



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 Delaware Bay and Estuary 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 Chesapeake Bay drainage in western 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](http://www.dnrec.state.de.us).

## Easy Reference Phone Numbers



### Environment Hotlines

Citizen Complaints (In State).....	1-800-662-8802
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

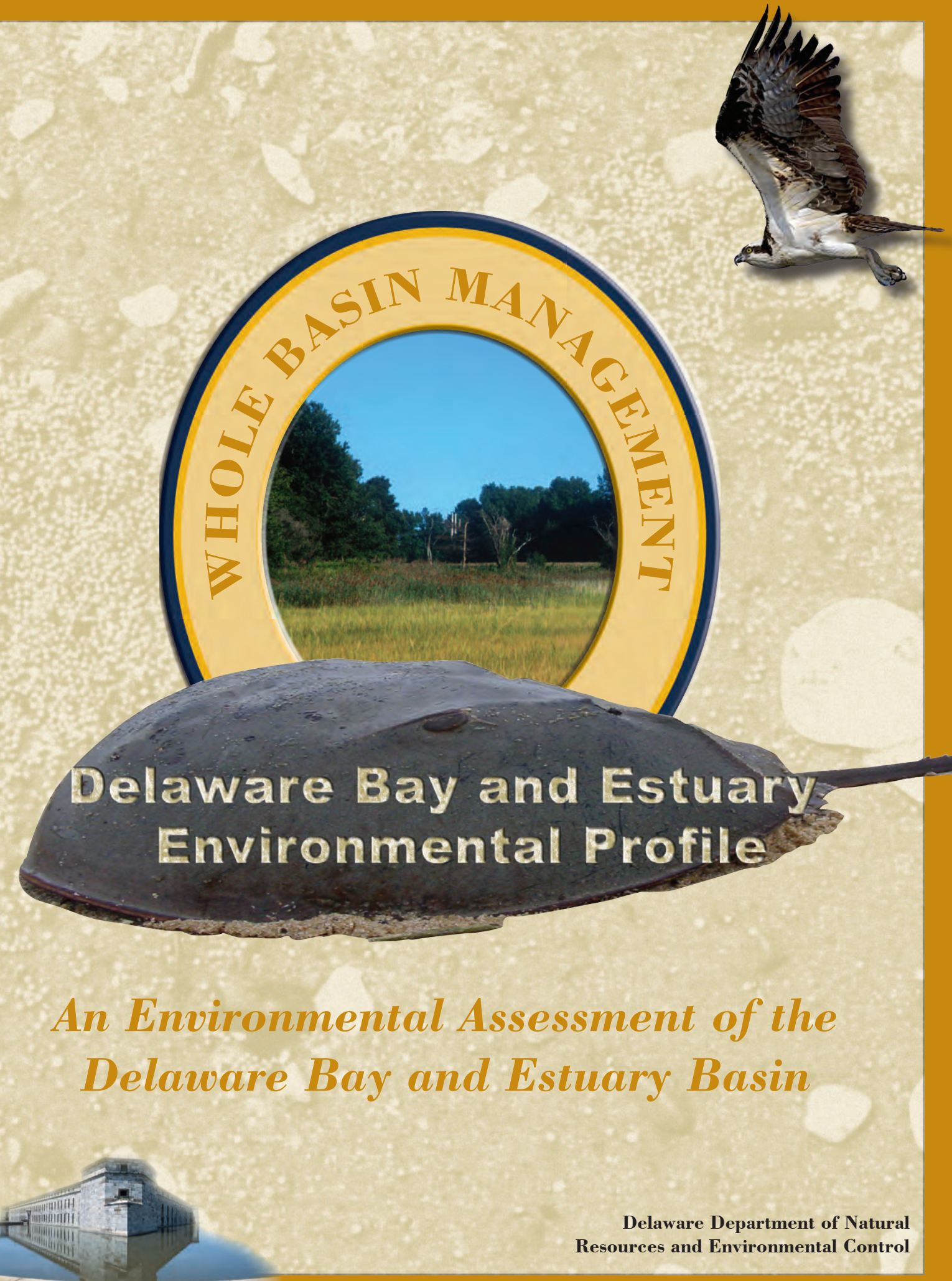
Director's Office .....	739-9921
Shoreline & Waterway	
Management Section .....	739-9921
Drainage Section .....	856-5488
Delaware Coastal Management Program .....	739-9283
Conservation District Operations .....	739-9921

### 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

Partnership for the Delaware Estuary .....	1-800-445-4935
Delaware River and Bay Commission.....	1-609-883-9500



## An Environmental Assessment of the Delaware Bay and Estuary 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 Delaware Bay and Estuary drainage basin in Delaware. It provides a summary of environmental information and highlights some of the treasures and challenges of the Delaware Bay and Estuary. This information is being used by the Department to establish 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 understanding that virtually every activity that takes place in the environment impacts multiple resources. For example, improper disposal of hazardous substances or excessive application of fertilizers on land can result in the leaching of these pollutants into ground water. Pollutants like these may also enter streams and other surface waters during storms. The consequences can be widespread, with potential impacts to public drinking-water supplies, habitat, aquatic life, and recreational fishing.

Managing the complex and dynamic natural world we call "the environment" requires examination of the many resources that compose it. Understanding and respecting the relationships that exist in nature between the air, land, water, and living resources has prompted the Department to focus on looking at the environment in an integrated fashion. This effort, which we refer to as "Whole Basin Management," involves monitoring, assessing, and managing all of Delaware's biological, chemical and physical environments on the basis of water drainage patterns.

Delaware has four major drainage basins: 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, 16 of which make up the Delaware Bay and Estuary Basin.

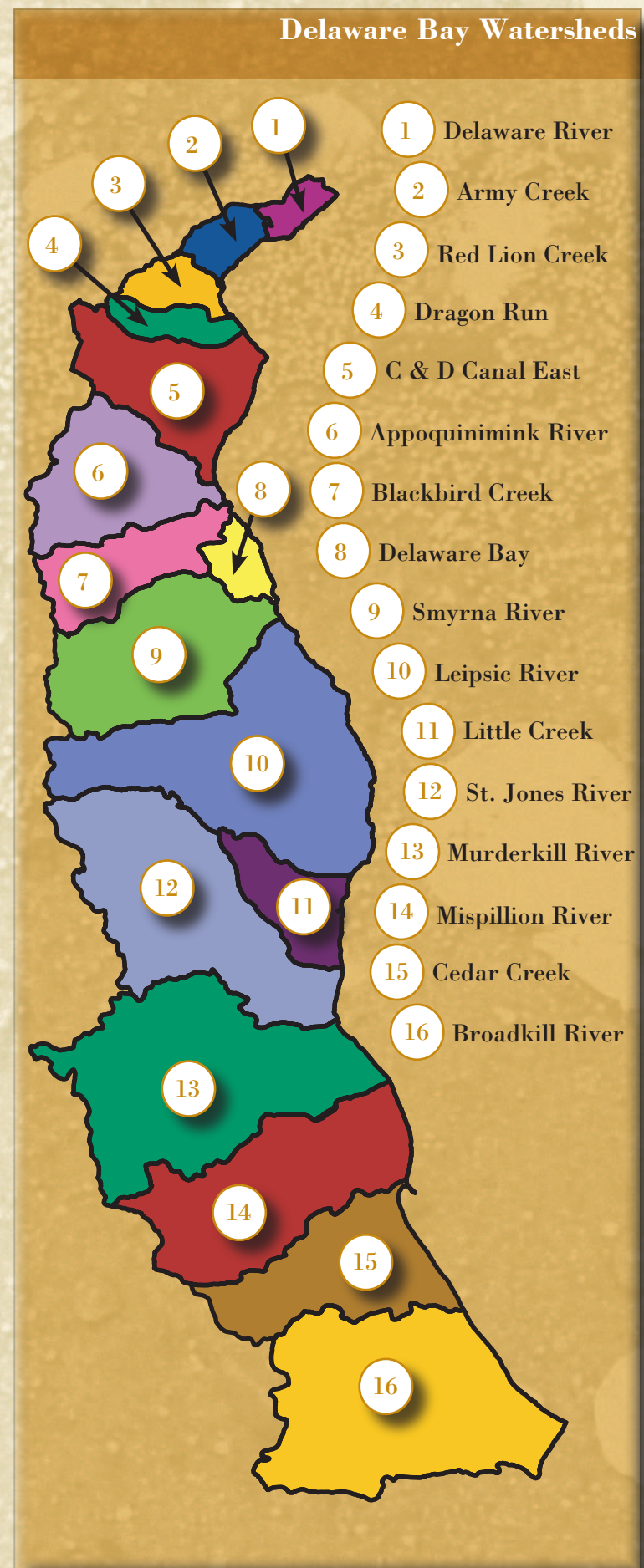
Delaware's four major drainage basins are highlighted below.



Shown at right are the 16 sub-basins that make up the Delaware Bay and Estuary Basin.

