



The Delaware Department of Natural Resources and Environmental Control's *Whole Basin Management* strategy focuses on protecting Delaware's environment by managing it in a new and natural way: by drainage basin. Using the state's four major drainage basins as our chief management units, we can bring together the expertise from all our 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 developing this strategy comes from our 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 that comprise it from multiple perspectives in an integrated fashion.

*Whole Basin Management* involves a phased approach to effectively assess the health of a targeted basin and develop an implementation plan to address its environmental problems. This report focuses on the Inland Bays/Atlantic Ocean Basin, the third of Delaware's four drainage basins. The first two basins that have been assessed include the Piedmont Basin in northern New Castle County and the Chesapeake Bay drainage in western New Castle, Kent, and Sussex counties. The last basin being assessed is the Delaware Bay and Estuary drainage, along Delaware's eastern corridor.

We encourage you to learn more about Delaware's major drainage basins and share with us your ideas and concerns about the region's environmental quality. 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 Office of Information and Education at (302) 739-4506. 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 . . . . . 1-800-523-3330

### Office of the Secretary

Secretary's Office . . . . . 739-4403  
 Development Advisory Service . . . . 739-6400  
 Land Use Planning . . . . . 739-3091  
 Business & Permitting Assistance . . 739-6400  
 Information & Education . . . . . 739-4506  
 Human Resources . . . . . 739-5823  
 Whole Basin Management . . . . . 739-4403

### Division of Air & Waste Management

Director's Office . . . . . 739-4764  
 Air Quality Management Section . . . 739-4791  
     New Castle . . . 323-4542  
 Solid & Hazardous Waste Branch . . 739-3689  
 Underground Storage Tank Branch . 395-2500  
 Site Investigation & Restoration Branch 395-2600  
 Environmental Response Branch . . . 739-3694  
 Environmental Protection Officers . . 739-5072

### Division of Fish & Wildlife

Director's Office . . . . . 739-5295  
 Fisheries Section . . . . . 739-3441  
 Wildlife Section . . . . . 739-5297  
 Enforcement Section . . . . . 739-3440  
 Mosquito Control Section . . . . . 739-3493

### Division of Parks & Recreation

Director's Office . . . . . 739-4401  
 Planning, Preservation & Development 739-5285  
 Operations and Maintenance . . . . . 739-4406  
 Cultural and Recreational Services . 739-4413

