphere.

Point Sources

Sewage effluent that is piped directly into a waterway is an example of point source pollution. While this wastewater is treated before it is released, some pollutants usually remain.

Surface Runoff

Heavy rains increase soil erosion and the volume of runoff to the Chesapeake Bay and its tributaries. Farms can contribute significant amounts of nutrients if crops are over-fertilized or if piles of chicken manure get wet. The nutrients wash into nearby streams and eventually reach the bay.

What is a Watershed?

It's the area of land that drains into a particular water body or stream. The Delaware portion of the Chesapeake Bay encompasses about 769 square miles of land that drains to the bay.

How Excess Nutrients Reach the Bay

As this graphic illustrates, the Chesapeake Bay receives inputs of the nutrients nitrogen and phosphorus from a variety of sources. While these nutrients are essential for plant and animal growth, when excess amounts enter the bay, water quality can deteriorate. The nutrients accelerate the growth of aquatic plants, reducing the amount of oxygen available in the water for fish and shellfish. Nutrient contamination of ground water is of critical concern since ground water supplies 100% of the drinking water in the Delaware portion of the Basin.

Private Wells

Ground water supplies all of the drinking water in the Delaware portion of the Chesapeake Bay Basin. One major concern is when wells become contaminated with nitrogen at levels that exceed the drinking water standard. High levels of nitrates in drinking water can cause "blue baby syndrome," a disorder of infants and young children caused by inadequate oxygenation of the blood.

Septic Systems

Discharges from septic systems contribute significant amounts of nutrients to the Chesapeake Bay. Many older homes in the Basin have substandard sewage disposal systems.

How Water Travels Through Aquifers

Rainfall percolates through the soil and travels through aquifers to discharge areas, such as streams and agricultural drainage ditches. This ground water moves very slowly through the tiny spaces in the soil. Typically, water in the water-table aquifer moves no more than 2 feet per day. The *water-table* aquifer is the uppermost layer of soil through which water and nutrients easily travel. The confining unit is a layer made of clay and silt that separates aquifers. Clay impedes the downward movement of water, trapping it in the aquifers. The aquifer is a layer of sandy soil and gravel through which water flows.



Efforts Under Way

As noted throughout this report, a number of serious environmental challenges face Delaware's Chesapeake Basin, from an overload of nutrients to a steady loss of habitat for the unique wildlife that depends on the Basin for its survival. Many efforts are underway in the Chesapeake Basin to help improve and protect the environment – and many opportunities exist for you to contribute to the solution of our environmental problems.

The Nanticoke River watershed (including the Marshyhope Creek) comprises the single largest river system in Delaware's Chesapeake Basin. Not surprisingly, it has several local and regional environmental organizations monitoring land use decisions and activities and protecting the river with a variety of education, research, restoration, and land use planning projects. There are also several national organizations that have local interests in the Chesapeake Basin, such as the Sierra Club and the Audubon Society. Five of the more active private organizations in the Chesapeake Basin are listed in this section. All are concerned with the Nanticoke River system and all offer opportunities for citizens to get involved.



Photo by NOAA

Volunteers participate in restoration activities, such as re-establishing native plants, thereby creating stream-side buffers and reducing erosion.

Nanticoke Watershed Alliance

In June of 1992, Maryland and Delaware conservation organizations reached across state lines in a formal agreement to create the Nanticoke Watershed Alliance (NWA). The NWA is a non-profit organization and bi-state consortium of 36 diverse constituencies. Their mission is “to conserve the natural, cultural, and recreational resources of the Nanticoke River watershed for the benefit of present and future generations.” Their goals are to:

- ◆ *Promote and support protection, conservation, and management of important watershed-related natural resources and responsible resource-based industries.*
- ◆ *Recognize sites, structures, and activities that are important parts of the Nanticoke Watershed heritage, history, and livelihood, and work to achieve their preservation.*
- ◆ *Encourage educational and low impact recreational uses of the river.*

The NWA believes that “the level of conservation action in the Nanticoke Watershed over the next five years will largely determine the long-term future of this ecosystem. It is this window of opportunity of which we wish to take advantage. We know education, advocacy, land protection, and pro-active partnerships can protect our ecosystem. We believe that a lack of proactive efforts to preserve natural characteristics of a region ultimately leads to destruction of those attractions and concurrently to the economy of the region. This unique coalition will help secure the future environmental and economic health of the watershed.”