The Delaware Bay and Estuary Basin is located in eastern New Castle, Kent, and Sussex counties and is the largest of the four basins. The basin is named for the water bodies into which it drains – the Delaware Bay and the Delaware Estuary. The basin encompasses approximately 520,960 acres, or 814 square miles.

The Delaware Bay and Estuary Basin is the fourth basin being assessed by the Department's Whole Basin Management Program. The primary objectives are to protect the environment, improve community outreach, maximize resource use, 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 watershed in which you reside.



This publication is a summary of the Delaware Bay and Estuary Assessment Report. The pages that follow contain information on the following topics:

- ◆ Watershed Hydrology
- ◆ Water Quality and Quantity
- ◆ Contaminant Sources
- ◆ Land Use and Comprehensive Planning
- ◆ Coastal Zone
- ◆ Living Resources
- ◆ Recreation
- ◆ Efforts Under Way
- ◆ What We Can Do
- ◆ Additional Actions
- ◆ Impaired Waters

As you read this document you are encouraged to think about the problems or issues that concern you in your watershed and the actions we can take together to protect and improve our environment. You'll find some suggestions for what we can all do to help the environment in the last section of this document.

Let's continue to be responsible stewards of the environment and create an environmental legacy that we can be proud to pass on to future generations. We must remember that we are simply borrowing the natural treasures of the Delaware Bay and Estuary from our children. Our goal is to leave them with the same treasures our ancestors left us to experience and enjoy in the bay and estuary!

*For more information about the Department of Natural Resources and Environmental Control's Whole Basin Management approach, please contact:*

**Stephen N. Williams**  
*Ecological Restoration and Whole Basin Management Coordinator*  
 302-739-9000

*For details about the Assessment Report for the Delaware Bay and Estuary Basin,*  
**Mark Biddle**  
*Delaware Bay and Estuary Team Leader*  
 302-739-4590

**Delaware's Good Nature Depends on You!**



# Watershed Hydrology

We tend to take the availability of water for granted. How often do we think about its source, how it flows from the tap above our sink or is pumped from our private or public wells? We're more appreciative in times of drought, but with increasing populations and development, the source and supply of our usable water and conservation of our water resources have become important watershed issues year-round, regardless of precipitation levels.

Almost all of the water that exists today was developed billions of years ago when the earth was formed. The amount of water stays fairly constant because our water supply is continuously being recycled through the earth's natural processes known as the water cycle.

The water cycle depicted in the diagram shows the different stages in the cycle. The sun heats oceans, lakes and rivers, causing the liquid water to evaporate into a gas called water vapor. Plants also release water through their leaves in a process called transpiration.

When the water vapor cools, it condenses to form clouds. Precipitation occurs when water from

the clouds falls to the earth as rain, sleet, hail, or snow. Some water is absorbed directly by plant roots. Other water seeps into spaces underground and becomes **ground water**. The water that seeps underground replenishes the **aquifers**. Waters the ground cannot absorb due to saturation or heavy precipitation events ends up as runoff. All water eventually reaches streams and rivers which flow to the oceans where the water cycle begins all over again – every day – all around the world.

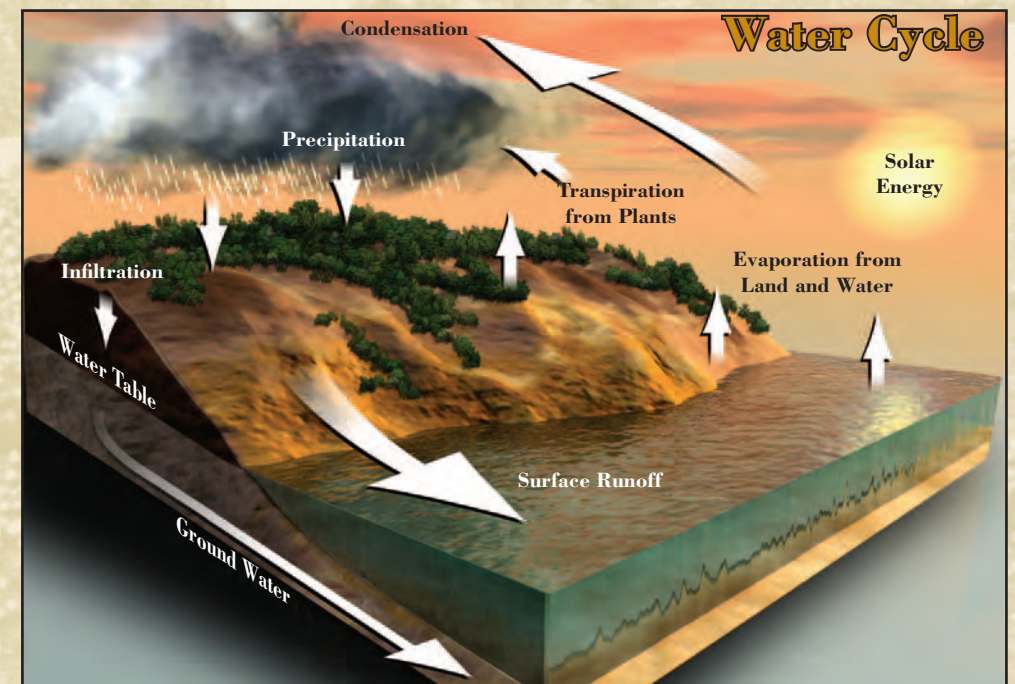
Water is stored in underground "reservoirs" called aquifers. Aquifers are porous sections of rock and soil that can supply significant amounts of water. There are 14 major aquifers in Delaware; thirteen are in the Delaware Bay and Estuary Basin. The water availability and depth of these aquifers differ throughout the basin.

Each day in the Delaware Bay and Estuary Basin, Delawareans use over 62 million gallons of fresh water for drinking, industrial, and agricultural purposes. Almost this entire amount is obtained from wells pumping ground water stored in the aquifers.

For example, in the accompanying cross-section

tion, or vertical slice of the earth through this basin, you can see that the towns of New Castle and Delaware City have wells that obtain water from an aquifer known as the Potomac Formation. Moving further to the south, the city of Dover's main water sources are from the **water-table** aquifer called the Columbia Formation and deeper water-bearing units called the Piney Point and the Cheswold aquifers. In the southern part of the basin, the town of Milford derives its water from the Columbia Formation and the Milford and Frederica aquifers.

Ground water is the sole source of drinking water in this basin. Ground water is available from both the unconfined, or water-table aquifer and several deeper, confined aquifers. Throughout much of the basin, however, the unconfined aquifer is connected with the underlying confined aquifers, as the sediments that separate them have been eroded away by the meandering course of the Delaware River, which acts as a reservoir for surface-water runoff

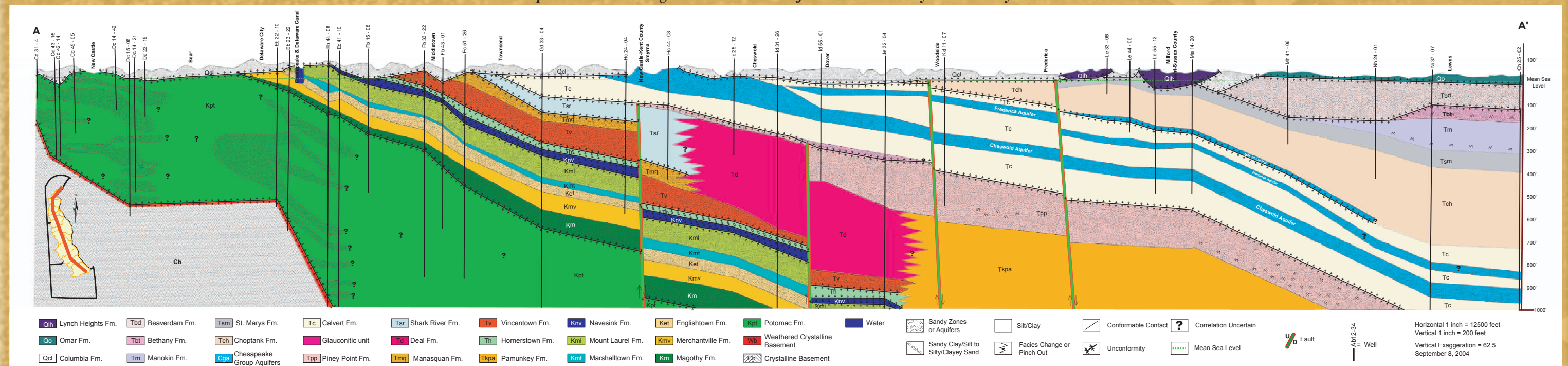


*Human activities can have a significant impact on the water cycle. When forests and other vegetation are removed and roads and buildings constructed, less precipitation can infiltrate the soil, and runoff increases.*

and **ground-water discharge** within the basin.

Despite the seemingly plentiful supply in deep aquifers, water is not an infinite resource. During the past decade, several serious droughts in Delaware – the most recent in 2002 that pushed stream levels in northern New Castle County to record lows – have served to illustrate this lesson for many residents.