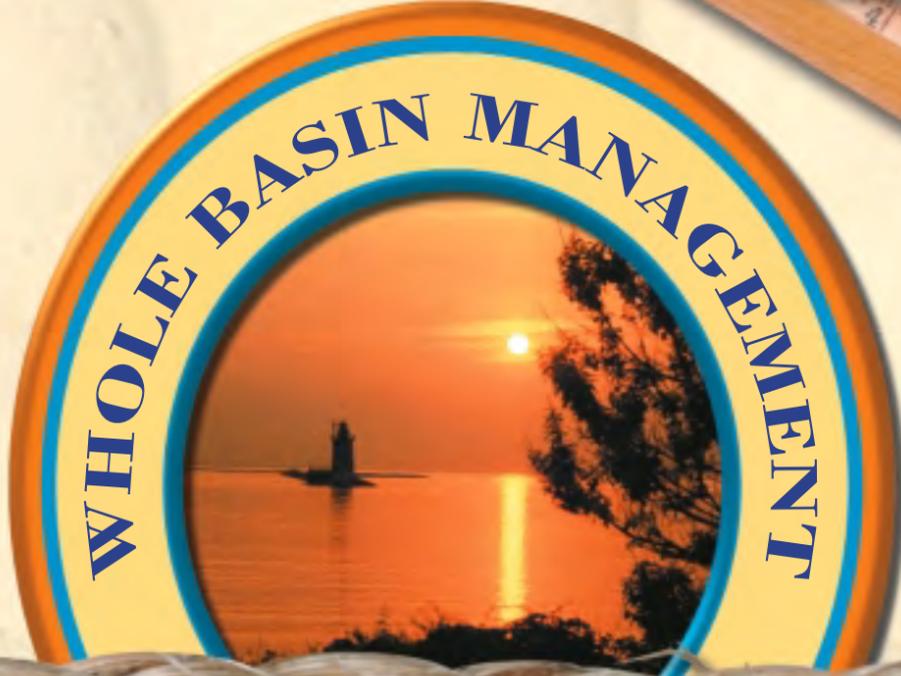
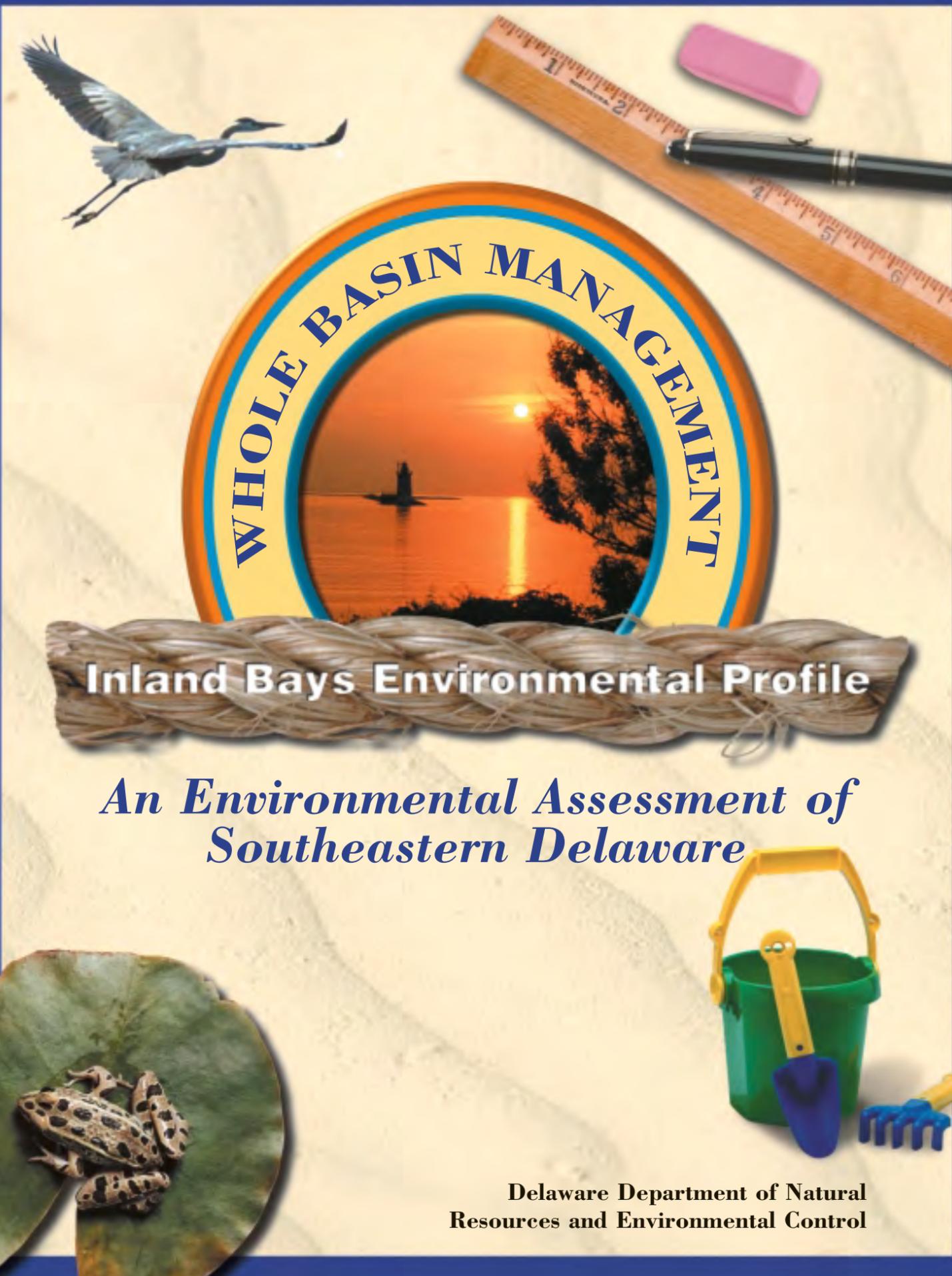
### Division of Soil & Water Conservation