Since their inception, this **volunteer** organization has worked with thousands of citizens to conduct education, research, restoration, land use planning, and coalition building projects throughout the Nanticoke watershed. All of their projects are conducted in partnership with other organizations. Though small in staff and budget, their scope is wide and their multi-faceted focus makes them an important force in consensus building and in keeping those with different agendas working together.

The NWA has conducted numerous projects in



Photo by NOAA

Natural coconut-husk logs are used to stabilize the banks along this stream in the Basin.

partnership with other organizations including:

- ◆ *an American shad restoration project;*
- ◆ *a water quality monitoring program;*
- ◆ *a canoe trail;*
- ◆ *a boater safety education project as a result of a recent study conducted with the Departments of Natural Resources in Maryland and Delaware;*
- ◆ *a proposal project for rural legacy funds to protect sensitive lands in the watershed;*
- ◆ *a joint effort with Wicomico County and Program Open Space to permanently protect Roaring Point;*
- ◆ *a joint effort with DuPont to permanently protect 200 acres along the Nanticoke River in Seaford, Delaware; and*
- ◆ *a joint project with Wicomico County and all interested parties to collaborate on rural design standards and an urban services agreement.*



Photo by NOAA

Other activities have included: co-hosting an annual shad festival on the banks of the river; distributing an environmentally-sensitive yard care guide to citizens with the help of realtors who have already agreed to give the guide to home buyers; planning a demonstration site for bayscaping - a design for native plants to be used in landscaping (Salisbury Zoo volunteered to be the first demonstration site); continuing to develop classroom education; developing a web site; and annually pulling 15 to 30 tons of trash out of the river or nearby woods to help keep waterways clean and safe. These projects enhance awareness and appreciation of the Nanticoke, help prevent problems associated with other rivers, and present a model for other river protection groups. As the NWA is fond of saying, “If we take care of our river now we are saving ourselves from the much more difficult task of cleaning it up later.”

“There comes a point where we have to preserve some part of what has shaped and molded us as people - some part of what our forefathers handed down to us that has made southern Delaware a unique and wonderful place. It is now, while the Nanticoke River is still largely unspoiled, that we must preserve its places of special beauty and natural value before they are only a memory.” - Marlene Mervine, Founding Member of the NRWC, Delaware Adopt-A-Wetland Coordinator, Land Conservation Specialist

Continuing Efforts



Nanticoke River Watershed Conservancy

Land trusts are springing up all over the country to help save exceptional land from development. The Nanticoke River Watershed Conservancy (NRWC), formed in 1992, is a local land trust based in Seaford, Delaware offering a variety of ways for landowners to protect their land. The mission of the Nanticoke River Watershed Conservancy is to identify, promote, and actively seek the acquisition of lands with natural, aesthetic and historic significance in the watershed and to promote the protection and balanced use of these lands.

Landowners typically choose to protect their land with a conservation easement. A conservation easement is a written agreement between a landowner and a conservation agency, such as the NRWC, ensuring that a property will not be developed beyond an agreed upon limit, or perhaps not at all. The land remains in private ownership while the NRWC assures that the terms of the agreement are forever followed. Conservation easements are tailored to the needs and desires of a property owner enabling him or her to control the future appearance and character and even the function of the land. Landowners continue to farm, harvest timber, and hunt as well as reserve building rights for future use. The NRWC offers landowners individual planning assistance as they consider the use of a conservation easement or other land conservation techniques.

Nanticoke Watershed Preservation Group

The Nanticoke Watershed Preservation Group, formed in 1990, is a citizen's group of friends and neighbors, landowners and business people, farmers and watermen committed to promoting the preservation of the environmental and scenic quality of the Nanticoke River watershed. They provide and promote discussion, presentations, and activities that include educational opportunities, water quality monitoring, planning and zoning, establishing water trails, American shad restoration, and bayscaping.