Representative Geological Cross Section of the Delaware Bay and Estuary Basin





# Water Quality and Quantity

Streams, wetlands and tidal rivers of the Delaware Bay and Estuary Basin support diverse populations of fish and wildlife and provide public drinking water supplies, agricultural and industrial needs. **Ground water** is the only source of public water supply located within the basin; however, many residents are served by public water suppliers that use **surface water** sources from the neighboring Piedmont Basin. Agricultural water users also rely on the basin's ground water, with the exception of a small number of farm ponds and streams used for withdrawals. Industrial water use is heavier than in any other basin and is almost exclusively drawn from ground-water sources and the Delaware River.

The five most heavily used **aquifers** in the Delaware Basin are the Columbia, Potomac, Cheswold, Frederica, and Piney Point. The Columbia and Potomac supply over 40 million gallons of water on a daily basis. The remainder of the withdrawals comes from the Cheswold, Frederica, Piney Point

and other aquifers within the basin. Of the five major aquifers, only the Columbia, Cheswold, and Frederica have adequate supplies to allow for further allocations. The declines in water levels in the Potomac and Piney Point, compared to their historical levels, are currently too great to allow additional large-water allocations.

These restrictions impact two of the three highest growth areas of the state – greater Dover and New Castle County. While water levels in the Piney Point have stabilized over the past several years, those in the Potomac have not and continue to show gradual decline, approaching the top of the aquifer in northern New Castle County. Due to the heavy use of the aquifer in that area, along with proposals for additional withdrawals, the Department is constructing a regional ground-water flow model under contract with the U.S. Army Corps of Engineers to determine the maximum yield from the aquifer. Once completed, the model will enable the Department to make decisions regarding exist-

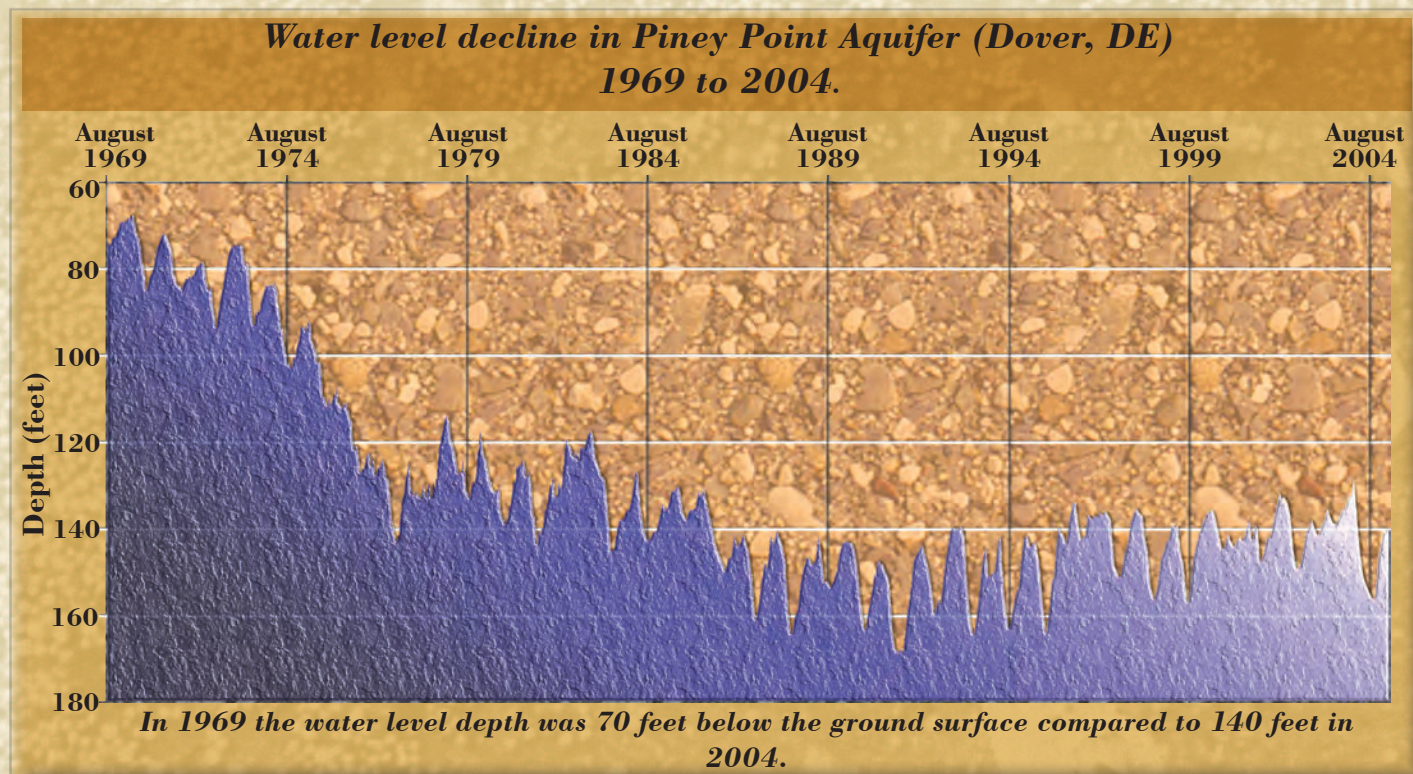


Photo by NOAA

ing allocations for the aquifer, and the possibility of any additional withdrawals. Further growth in these areas will require development of new water supplies and the integration of water supplies on a regional basis connecting water sources in less-stressed areas with populations in high-growth areas.

Regarding water quality, the Delaware River in the Philadelphia area was once one of the most polluted estuarine regions nationwide. Low levels of dissolved oxygen – a primary sign of poor water quality – were a chronic condition in warm weather. Today, water quality has vastly improved due to advances in wastewater treatment systems and regional bay monitoring. Dissolved oxygen levels in the estuary have returned to moderate levels that will now sustain fish populations. The Delaware Bay coastline has been largely preserved and the fresh water and estuarine habitats have remained environmentally productive due to enactment of the Coastal Zone Act in 1971. The headwaters and upland sections of the streams that discharge to the bay in the **coastal zone**, however, are susceptible to contamination from agricultural, urban, septic and industrial sources.

The maximum pollution limit that streams can tolerate and meet water quality standards is called the **total maximum**

**daily load** (TMDL). The Department is currently establishing TMDLs for impaired waterways and works with citizens, environmentalists, local officials and other groups to develop pollution reduction strategies and restore water quality. The Appoquinimink watershed's level of stream contamination has caused it to be one of the first watersheds subject to TMDL restrictions. TMDLs have also been set for **nutrients** and **dissolved oxygen** in the Murderkill River and its tributaries. **Pollution control strategies** are being developed which, when implemented, will help meet those limits.

Contamination of the shallow aquifers – the Columbia, for example – is also a concern because of the basin's high industrial concentration. The detection of **BCEE (bis[2-chloroethyl] ether)** – a known carcinogen – in the Llangollen wellfield (Potomac aquifer) required its removal through water treatment at great expense and led to a statewide investigation of surface and ground-water public drinking water supplies located near **hazardous waste** sites, nearly half of them in this basin. Fortunately, results indicated that none of the treated water supplies in the study exceeded existing regulatory standards for drinking water.

Salt-water intrusion can also affect the basin's aquifers. Normally, salt water does not impact a large area in any of Delaware's aquifers. However, wells pumping from the fresh water portion of the aquifers lower the water level, causing the salt water to move further inland. This has mainly occurred in coastal New Castle and coastal Sussex counties.





# Contaminant Sources

The Delaware Bay and Estuary Basin contains a variety of known and potential **contaminant** sources such as active and abandoned industrial sites, gas stations, landfills and septic systems, as well as other **non-point sources** such as urban and agricultural stormwater runoff. A contaminant source is anything that has released, or has the potential to release, pollutants to air, soil, ground water, surface water or sediments. The contaminants can come from a variety of sources like industrial complexes and factories, or from urban and suburban residential areas and agricultural operations.

Fish consumption advisories have been issued in segments of several watersheds within the Basin: Red Lion Creek, Delaware River and Bay, C & D Canal, Appoquinimink River, St. Jones River. **PCBs** (polychlorinated biphenyls) are the primary contaminants of concern, while **dioxins**, chlorinated pesticides and mercury exist and present a concern. Potential industrial and municipal sources in the Delaware Bay basin are being monitored by the Delaware River Basin Commission to identify PCB origins. Many of the basin's streams and ponds are enriched with nitrogen and phosphorus. These excess nutrients can cause overgrowth of aquatic plants that deplete water oxygen levels important for fish survival, and result in deterioration of water quality in a process called **eutrophication**.

More information about fishing advisories and water quality issues can be found either in the Department's Fishing Guide or online at: <http://www.dnrec.state.de.us>



The Delaware Estuary contains the world's largest freshwater port



The Delaware Solid Waste Authority's Cherry Island Landfill; located along the Delaware River in New Castle County

## Solid and Hazardous Waste

Hundreds of small and large businesses produce and manage **hazardous waste** within the basin. Hazardous wastes come from processes that supply goods and services we use routinely, from fuels and chemicals to dry cleaners and auto repair shops. Hazardous waste improperly managed can pollute the land, air and water and harm people, animals and plants. The Department works with businesses to manage their household hazardous waste to reduce the potential to cause harm and the amount produced.