Their biggest project recently involved bay-scaping - conservation landscaping with native plants for a healthy watershed. They also maintain and monitor an Adopt-A-Wetland water trail and sponsor lectures and workshop series, including a fall lecture series on various topics that range from cultural, historic, and environmental subjects. A River Watcher program is in the works.

Chesapeake Bay Foundation

The Chesapeake Bay Foundation (CBF) is the largest conservation organization dedicated solely to saving the Chesapeake Bay watershed. Their motto, Save the Bay, defines the organization's mission and commitment. With headquarters in Annapolis, Md., state offices in Maryland, Virginia and Pennsylvania, and a varied group of educational centers and programs, CBF works throughout the Chesapeake's 64,000-square-mile watershed.



The Chesapeake Bay Foundation, founded in 1967, is a not-for-profit organization. CBF is supported by more than 110,000 active members, has a staff of approximately 175 fulltime employees, and an annual budget of \$20 million.

The Chesapeake Bay Foundation's Heart of the Chesapeake project aims to protect and enhance water quality and natural resources in the drainage basins of Tangier and Pocomoke Sounds. The project works to preserve the rural character and quality of life in the region by integrating sensible land-use strategies with well-managed economic development. The Heart of the Chesapeake includes a large portion of Maryland's Eastern Shore and smaller sections of southwestern Delaware and Virginia's Eastern Shore. Pressure from development is forcing communities to create new strategies for managing growth and preserving the character of their region. Residents are working to ensure that their livable communities avoid rapid suburban sprawl and increased population and traffic in the countryside, a trend that debilitates town centers and diminishes established farming, timbering, and fishing industries. The Heart of the Chesapeake Project aims to help citizens take a balanced approach to addressing needs for economic development, environmental preservation, and levels of growth consistent with a high quality of life. The Heart of the Chesapeake project is addressing growth management issues by providing a forum for residents to envision what they want for the future of their community. Work to date in the Heart of the Chesapeake project area indicates that residents value:

- ◆ thriving farming, fishing, forestry, and tourism industries;
- ◆ well-managed growth;
- ◆ preserved land for environmental and economic advantages;
- ◆ reduced threats to water quality and wildlife habitat; and
- ◆ the sense of community and quality of life that has been enjoyed by residents in the Heart of the Chesapeake for centuries.

During the initial stages of the project, CBF Salisbury staff members have been meeting with citizens, government officials, industry representatives, educators, and advocacy groups to learn more about their vision for their communities. CBF intends to continue working with these groups

to develop and implement strategies for achieving that vision. The effort will set in motion a process for balancing priorities for land use, economic development, and conservation.

As the community's vision unfolds under the Heart of the Chesapeake project, residents will look critically at how things such as agricultural infrastructure and prosperous downtown shops contribute to a sense of community and its quality of life. The effort will help establish regional priorities and principles for use in refining growth management tools, including county land-use plans and development regulations.

Tributary Teams

Tributary Action Teams were formed in watersheds where a Pollution Control Strategy needed to be developed to help the watersheds meet the **Total Maximum Daily Loads** (TMDLs) of certain nutrients. Under the leadership of a team facilitator, tributary teams include environmentalists, farmers, government officials, students, industrial professionals as well as residents like you. They learn about the issues affecting their watersheds and develop ways to reduce the pollution. The reduction will help the waterways meet the TMDLs set by DNREC and the U.S. Environmental Protection Agency for every waterway in the state. The Watershed Assessment Section of DNREC's Division of Water Resources has a newsletter called the Tributary Times - a newsletter developed to update Delawareans on the activities of the state's Tributary Action Teams. Each bi-monthly issue features a statewide news section, a short feature on a team member, informational articles on different issues and Tributary Team news. Learn more about the Tributary Action Team in the Nanticoke watershed and how you can make a difference.



What You Can Do

There are lots of ways that each of us can contribute to the improvement of Delaware's Chesapeake Basin. This list includes only a few of them. The future of this environmental treasure – and the health of future generations – rests with each of us. Get involved!

Car Care

Activities such as washing the car, washing down the driveway, or draining the car's fluids can send detergents and harmful chemicals into your local storm drain and local waterway. Liquids that enter a storm drain are not treated, but go directly into a water supply, carrying with it chemicals that can pollute the water causing fish kills and human illnesses.

Wash the car on grass so that water and detergents are filtered through the grass before entering the watershed. Also, use an automatic shut-off nozzle to reduce water usage and runoff from your hose. Motor oil, anti-freeze, battery acid, brake fluid, gasoline, car wax, and rust preventatives harm the Chesapeake Bay when they flow into storm drains or off paved surfaces into a waterway, so check for leaks and contain these fluids when you change them. To discard these materials, contact your local service station about their recycling programs or call (DE) 1-800-662-8802 or (MD) 1-800-492-9188 for more information about safe disposal of chemicals.

Lawn Care

Pesticides, fertilizer, and eroded soil can make their way into storm drains and local waterways. Since storm drain matter is not treated, this means that harmful lawn runoff can pollute local waters causing algae blooms, fish kills, human illnesses, and restrictions on water recreation.

Limit your use of fertilizers to only what is absolutely necessary. Most lawns are over-fertilized, so perform a soil test every 3-4 years to determine the lawn's nutrient needs, and use phosphorus-free fertilizer. Call your local soil conservation district for more information about soil testing.



Lawns with trees and shrubs prevent erosion, soak up polluting fertilizer and pesticides before they run into streams, and improve soil quality by adding organic material. Test your soil and plant the right grasses and plants for your region. Compost leaves and lawn clippings to use as mulch or use a "mulching mower" and reduce the need for fertilizer. Also, remember that cutting the lawn too short weakens the grass and increases the likelihood of weeds.

Try to reduce the use of pesticides and if pesticides are used, try to use a natural (non-toxic) alternative. Follow the directions carefully on all pesticide labels and avoid applying when rain is in the forecast. A better way to eliminate harmful bugs is to encourage helpful bugs, birds, and animals in your yard.

Firewood attracts termites, so make sure it's stored away from your home. Remove water from old tires to prevent mosquitoes from breeding.

Home Care

Household chemical products, septic systems, and erosion can result in harmful chemicals and sediment making their way into storm drains and local waterways causing algae blooms, fish kills, human illnesses, and contaminated swimming areas, drinking water, and food.

Maintain your septic system. Inspections and pump-outs are an important part of septic system ownership. The Center for Watershed Protection

reminds homeowners that "the cost of regular inspection and pump-outs every three years (\$100-\$250) is far cheaper than the estimated \$2,000-\$8,000 it may cost to replace a malfunctioning system. Even those with relatively new homes need to be informed that the relative age of a system does not guarantee its proper function, and that an improperly installed system can fail within three to five years."

If a septic system fails, its untreated waste seeps into streams, rivers, ground water, and the Bay. Your system is not working properly if drains and toilets drain slowly or if effluent seeps upward from the ground. Never use your toilet as a garbage can. Use your garbage disposal sparingly to reduce grease and solids in your septic system. Know the location of your septic system and keep heavy equipment off the drainage area to prevent compacting and clogging.

Many household products like paints, preservatives, brush cleaners, and solvents can harm the Chesapeake Bay. Never pour them down the drain since sewers and septic tanks do not treat these materials. Buy products with the least amount of toxic material. Stuff empty paint cans and other chemical containers with newspaper and refer to a household hazardous waste chart for proper dis-



posal. Call your local wastewater treatment facility or the Water Environment Federation at 703-684-2400 for guidance.

When rain falls on hard surfaces such as walkways, patios, and driveways, it enters storm drains and ditches and finds its way into the Chesapeake Bay. This water carries with it elements that may be harmful to the river. You can slow run-off by reducing the amount of hard surfaces around your home. Wood decks with space between the boards allow water to drain into the ground. Brick or interlocking stone walkways also permit water to seep into the soil. Diverting rain from paved surfaces and roofs onto grass also reduces run-off into storm drains. Planting trees can help keep streams and the Chesapeake Bay free of nutrients and sediment and improve water quality. They can also reduce non-point source pollution, which is runoff and erosion from no single point of origin. Put a rain barrel under your rainspout to reduce runoff created by hard rains, and use that water in your garden.