Historic releases of hazardous substances occurred when industries spilled, mishandled, or disposed of hazardous materials. Modern-day laws and environmental oversight programs are now in place to remediate existing hazardous waste sites and ensure that everyone properly handles and disposes their hazardous waste. Many of the historic hazardous release sites are now located in and around urban areas due to growth. The Department's Site Investigation and Restoration Branch is responsible for the investigation and remediation

of Superfund sites within the basin.

Underground tanks that leak can pollute the ground water and soil. This basin has dozens of leaking underground storage tank sites with severe ground-water contamination, most of them located at gas stations. The Department's Underground Storage Tank Branch is remediating these sites with clean-ups tailored to specific conditions at each site.

Delaware residents and businesses together throw away over 1.2 billion pounds of trash each year, nearly all of it into landfills. The state has regulated landfills since the mid-1960s to reduce environmental risks. In modern landfills, the waste is covered to control insects and rodents, a bottom liner prevents leachate ("garbage juice") from contaminating ground or surface water, and gas collection systems control odors and collect **methane**. These protective measures are most efficient at large landfills and today, just one large, modern landfill operates in this basin.

## Nutrients

Urbanization and agricultural activities are primary sources of nitrogen and phosphorus in the basin. Phosphorus enters waterways primarily on soil particles through soil erosion and runoff; nitrogen can enter through **point source discharges**, **atmospheric deposition**, **erosion**, runoff, and **ground-water discharge**. Nutrient sources include on-site septic systems and domestic sewage treatment plants, lawn and crop fertilizers, sediments from construction activities, exhaust emissions and open burning.

**Septic system** discharges may contribute the greatest suburban and rural loading of nutrients to waterways. More than 32,000 septic system permits have been issued in the basin, adding as much as 350,000 pounds of nitrogen and 15,000 pounds of phosphorus to the soils annually. Most of the nitrogen from septic tanks is converted to nitrate-nitrogen, which easily enters the ground water and eventually discharges into the waterways.

Agricultural settings contribute significant amounts of nitrogen and phosphorus via field applications of manure, litter, and chemical fertilizers. The nutrients are transported to surface waters when over-applied to the fields. Comprehensive nutrient management plans being implemented significantly reduce agricultural nutrient impacts. Many poultry operations now have manure storage facilities. State and federal cost-share funds and low-interest loans are available for installation of manure storage sheds and dead-bird composters. Research continues on methods to reduce phosphorus levels in manure through poultry feed modifications.

The drinking water standard for nitrate (as nitrogen) is 10 parts per million (ppm). Nitrate concentrations in ground water vary from less than 0.5 ppm in natural areas to greater than 100 ppm in areas with historically intensive poultry production.



Excessive amounts of poultry litter contribute to high nitrate levels in surface and ground water

Photo by DSWA



# Land Use and Comprehensive Planning



*The Delaware Memorial Twin Bridges - the world's longest twin-span suspension bridge - crosses the Delaware River connecting Delaware and New Jersey*

Diversity best describes land use in the Delaware Bay and Estuary Basin. From the coastal marshes to rural farms and housing, to small towns and cities, the basin encompasses every type of land use. Balancing land development and the increasing population pressures at the northern and southern portions of the basin with development around the state capital at the basin's midpoint will be one of the most important land use planning issues for the next 20 years.

A critical point of land use change is evolving in this basin and throughout the state. For many years, this basin resembled a rural farmed landscape interspersed with small towns. Beginning in the 1960s, an influx of people from adjoining states seeking a less hectic living environment has added to a steady increase in Delaware's population. This influx of people has increased dramatically

since the 1980s. Most of the new residents have established permanent residency; however, within coastal communities in the southern portion of the basin, seasonal populations have evolved.

The population of the Delaware Bay and Estuary Basin is roughly 222,000 based on the latest 2000 census data. Population projections for Delaware's three counties show expected increases of 21% for New Castle County, 30% for Kent County, and 55% for Sussex County between 1990 and 2020. These figures translate into an estimated additional 100,000 residents to the Delaware Bay and Estuary Basin for the 30-year period.

These population changes can burden the infrastructure needed to support growth. New residents and developments often require more roads, shopping areas, police/fire/ambulatory services,

*On March 22, 2001, Gov. Ruth Ann Minner unveiled a Livable Delaware growth initiative for the First State.*

*Livable Delaware addresses sprawl, congestion and other growth issues that ultimately affect the air we breathe, the water we drink, public health, recreational waters and fisheries, habitat protection, biodiversity, open space, recreational opportunities and many other "quality of life" issues.*

*Gov. Minner's Livable Delaware agenda began with an executive order that restates the goals and strategies in "Shaping Delaware's Future" to guide the state's overall development in the 21st century.*

*The executive order directs all state departments and agencies to examine their policies, programs and regulations and identify programs that are or can be utilized to direct growth and control sprawl.*

## Livable Delaware

*Five Livable Delaware bills were signed into law by Gov. Minner in 2001:*

- ◆ *Graduated impact fees based on state investment strategies;*
- ◆ *Comprehensive plan implementation and annexation standards;*
- ◆ *Changes to the Open Space formula to allow acquisition for 18 additional years and provide funds for stewardship of acquired lands;*
- ◆ *Matching grants to encourage redevelopment of brownfields; and*
- ◆ *New Advisory Council on Planning Coordination with land use responsibilities that include developing a graduated impact fee structure and annexation standards, approving and monitoring "Livability Indicators" and facilitating governmental dispute resolutions.*

schools, hospitals and other services. Proper planning at the county and municipal levels in coordination with state agencies has become a necessity to eliminate further sprawl and accommodate growth. While rapid increases in population and development can cause deterioration in air and water quality and natural habitat, increase pressure on water supplies and threaten preservation of open space, sound comprehensive land use plans for future development can mitigate negative environmental impacts.

Urban land use now covers about 18% of the basin, which includes residential, industrial, com-



*Sanitary sewer lines being installed, part of the wastewater infrastructure in the basin*

mercial, and transportation land uses. Between 1992 and 1997, an approximately 3% increase in urban land use occurred in Delaware. If the trend continues, by 2020, the Delaware Bay basin urban land use will be approaching 30%. Urbanization has caused losses primarily to farmland, forestland and wetlands. Land use decisions that provide protective mechanisms and steer development to pre-determined growth areas could slow down these losses caused by urban development.

Land-use planning and zoning authority in Delaware resides with the three county governments and individual municipalities. Each county and some municipalities develop land use plans in 5- or 10-year increments to help guide development to desired areas based on input from government agencies regarding issues such as agricultural preservation, infrastructure and the environment. Other planning and review processes allow input from various agencies on development projects and requests for zoning changes. These processes are extremely important in protecting exceptional forest and wetland habitat that may harbor state or globally rare species, and in helping to achieve the state's goals of protecting the quality of our air and water.



# Coastal Zone Act

The Delaware Coastal Zone Act (CZA) has been extremely successful in preserving the natural conditions along the approximately 4-mile wide area bordering the state's shoreline, especially north of Lewes to New Castle. Since Gov. Russell Peterson signed the Act into law in June 1971, no new heavy industrial plants have been erected in this environmentally sensitive coastal area used mainly for outdoor recreation and resort communities. Yet without the CZA, it could have been a different story. Nonconforming heavy industry uses are slowly disappearing due to changing business climates and fate. The Fisher fish plant in Lewes, the Stouffer Chemical plant, Abex, Amoco Refinery in New Castle County, and an oil terminal near Milford have all closed for various reasons. The following overview highlights significant events that shaped the CZA program.

**Early 1970:** Gov. Russell Peterson appoints a Task Force on Marine and Coastal Affairs to advise the governor on a proper course of action to protect the state's interest in its coastal resources, especially regarding industrialization of the coastal area.

**February, 1971:** The task force

*recommends in a preliminary report that industries compatible with high environmental quality standards be encouraged, but that no further incompatible heavy industries be allowed. The task force also recommends prohibition of a deep-water port and emphasizes the coastal area's recreational value.*

**Spring, 1971:** Gov. Peterson has legislation (H.B. 300) introduced in the General Assembly to implement the task force's findings.

**June 28, 1971:** Gov. Peterson signs the Coastal Zone Act (Title 7, Chapter 70, Del. Code) into law. The State Office of Management, Budget and Planning is the administering agency and the State Planner is the Act's official administrator.

**July 23, 1971:** Delaware Terminal Company proposes the first project, consisting of a land purchase near Claymont for a new oil transfer dock and tank farm, but eventually chooses not to proceed.

**Dec. 17, 1971:** First CZA victory – Delaware's State Planner rules that a proposed monobuoy for supertankers 26 miles east of Rehoboth to transfer crude oil through the zone on a sea-floor pipeline to a proposed



tank farm near Rehoboth, is a prohibited offshore bulk product transfer facility.