If possible, purchase non-phosphate laundry detergents and non-toxic cleaning products; choose latex paint rather than oil-based paint; and use fabric softener sheets rather than liquids.

Finally, saving water helps the Chesapeake by reducing the volume of water going through sewage treatment plants. It also can save you money. In one day, a dripping faucet wastes 20 gallons of water and a leaking toilet wastes 200 gallons. Use water sparingly while brushing your teeth, washing dishes, or shaving. Install a water conservation showerhead and take short showers instead of baths.

Pet Care

Pet waste can be detrimental to water quality because it can introduce harmful nutrients and bacteria into storm drains and local waterways causing algae blooms, fish kills, human illnesses, and contaminated swimming areas, drinking water, and food. The Center for Watershed Protection reports that approximately 40% of Chesapeake Bay area residents own a dog, so cleaning up after pets is vital to keeping the Chesapeake Bay healthy and safe. Take along a plastic bag when walking the dog and help keep bacteria out of the Bay.

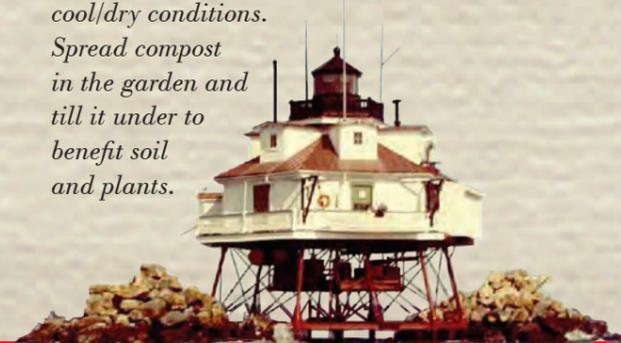
Additional Actions



Build a Compost Pile

Composting is a simple, cost-effective way to turn household scraps and landscaping debris into a beneficial resource. This reduces waste entering the landfills, diminishes the need for chemical fertilizers, and reduces the pollutant loads in residential run-off. Some key steps to get started are:

- ◆ Select a flat, well-drained spot that gets full sun. Try to build the pile in the middle of the garden.
- ◆ Construct a compost bin out of scrap lumber, bricks, concrete blocks, or wire. Make sure the bin has openings to let air penetrate the pile.
- ◆ Feed the pile, mixing coarse and fine materials in 6- to 8-inch layers. The bottom layer should contain twigs, chopped cornstalks, or other coarse material. Next, add a layer high in nitrogen such as grass clippings or manure. Top with soil and repeat the process. Sprinkle the pile with water.
- ◆ Mix the layers well and shape so the center is lower than the sides to help water flow into the pile. Turn the pile once a month and remoisten the material as you turn it.
- ◆ Plant material should decompose into compost within five months in warm weather, longer under cool/dry conditions. Spread compost in the garden and till it under to benefit soil and plants.



Follow Bay-Friendly Boating Practices

Many people cherish the recreational opportunities provided the waterways in the Basin. By obeying the law and taking common-sense measures into account during the use of the waters we can preserve or enhance the quality of life for generations to come. Therefore:

- ◆ Avoid discharging sewage directly into the water. Sewage contains disease-carrying organisms and nutrients that are harmful to humans, plants, and wildlife. Boaters should have some type of sanitation device on board, such as a portable toilet or holding tank, to treat the sewage. The waste should be disposed at dump stations or pumpout facilities. Dumping of sewage directly into the water is illegal. Take the time to find the proper disposal area near your boating area and, whenever possible, use onshore rest rooms.
- ◆ Don't litter. Dispose of trash in proper containers once onshore.
- ◆ Clean fish at designated areas and dispose waste in proper containers. Do not throw fish waste into surface waters at marinas; the waste can cause water-quality problems within the marinas.
- ◆ Dispose of or store liquid waste (e.g., oil, grease, detergents, paint) in the proper containers.
- ◆ Avoid over-fueling. One quart of engine oil spilled in 1 million quarts of seawater will kill half of the exposed crab larvae. Do not top off tanks. Purchase vents that act as fuel/air separators so that fuel does not enter the bilge. Use oil-absorbing pads in the bilge and dispose properly.
- ◆ Perform boat maintenance out of the water if possible. Use areas designated for dust and scraping control, where wash water is effectively treated. Treat paint dust and scrapings as hazardous waste and dispose properly. Recycle boat engine oil and other fluids.
- ◆ While keeping boat hulls clean is important for efficient operation, use detergents and antifouling treatments that do not contain phosphate and are biodegradable to minimize environmental impacts.

Antifouling paints work by releasing chemicals that are toxic to unwanted organisms that attach to boat surfaces. Unfortunately, high concentrations of chemicals such as copper and tin can be extremely harmful to other aquatic organisms in enclosed marine environments such as bays, harbors, and marinas.

- ◆ Obey speed limits and no-wake zones. Slow your boat before coming to speed-limit markers. Boat wakes contribute to shoreline erosion. Be careful in shallow areas; do not disturb the sediment or uproot vegetation with the boat propeller.

Recycle

Recycle Delaware is a voluntary recycling program. Most centers are located within a 5-mile radius of most households so residents can easily drop off recyclables. For the center nearest you, call the the Delaware Solid Waste Authority's Citizens Response Line, 1-800-404-7080.

Items accepted through Recycle Delaware:

- Paper** — newspapers, magazines, phone books, newspaper inserts and paperback books.
- Plastic** — narrow-neck plastic bottles only (milk jugs, soda bottles, laundry detergent, salad dressing, cooking oil, shampoo, cleaning bottles). Rinse lightly, remove lids, and crush. Labels and rings can stay on.
- Cans** — aluminum, steel, and empty aerosol cans (drink/food cans, pet food, hair/bug spray). Rinse lightly. Crush if possible. Labels can stay on. Remove plastic spray knob from aerosols.
- Glass** — food/beverage containers, jars. Rinse lightly. Remove lids. Label and ring can stay on.
- Cardboard** — (specified locations only, call 1-800-404-7080 for locations) corrugated cardboard only. Fold to fit in 60-inch by 5-inch opening.



Photo by DSWA

Motor Oil — (specified locations only, call 1-800-404-7080 for locations) used motor oil, hydraulic or diesel oil.

Oil Filters — (same locations as motor oil) used car and truck oil filters.

Batteries — small household batteries (A, C, D) and button type (watch, hearing aid, camera).

Buy Recycled Products

We can all be more environmentally conscious when making purchases. Consider buying recycled products. Ask local suppliers about the following:

Household Items — carpet and backing, kitchen containers, wall panels, roof materials, tissues, toilet paper, paper towels, gift wrap, trash bags, plastic lumber, floor tile, steel/aluminum containers, benches, picnic tables, flower pots, mailboxes.

Office Items — computer paper, stationery, envelopes, file folders, copier paper, notepads, printer and laser cartridges, rulers, wastepaper baskets, pens and pencils, binders.

Auto Parts — retreaded tires, oil filters, license plate frames, batteries, rubber accessories, rebuilt auto parts, oil.

Home*A*Syst Program

Home*A*Syst, a companion program of the Farm Assessment System, takes you step-by-step through a series of worksheets that help you understand potential hazards around your home. Topics include: drinking water; fuel storage; septic systems; fertilizers, herbicides/insecticides; hazardous waste; indoor air; and lead. Call University of Delaware Cooperative Extension for more information, (302) 856-7303.

Impaired Waters



Eutrophication can cause excessive plant and algae growth leading to further water quality problems.

Simply put, “impaired waters” are polluted waters. More technically, they are surface waters that do not meet water-quality standards for their designated uses, such as recreation, fishing, or drinking. Impaired waters could be suffering from excess nutrients, low dissolved oxygen, toxins, bacteria, heat, or any combination of these problems.

More than 90 percent of Delaware’s waterways are considered impaired. The state’s list of impaired waters, filed with the Environmental Protection Agency, includes 377 bodies of water that suffer from 11 different impairments, the most common of which are pathogens and nutrients (nitrogen and phosphorus). Most impairments come from non-point sources of pollution, which are difficult to control.