**Nov. 1, 1981:** Gov. Pete DuPont terminates the Office of Management, Budget and Planning and amends the CZA to move it to DNREC with the Department Secretary as the official administrator.

**1985-1987:** Norfolk Southern and the U. S. Department of Commerce fight the legality of the CZA. Norfolk Southern had received DNREC approval to transfer coal between ships in the Delaware Bay. The Secretary's decision was appealed to the state Coastal Zone Industrial Control Board, which, after a public hearing, voted to overturn the decision. The company challenged the decision in state and federal courts. The Department of Commerce sided with Norfolk Southern, claiming that the coal transfer prohibition interfered with interstate commerce. Eventually, the state prevailed and the company discontinued the legal fight.

**July 10, 1992:** The CZA is amended to clarify that pre-existing heavy industry uses in operation on June 28, 1971, can expand or extend their operations by acquiring a CZA permit, just as any light manufacturing plant can expand.

**March 19, 1998:** A Memorandum of Understanding laying out the concepts for formal regulations to support the CZA is signed March 19, 1998 by all business representatives and environmental advocates of Gov. Tom Carper's Coastal Zone Act Regulatory Advisory Committee.

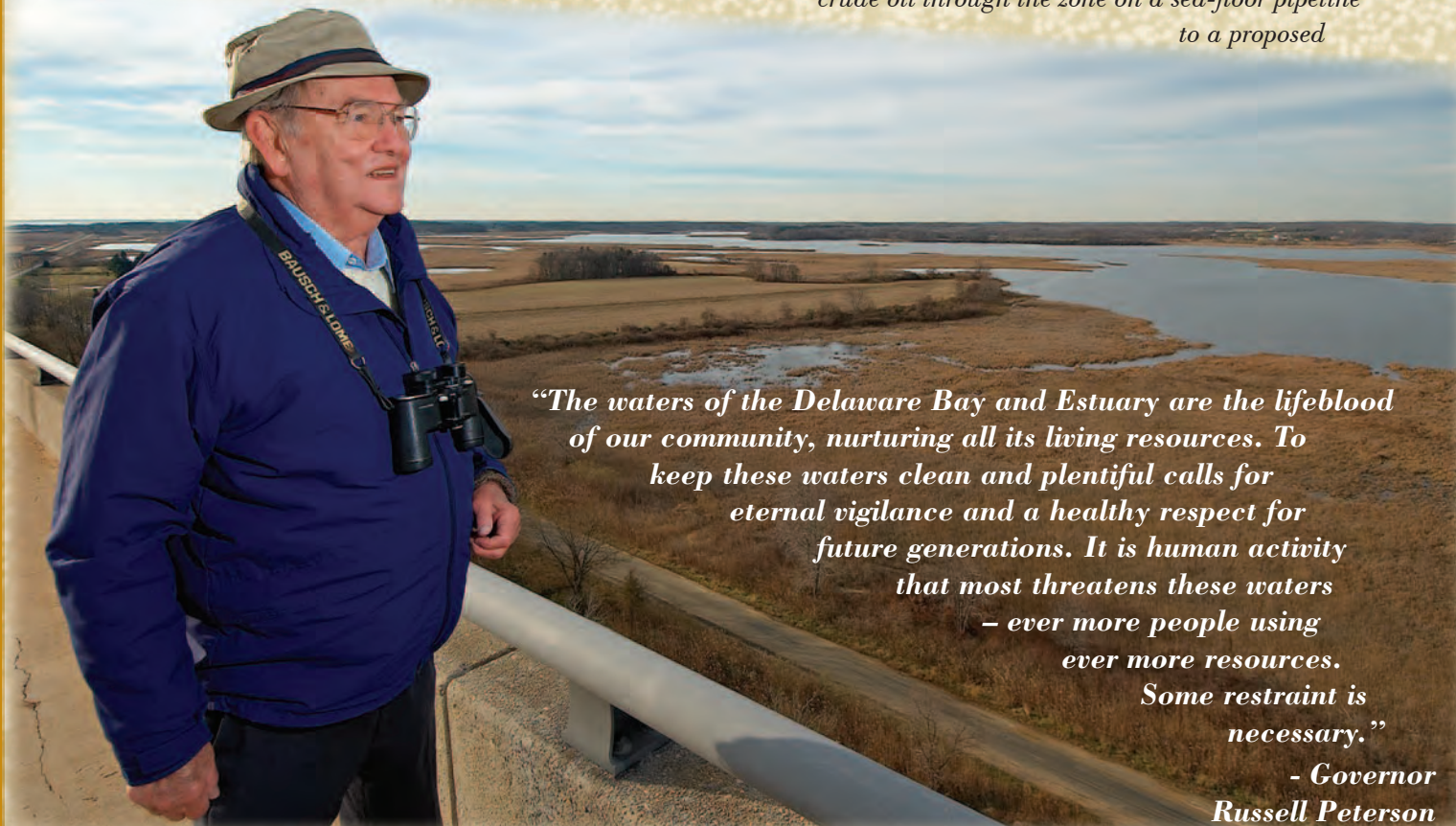
**May 1999:** The "Regulations Governing Delaware's Coastal Zone" become effective. The

regulations have a win-win concept – business interests win the right to expand and the environment wins by receiving a net improvement. Any new environmental damage must be more than offset by an "offset project" that makes up for an applicant's additional pollution. All CZA permits are now pro-environment. Several lawsuits are filed by local governments against Section F that requires sewage treatment plants to acquire permits for major modifications. A 2001 agreement among all parties drops this requirement.

**June, 1999:** The General Assembly passes House Bill 330, which defines "incinerator" as a prohibited use in the coastal zone. No waste-to-electric power plants are allowed in the zone along with any medical waste incinerators.

**Oct. 16, 2000:** The first major CZA permit issued under the regulations is granted to Conectiv Energy for expanding its electric generation capacity by 550 megawatts and lowering its net air emissions by many tons of NO<sub>x</sub> (nitrogen oxides) and SO<sub>2</sub> (sulfur dioxide) per year. The permit illustrates the win-win concept envisioned in the regulations.

*"Here is what we said when industrialization threatened the Delaware Coastal Zone, 'We have faced the challenge and made a choice. If uncontrolled industrial growth means great loss of our natural resources, then the price is too high and we don't want it.'" - Governor Peterson*



*"The waters of the Delaware Bay and Estuary are the lifeblood of our community, nurturing all its living resources. To keep these waters clean and plentiful calls for eternal vigilance and a healthy respect for future generations. It is human activity that most threatens these waters – ever more people using ever more resources. Some restraint is necessary."*

*- Governor  
Russell Peterson*



# Living Resources



Photo by DSWA

The Delaware Bay and Estuary Basin encompasses major habitats for diverse living resources within its vast expanse of coastal salt marsh and its upland forests. Many rare reptile, amphibian, birds, shellfish, and insect species reside within the basin. However, wildlife habitat is being reduced by ever-present human activity, and the fragility of aquatic and other species becomes more apparent every year.

## Priority Communities

Wetlands serve a variety of vital ecological functions: they filter nutrients, sediments, and toxic chemicals from the water; minimize storm and tidal flooding; and slow erosion by providing a buffer against tides, waves and storm-event flow. They produce food through breakdown of biological material and provide important primary and seasonal habitat for animal and plant species dependent upon wetland environments.

Some of Delaware's most diverse freshwater, brackish and saltwater wetland com-

munities constitute more than 27% of the basin. Moving upstream from estuarine marshes, travelers pass through brackish river wetlands dominated by forest or shrubby vegetation, through linear freshwater stream wetlands to headwater wetlands known as flats that vary from forested to shrubby to emergent vegetation. Depression wetlands, driven by ground water or precipitation, exist throughout the basin.

Most significantly, this basin contains wetlands with rare and unique ecological community types such as the Atlantic white cedar and bald cypress swamps, and Coastal Plain ponds, known also as Delmarva bays. These ponds are small but extremely significant isolated freshwater wetlands that are home to dozens of rare plant species, including five species considered globally rare.

Historically, this basin has lost substantial wetlands acreage to development and agricultural land conversion. An estimated 54% of Delaware wetlands have been lost since 1780, although the rate of loss has slowed recently. Of the nearly 2,000 acres of freshwater and saltwater wetlands lost in Delaware between 1982 and 1992, about 740 were in this basin. Today, much of the saltwater marshes and coastal lands are owned and/or controlled by

state or federal government, reflecting the success of the Coastal Zone Act.

Mature forests provide diverse habitat for many species of native mammals, invertebrates, amphibians, reptiles, and birds, including migratory songbirds. Of the 58,014 remaining forested acres, most tracts in the basin are less than 150 acres. Clearing for agriculture and development continues to fragment existing forests, and very little regulatory protection exists for upland forests.

Pea Patch Island, off the coast of Delaware City, is home to the largest colony of nesting herons on the east coast north of Florida. The population has declined from more than 12,000 nesting pairs in the late 1980s to about 3,000 pairs today. In 1998, the Delaware Coastal Management Program developed a Special Area Management Plan which outlines strategies to protect the heronry.