A 1997 federal court case required Delaware to develop pollution limits called “Total Maximum Daily Loads,” or TMDLs, for all impaired waters. A TMDL is the maximum daily amount of a pollutant that a body of water can absorb without violating water quality standards. A non-scientific definition for TMDL could be “pollution limit.”

Pollutants in Delaware waters are often chemicals, such as nitrogen and phosphorus from fertilizer runoff, but TMDLs could also be set for other pollutants such as bacteria, sediments, or even heat - anything that can injure a waterway’s natural health. Pollutants can come from specific “point” sources, such as sewage treatment plants, or from “nonpoint” sources, like runoff from lawns, farms, parking lots and golf courses. TMDLs have been established for the watersheds that drain into the Inland Bays, the Nanticoke River, the Appoquinimink River, the Christina River, the Murderkill River, Broad Creek, Red Clay Creek and White Clay Creek. As more than 90 percent of Delaware’s waterways are considered “impaired,” TMDLs will have to be set for many more waterways over the next few years. The deadline for setting them is 2007.

Setting pollution limits is just the first step toward improving water quality --- the important next step is the development of “pollution control strategies,” which is the mission of the Tributary Action Teams. Citizens on Delaware’s Tributary Action Teams have been identifying ways to improve water quality in Delaware’s rivers and bays

--- partly in response to the federal lawsuit, but also because they want to protect these valuable resources for recreational and commercial use, and for future generations. The Tributary Action Teams allow citizens to become involved early in the process and lets them sort out the difficult issues, wrestling with the trade-offs, and develop ways to reduce pollution. The Tributary Team concept, in-

roduced in Delaware by the Center for the Inland Bays, is an exciting opportunity for the citizens of Delaware to make a big difference in the health of their environment.

To learn more about Tributary Action Teams that may exist in your area, contact the Watershed Assessment Section at (302) 739-4590.

Glossary

Anadromous Species: Fish that spend part of their life in salt-water and part in freshwater.

Aquifer: A water-bearing geological formation that will yield water to a well or spring. Aquifers can be classified as confined or unconfined.

Basin: The surface area that drains into a surface water system.

Contaminant: Any element, substance, compound, mixture, or agent, other than a hazardous substance, which, after release from a facility and upon exposure of, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations in the organism or their offspring.

Erosion: Wearing away of soil by running water, wind, or ice; erosion is the process by which the Earth’s surface is shaped and occurs even in remote, uninhabited areas at a slow rate (geologic erosion); of more concern is accelerated erosion

caused by human activities.

Eutrophication: The enrichment of natural waters with inorganic material, especially nitrogen and phosphorus, such that they support excessive growth of plants/algae.

Ground Water: Water beneath the Earth’s surface at varying depths in reservoirs called aquifers.

Hazardous Waste: Any waste material that is potentially dangerous, including explosives, radioactive materials, and chemicals.

Non-Point Source Pollution: Pollution of surface or groundwater supplies originating from land-use activities and/or the atmosphere, having no well-defined point of entry.

Point Source Pollution: Pollution of surface or groundwater supplies at well-defined, usually manufactured points or locations; discharges of treated wastewater from municipal and industrial treatment plants are common point sources of pollution.

Septic System: An on-site system designed to treat and dispose of domestic sewage. A typical sewage system consists of a tank that receives wastes from a residence or business and a

system of tile lines or a pit for disposal of the liquid effluent remains after decomposition of the solids by bacteria in the tank.

Surface Water: Lakes, ponds, streams, rivers, and other water bodies, which lie on the surface of the land; may be partially or fully supplied by ground water.

TMDL or Total Maximum Daily Load: a calculation of the maximum amount of a pollutant that a water body can receive and still meet water-quality standards, and an allocation of that amount to the pollutant’s sources.

Turbidity: A measure of the amount of fine particles of solid matter suspended in water.

Watershed: An area of land that contributes runoff to one specific delivery point; large watersheds may be composed of several smaller “sub-watersheds,” each of which contributes runoff to different locations that ultimately combine at a common delivery point.

Water Table: The upper level of a saturated zone below the soil surface, often the upper boundary of a water-table aquifer.