## Priority Species

The Delaware Bay basin and its wetlands provide important migratory staging grounds and wintering habitat for many waterfowl species of the Atlantic Flyway. Losing half of the wetlands in the Atlantic Flyway over the last 200 years led to wetlands management and restoration efforts to create staging, brood rearing and wintering areas, and creation of the North American Waterfowl Management Plan and other focused efforts.

The Delaware Bay coastline is integral to the survival of migratory shorebirds that depend on horseshoe crab eggs for food. More than a million shorebirds migrate from as far south as South America and stop over in the Delaware Estuary to engorge on the eggs before continuing their migration to Arctic nesting grounds.



Oysters being harvested from the Delaware Bay

Oyster beds in the Delaware Bay extend roughly from Woodland Beach to Big Stone Beach across to Cape May, N. J., in addition to scattered riverbeds. Delaware sustained a commercial harvest through 1985 followed by 2-week harvests in June from 1991-95. On Nov. 1, 2001, the state opened its first "direct harvest" season in which oysters go directly from public beds to shippers to consumers. Traditionally, oysters were taken from public beds and transferred to lease beds further down the bay, which resulted in 50% oyster mortality.

The Delmarva fox squirrel is found in mature hardwood and loblolly pine forests along streams and the bay. Population declines from loss of habitat put this squirrel on the Federal Endangered Species list in 1967. It was reintroduced in Delaware, but their numbers remain low.

Freshwater mussels – our country's most endangered family of animals – live in bottom sediments of freshwater streams, rivers, and ponds and are important indicators of water quality. Of the 13 species in Delaware, 11 are rare or extremely rare.

The Atlantic blue crab is near the northern edge of its eastern range in the Delaware Bay. Harvesting pressure keeps the population moderate at most due in part to harvest declines in the Chesapeake Bay.





# Recreation

The natural resources of the Delaware Bay and Estuary Basin provide numerous recreational opportunities. Situated along the Atlantic Flyway, Delaware's coast has become a well-known, ideal destination for birders. The vast salt marshes rimming the coast serve as outdoor environmental laboratories for studying and observing nature. Throughout the basin, a wide variety of ponds and interlacing streams provide exploration opportunities for canoeists and kayakers. Hunting, boating and fishing have long been popular pastimes for residents and visitors.

The basin is home to four state parks, 10 state wildlife areas, 25 fishing access areas, and two national wildlife refuges that offer recreational experiences in a variety of natural settings. Many of the state wildlife areas are situated along the coast, taking in tidal marsh. Bombay Hook and Prime Hook national wildlife refuges also lie along the coast, protecting and providing the public access to marsh environment.

Delaware's historic role in the nation's defense is reflected in the architecture and activities at Fort Delaware and Fort DuPont state parks. In addition to the living history programs at the restored fort on Pea Patch Island, Fort Delaware

State Park provides another mecca for birders at the Pea Patch Island Heronry, encompassed within the park's 287-island acreage. Visitors to an observation deck often catch a glimpse of nesting great blues or other wading birds. Former mill ponds at Killens Pond and Lums Pond State Parks are popular year-round fishing spots as well as destinations for picnicking, camping, hiking and boating. Horseback riding trails add another dimension to outdoor recreation at Lums Pond State Park.

Though a good number of opportunities exist for fishing and boating on state ponds and in the Delaware Bay and Estuary, water quality concerns are bound to affect the viability of these resources for continued enjoyment by the public.

## Community-Based Recreation

In addition to the recreation built around the basin's natural resources, residents have a need for close-to-home recreational opportunities. Local recreation programs and opportunities vary from county to county. Both New Castle and Kent counties provide parks for their residents; Sussex County does not. At this time, Sussex County government has no plans to begin providing recreation services for its residents. New Castle and Kent counties also require that open space be set



*Fort Delaware State Park, Pea Patch Island.*



aside when land is developed for residential purposes. Many municipalities within the basin operate parks that help to meet the recreation needs of their residents.

Within the Delaware Bay and Estuary Basin are 90 county open space and parkland sites accounting for 997 acres as well as 96 municipal parks totaling 618 acres. While these parks and their amenities provide recreation opportunities, the demand for outdoor recreation facilities continues to outpace supply.

The Division of Parks & Recreation keeps a pulse on the changing demand for outdoor recreation facility needs and issues. In addition to facilitating 14 public workshops throughout the state in 2002, the division conducted a telephone survey of 1,800 Delaware households and a local official mail-in survey as part of the planning process to identify and prioritize outdoor recreation and conservation needs in Delaware. The result of this extensive public input is the 2003-2008 Statewide Comprehensive Outdoor Recreation Plan (SCORP) used as a tool to assist communities and counties in their planning efforts as well as to guide investments in park development and land acquisition. The state was divided into 5 regions for the purpose of refining the data and findings. Development patterns and census tracts were among the many factors considered in determining the regions. The plan identifies and prioritizes the recreation priorities for facilities in each region. The Delaware

Basin encompasses 3 of these planning regions.

Several facility needs were consistently reflected as being a high or moderate priority throughout the state, including walking and bike paths, picnic areas, playgrounds, swimming pools and fishing areas. In addition, 9 out of 10 Delawareans surveyed indicated that outdoor recreation programs for persons with disabilities, programs for teens and nature and historic education programs should be a very or somewhat important priority for state and local funding.

Delawareans are aware of the landscape changes occurring throughout the state. According to the phone survey, approximately 1 out of 2 responded that there are too few forests, farmland or urban green spaces in Delaware while less than 5% responded that there are too many of these landscapes in Delaware. Although less than 5% responded that there are too many wetlands, nearly 1 out of 4 responded that they did not know if there are too many, too few or the right amount of wetlands in Delaware. When asked about the amount of development in Delaware, 7 out of 10 responded that there is too much development.

DNREC's Division of Parks and Recreation provides grants for park and trail acquisition and development through the Delaware Land and Water Conservation Trust Fund. Grants are awarded annually to municipalities and counties.



# Efforts Under Way

As noted throughout this report, a number of serious environmental challenges face the Delaware Bay and Estuary, including depletion and contamination of aquifers, land use pressures, wetlands impacts and losses, watershed water quality impairment, air pollution, and threats to biodiversity and habitat.

Efforts under way in the basin to improve and protect the environment include initiatives spearheaded by partnerships comprised of the Partnership for the Delaware Estuary, the Delaware Department of Natural Resources and Environmental Control, the Delaware Estuary Program, the U.S. Environmental Protection Agency, the Delaware River Basin Commission, and many other state and non-profit agencies and conservation groups. Many efforts are ongoing. The following is a partial listing.

## Partnership For The Delaware Estuary

The Partnership for the Delaware Estuary, Inc. is a regional, non-profit organization, based in Wilmington, Delaware, that is dedicated to the promotion and conservation of the Delaware Estuary. The Partnership promotes education on the importance of the estuary, both from within the formal school-based education structure and through hands-on educational initiatives directed to the general public. They also coordinate habitat restoration projects for corporations, and through their mini-grant program, provide funding and support for other non-profit organizations. The Partnership for the Delaware Estuary involves all of these groups in activities that reach thousands of individuals in building stewardship for the estuary and its natural resources.



Photo by NOAA

## Tributary Action Teams

A Tributary Action Team program was initiated during the autumn of 1998 by the Center for the Inland Bays to bring together local stakeholders to develop strategies for reducing nutrients and restoring habitat in the bays. The goal is for the teams to develop a list of strategies that, when implemented, will help to control and reduce pollutants identified as causing impairments to the surface water quality and biological communities. These strategies are necessary to meet the **total maximum daily loads** (TMDLs) established for targeted pollutants for all of the state's impaired waterways.

The program has extended from the Inland Bays to other state watersheds. The Appoquinimink Tributary Action Team is working on a pollution control strategy to reduce **non-point source** nutrient loading by at least 60 percent for nitrogen and phosphorous. The Murderkill team continues to refine strategies to achieve a 30 percent reduction in nitrogen and 50 percent reduction in phosphorus loads from non-point sources. Both teams hold regular public forums.

## Nutrient Management Commission

The Delaware Nutrient Management Commission was established in June 1999 after passage of the Delaware Nutrient Management Law. The Commission is tackling the task of managing nutrients with a comprehensive program addressing not just agricultural sources, but the entire spectrum of nutrient contributions, including golf-course landscape operations, residential inputs, and residential and commercial fertilizers. Current nutrient management plans are in place for more than 300,000 acres statewide.

The 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 storage facilities limit nutrient runoff manure (figure includes 44,000 tons exported by Perdue AgriRecycle pellet-fertilizer plant).

## Watershed Road Signs

As part of a statewide campaign to educate Delawareans and visitors about the state's four major drainage areas, watershed signs have been placed throughout the state to identify the Christina, Inland Bays, Chesapeake Bay and Delaware Estuary drainage areas. The watershed road-sign project is part of a comprehensive outreach program that includes a watershed curriculum taught in seventh grade science classes throughout the state.

The road sign initiative has been accomplished through a cooperative effort between DNREC, the state Department of Transportation and the University of Delaware's Water Resources Agency.

## Northern Delaware Wetland Rehabilitation Plan

The Northern Delaware Wetlands Rehabilitation Program was established by the Department of Natural Resources and Environmental Control to bring together civic and business leaders, scientists, resource managers and property owners to develop strategies to restore nearly 10,000 acres of wetlands – 31 distinct sites along the Christina and Delaware rivers in New Castle County.

These marshes once contained some of the state's richest waterfowl populations. They served as important nursery grounds and breeding habitat for a wide variety of fish and other wildlife. They also helped filter pollutants and sediments out of river water and provided a buffer zone during storms, protecting properties from flooding. Many of these wetland marshes have been impacted, some as far

back as when the early settlers arrived. It is important to restore these marshes to improve water quality, increase wildlife populations, control and eradicate nuisance plants, and help sustain rare and threatened species.

## Toxics Advisory Committee

The Delaware River Basin Commission's (DRBC's) Toxics Advisory Committee is helping to guide development of the overall TMDL for **polychlorinated biphenyls**, or **PCBs** – identified as a contaminant of concern in water, sediment and fish of the Delaware Estuary. Elevated levels of PCBs in fish tissue have caused Delaware, Pennsylvania and New Jersey to recommend that people limit or curtail their consumption of fish caught from the Delaware Estuary. A listing of Delaware fish advisories that apply to the main stem of the Delaware Estuary and tributaries can be found in the Delaware Fishing Guide brochure or at the following web site: <http://www.dnrec.state.de.us/fw/advisory.htm>

A Stage 1 TMDL for PCBs in the Delaware Estuary was established on December 15, 2003 by the EPA on behalf of Delaware, New Jersey and Pennsylvania for the area from the head of tide at Trenton, NJ to Liston Point, DE. A Stage 2 PCB TMDL is currently under development and is scheduled to be established by December 15, 2006. The Stage 2 TMDL will refine the work done in Stage 1 for the area from Trenton to Liston Point, plus will add the additional area of the Estuary from Liston Point to the mouth of the Delaware Bay. Further details of the overall PCB TMDL effort can be found at the DRBC web site (<http://www.state.nj.us/drbc/drbc.htm>). The DRBC is serving to coordinate the technical activities associated with the PCB TMDL.

## Environmental Indicators

The Delaware Estuary Program has established nine environmental indicators for the Delaware Estuary that will help to measure progress toward improvements. The initial indicators are: American Shad Abundance; Dissolved Oxygen; Suitability of Estuary Waters for Swimming; Geographic Extent of Approved Shellfish Harvesting Areas; Developed Land and Population; Agriculture in the Delaware Estuary; Acres of Parkland; Water Use Efficiency; and Contaminated Sediments in the Estuary.



# Continuing Efforts



## Pea Patch Island

The Pea Patch Island Special Area Management Plan is reaching its goal of a broad, ecosystem-based approach in management of the island's special resources. The June 2001 progress report highlighted efforts to protect and improve the resources that support the heronry, and strategies have been developed to address issues affecting the herons.

In April 2002, Pea Patch Island Nature Preserve was designated as a Continentally Important Bird Area by the Audubon Society's Important Bird Area Program. The heronry is one of the largest of mixed species of herons and egrets on the East Coast, containing great blue herons, great egrets, little blue herons, snowy egrets, cattle egrets, yellow crowned night herons, black crowned night herons, glossy ibis, and green herons.

## Artificial Reef

The Department of Natural Resources and Environmental Control's Division of Fish and Wildlife has an artificial reef program designed to enhance fisheries habitat and benefit structure-oriented fish such as tautog, seabass, scup, spadefish and triggerfish, as well as provide fishing opportunities for anglers. The Division has used recycled materials



to build 11 permitted sites – eight of them in the Delaware Bay. The sites are charted in the updated 2002 Reef Guide available from the Division.

Since 1995, over 42,000 tons of concrete and ballasted tire units, 86 decommissioned military vehicles and six tugboats and barges have been placed on the artificial reef sites. The donation of 400 subway cars by New York City Transit in 2001 has provided over one million square feet of surface area for attachments of blue mussels and other invertebrates that support reef fish.

## Recycling Grants



Photo by DSWA

The Department of Natural Resources and Environmental Control, in cooperation with the Recycling Public Advisory Council, has \$50,000 in matching grant funding available for the fiscal year 2005 Recycling Assistance Grant Program. The matching grant funding is available to local governments and community organizations to help boost recycling in Delaware. Recipients must provide 25 % of total project funding either in cash or an equivalent valuation of in-kind services.

Projects already funded by the grant program in Delaware City, Camden and Rehoboth Beach are recovering tens-of-thousands of pounds of recyclables that otherwise would have been discarded.

## Conservation Coordination Initiative

In October 2004, Governor Minner signed Executive Order 61 relative to green infrastructure. This Order, with DNREC as the lead agency, calls for a coordinated approach between non-governmental organizations, private landowners and state agencies to ensure that the green infrastructure necessary for Livable Delaware is achieved and preserved during a time of intensive development in the State. Through a cooperative and coordinated approach, agencies can leverage resources and expertise to better accomplish the goals and objectives of Livable Delaware. The strategy includes on-the-ground habitat restoration, protection and enhancement in critical resource areas as defined by the State's Livable Delaware Green Infrastructure maps as well as public education, outreach, and private landowner incentives.

## Ecological Restoration and Protection

In the fall of 2003 the Department established an Ecological Restoration and Protection Team comprised of individuals possessing expertise in understanding and reproducing stream and wetland habitats utilizing various restoration techniques. The primary responsibilities of this team are to implement on-the-ground restoration projects that maximize the environmental benefits derived from every project. Some of the key goals include: enhance fish and wildlife habitats, improve water quality, restore degraded natural stream systems, reduce sediment loading, introduce native plant species and eradicate invasive plant species. The Ecological Restoration Team serves as the "implementation arm" to the Green Infrastructure Conservation Coordination Initiative.



Wetland restoration project at the Division of Fish and Wildlife's Hunter Education Training Center located in Ommelanden, New Castle County



# What You Can Do

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

## Plant Beach Grass

Since 1990, dedicated volunteers have stabilized Delaware's sand dunes by planting more than 3 million stems of Cape American beach grass on them. The beach grass is planted annually in March on all public dunes from Pickering Beach south to Fenwick Island. Call the Division of Soil and Water Conservation, Department of Natural Resources and Environmental Control for information at (302) 739-9921.



## Clean Up The Coast

An annual cleanup of Delaware's coast has been under way for 16 years as part of the Delmarva Coastal Cleanup and Ocean Conservancy's International Coastal Cleanup. Volunteers join a cooperative effort with other groups on the Delmarva Peninsula to pick up debris along the coast as well as collect data for the Ocean Conservancy. Delaware's cleanup areas span the length of the state's 97-mile eastern coastline. Call the Department of Natural Resources and Environmental Control for information at (302) 739-9902.

## Stream Watch

Join this grassroots volunteer waterway protection program co-sponsored by the Delaware Nature Society and the Department of Natural Resources

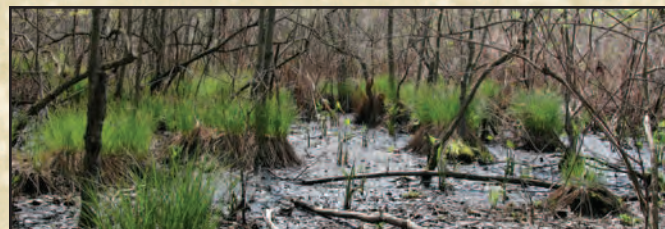
and Environmental Control. Opportunities include two citizens monitoring programs: Stream Adoption and Technical Monitoring. Free training workshops are held seasonally. Contact the Delaware Nature Society at Ashland Nature Center at (302) 239-2334 or leave a message at the Nature Society's other facility, Abbott's Mill Nature Center in Milford at (302) 422-0847.

## Conserve Water

We can all do more to conserve one of our most valuable and increasingly priceless natural resources. Conservation has gone beyond its drought-oriented concept and become an everyday necessity in many parts of the United States and other countries. Millions of gallons are lost through leaking pipes, faucets and toilets. Adopting new habits such as only running full washer and dishwasher loads as needed, taking shorter showers, and not letting the faucet run when washing dishes and brushing teeth can save hundreds of gallons of water. Adding conservation shower heads and other devices saves even more. Contact your water utility for additional water saving measures.

## Adopt A Wetland

Delaware Adopt-A-Wetland is a volunteer-oriented program aimed at promoting public awareness of wetland values and benefits through opportunities for citizen-based monitoring and stewardship. Everyone can be involved in this program. Adopting groups include businesses, schools, community groups, families and individuals. An understanding of wetlands processes, functions and importance leads to a greater appreciation of these ecological wonders. Delaware Adopt-A-Wetland is administered by the Department of Natural Resources and Environmental Control's Divisions of Fish and Wildlife and Water Resources. Contact the Aquatic Resource Education Center at (302) 653-2882.



## Volunteer At The National Estuarine Research Reserve

Become a Friend of the Reserve and volunteer for activities in this cooperative natural estuarine habitat research and educational program between the National Oceanic and Atmospheric Administration and the Division of Soil and Water Conservation, Department of Natural Resources and Environmental Control. Volunteers are needed for horseshoe crab spawning counts and migratory shorebird research, wetland walk guides, school group teachers, and landscaping projects to maintain trails and flower beds. Call the Reserve at (302) 739-3436; or Department of Natural Resources and Environmental Control at (302) 739-9283.

## Volunteer In A State Park

Delaware's state parks offer a variety of opportunities to get involved with projects ranging from trail construction and maintenance to helping out with special programs. For information on volunteer opportunities within our state parks, call the Division of Parks and Recreation, Department of Natural Resources and Environmental Control at (302) 739-9200.

## Reduce Household Hazardous Waste

Our everyday activities can contribute significant levels of pollution to waterways. Nonpoint sources of pollution, such as chemical fertilizers that are transported through erosion and runoff, must be reduced if we are to make progress in cleaning up our waters. We must also be mindful not to overburden wastewater systems by adding hazardous, toxic, or unnecessary materials. Here are some tips for reducing household impacts.

- ◆ Use non-phosphate laundry detergents. Phosphates may over-stimulate plant growth in the bays and deplete oxygen levels needed by fish.
- ◆ Purchase non-toxic cleaning products.
- ◆ Read and follow directions on labels carefully.
- ◆ Use latex paint instead of oil-based paint when possible.
- ◆ Use fabric softener sheets rather than liquids (they have a lower metals content), or add one cup vinegar or a quarter cup of baking soda to the final rinse.

- ◆ Use stains and finishes derived from natural sources such as shellac, tung oil, and linseed oil.
- ◆ Know how to identify a hazardous product. Federal law requires that hazardous products be labeled Danger, Warning, or Caution.
- ◆ Safely dispose of hazardous substances at Delaware Solid Waste Authority's household hazardous waste collection events from 8 a.m. to 4 p.m. the first Saturday of the month listed for the following locations: Delaware Recycling Center – September; Cheswold Collection Station – October; Pine Tree Corners – April; the Southern Solid Waste Management Center in Sussex County – May. You can drop off product containers marked, "Warning: Hazardous," "Flammable," "Corrosive," or "Explosive."

### The following items are accepted:

- ◆ Household — full aerosol cans; bleach; chemistry kits; nail polish; nail polish removers; perfumes and colognes; disinfectants; drain cleaners; floor wax; mercury thermometers; moth balls; oven cleaner; smoke detectors; spot remover; toilet cleaner.



Recycling Household Hazardous Waste

Photo by DSWA



# Additional Actions

- ◆ **Home Health Care** — prescription medications; used syringes.
- ◆ **Explosives** — ammunition; firecrackers; gunpowder.
- ◆ **Workshop** — corrosives; paints (other than latex); small compressed-gas cylinders; solvents; stains; strippers; thinners; varnish; wood preservatives; fluorescent bulbs.
- ◆ **Garden/Yard** — fungicides; herbicides; pesticides; pool chemicals.
- ◆ **Automotive** — antifreeze; auto batteries; degreasers; waste fuels-gasoline, kerosene; used motor oil mixed with other fuels.

## The following items will not be accepted:

- ◆ **Friable asbestos** — accepted by appointment at all Solid Waste Authority landfills for a fee. Call (302) 764-2732.
- ◆ **Non-friable asbestos** — accepted by appointment at all Solid Waste Authority landfills for a fee.
- ◆ **Unknown substances** — greater than 1 gallon or 8 pounds.
- ◆ **Radioactive waste** — not accepted.

## Materials with other disposal methods:

- ◆ **Latex paint** — water-soluble, not hazardous; can be taken to landfill.
- ◆ **Containers with less than 1-inch of material** — can go in regular trash.
- ◆ **Used motor oil** — accepted at specific “Recycle Delaware” locations.

## Maintain a Healthy Lawn and Garden

A healthy lawn and garden makes a home more attractive and is also environmentally beneficial. Healthy lawns and gardens, coupled with trees and shrubs, can help prevent erosion and runoff to the bays. However, lawns can be a source of pollution if proper lawn-care techniques are not followed.

- ◆ **Perform soil tests every 3–4 years** to determine the amount of nutrients necessary for a healthy lawn. Contact your local soil conservation district for more

information and test kits.

- ◆ **Use fertilizers only as needed in the fall.** Do not heavily water lawn after application because it may lead to excessive growth of aquatic algae.
- ◆ **Don't give your lawn a crew cut.** Lawns should be 2–4 inches high. Cutting too short or too frequently weakens grass and fosters weed growth.
- ◆ **Leave grass clippings on the lawn** to serve as a natural fertilizer or compost them.
- ◆ **Use pesticides sparingly.** If using pesticides, read and follow directions carefully. Try to use natural (non-toxic) alternatives to pesticides, such as insecticidal soap. Never use pesticides if rain is in the forecast because the chemicals will run off into a local stream or storm drain.
- ◆ **Consult your local nursery for advice on selecting plants suited for the site characteristics.** Use mulch to reduce weed growth and evaporation.
- ◆ **Do not over-water your lawn or garden.** Excessive watering can cause chemicals to leach into ground water and can make plants more prone to disease.

## 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.

## Keep Septic Systems Functioning Properly

Septic systems require periodic check-ups and proper care to function properly. They must have a healthy diet to prevent ground water and soil contamination as well as costly repair bills.

- ◆ **Keep all toxic and hazardous chemicals out of your septic systems.** Even small amounts can destroy your system's biological digestion.
- ◆ **Avoid dumping grease/fats down kitchen drains.** They can cause blockages in the system. Collect grease in a container near the sink.
- ◆ **Have your septic tank pumped by a certified contractor every three years.** Failure to pump can cause clogging and result in costly repairs.
- ◆ **Don't drive over absorption fields.** This can cause compacting, which can result in clogging. Do not plant trees over the system or construct walkways, patios, swimming pools, or other permanent structures over or within the leach field.
- ◆ **Minimize the solids load.** Minimize or avoid using a garbage disposal unit. Remove scraps with the garbage or compost them.
- ◆ **Minimize the liquid load.** The less wastewater you produce, the less the soil has to absorb. Repair leaky fixtures, wash clothes only with a full load. Use water-saving devices. Do not let water run while brushing teeth or washing dishes.
- ◆ **If you have a holding tank, it should be pumped out every 10 to 15 days.**

## 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.



# 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, introduced 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

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

**Atmospheric deposition:** pollutants from the air falling on the land or water, sometimes at great distances from their original sources. Can be an important contributor to declining water quality.

**BCCE (Bis[2-chloroethyl] Ether):** A colorless, nonflammable liquid with a strong, unpleasant odor manufactured by humans for use in the production of pesticides and other chemicals.

**Coastal Zone (Delaware):** Approximately 4-mile wide area bordering the state’s shoreline encompassing approximately 270,000 acres.

**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.

**Dioxins:** A group or family of chemical compounds formed as an unintentional byproduct during combustion processes such as waste incineration, uncontrolled burning and some industrial processes such as paper manufacture. They are persistent in the environment and the level of their toxicities varies greatly.

**Dissolved oxygen:** The concentration of free oxygen (a gas) dissolved in water and most commonly expressed as milligrams per liter or parts per million. Adequate concentrations are necessary for aquatic life to survive.

**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, and thereby reduce dissolved oxygen in these waters.

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

**Ground-water discharges:** Discharge of a water table aquifer to streams, ditches, wetlands, or other waterbodies.

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

**Methane:** An odorless, colorless, flammable hydrocarbon present in natural gas and formed by decomposition of organic matter, for example, in landfills, marshes and swamps.

**Non-point source pollution:** Pollution of surface or ground water supplies originating from land-use activities and/or the atmosphere, having no well-defined point of entry.

**Nutrients:** Chemical elements, such as nitrogen and phosphorus, which occur naturally in water, soil and air, are vital to plants, and are added to fertilizers to aid growth of agricultural and other crops. Excess amounts entering water bodies cause deterioration in water quality by supporting an overabundance of plants/algae.

**PCBs (polychlorinated biphenyls):** Mixtures of chlorinated chemical compounds formerly used as coolants and lubricants in transformers, capacitors and other electrical equipment

before their manufacture was stopped in 1977 when evidence of their potential harmful health effects became known. PCBs persist in the environment and can accumulate in fish and marine mammals.

**Point source pollution:** Pollution of surface or ground water 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.

**Pollution control strategies:** Methods or strategies to meet pollution limits called Total Maximum Daily Loads (TMDLs) developed to improve water quality in the state’s impaired waterways.

**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.

**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 top of the saturated portion of an unconfined aquifer.