Director's Office . . . . . 739-4411  
 Shoreline & Waterway  
     Management Section . . . . . 739-4411  
 Drainage Section . . . . . 856-5488  
 Delaware Coastal Management Program 739-3451  
 Conservation District Operations . . . 739-4411

### Division of Water Resources

Director's Office . . . . . 739-4860  
 Customer Services . . . . . 739-6330  
 Environmental Services Section . . . . 739-4771  
 Surface Water Discharges Section . . 739-5731  
 Ground Water Discharges Section . . 856-4561  
 Water Supply Section . . . . . 739-4793  
 Watershed Assessment Section . . . . 739-4590  
 Wetlands & Subaqueous Lands Section 739-4691

Center for the Inland Bays . . . . 645-7325



## Inland Bays Environmental Profile

## An Environmental Assessment of Southeastern Delaware

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 Inland Bays/Atlantic Ocean Basin in Delaware. It provides a summary assessment of environmental information and highlights some of the numerous treasures and challenges of the Inland Bays. This information is being used by the Department to establish environmental priorities and to educate other governmental agencies and the citizens of Delaware about significant issues of concern in the basin.



Delaware's Inland Bays — Rehoboth, Indian River, and Little Assawoman bays — represent the most popular boating destination in the state.

The basis for developing this report comes from the Department's realization 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 the ground water. Pollutants like these may also enter streams and other surface waters during storms. The consequences can be widespread, causing 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 among the air, land, water, and living resources has prompted the Department to focus on looking at the environment from multiple perspectives 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 drainage patterns.

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, or watersheds, which represent the area drained by a river, stream, or creek. Delaware has 45 sub-basins, or watersheds.

The Inland Bays/Atlantic Ocean Basin is located in southeastern Sussex County. The basin is named for the water bodies into which it drains — the Inland Bays and Atlantic Ocean. The Delaware portion of the basin encompasses approximately 200,702 acres, or 314 square miles.

The Inland Bays/Atlantic Ocean Basin is the third basin being assessed by the Department's Whole Basin Management Program, which involves a phased process to effectively assess the health of a targeted basin and develop an implementation plan to address environmental problems. The paramount objectives of the process are to protect the environment, improve community outreach, maximize wise 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 region in which you reside.

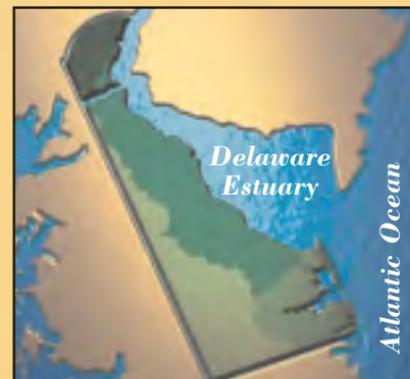
As a conservation reminder, the Department and the Center for the Inland Bays recently erected signs along the perimeter of the Inland Bays watershed alerting visitors of the need to protect the bays.



## DELAWARE'S MAJOR DRAINAGE BASINS

Delaware's four major drainage basins are highlighted below. Each basin consists of smaller management units or sub-basins.

- Piedmont
- Delaware Bay/Estuary
- Chesapeake Bay Drainage
- Inland Bays/Atlantic Ocean



### Inland Bays/Atlantic Ocean Basin

Shown at right are the eight sub-basins that make up the Inland Bays/Atlantic Ocean Basin.

- 1 — Lewes Rehoboth Canal
- 2 — Rehoboth Bay
- 3 — Indian River
- 4 — Iron Branch
- 5 — Indian River Bay
- 6 — Buntings Branch
- 7 — Assawoman
- 8 — Little Assawoman



This publication is a summary of the Preliminary Assessment report for the eight watersheds that make up the Inland Bays/Atlantic Ocean Basin. The pages that follow contain information on these topics:

- ◆ Watershed Hydrology
- ◆ Land Use & Population
- ◆ Contaminants
- ◆ Water Quality
- ◆ Living Resources
- ◆ Recreation
- ◆ Efforts Under Way
- ◆ What We Can Do

As you read this environmental profile, you are encouraged to think about the problems or issues that concern you in your region 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 toward the back 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 Inland Bays from our children. Our goal is to leave them with the same treasures our ancestors left us to experience and enjoy in the Inland Bays!

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

Stephen N. Williams  
Whole Basin Management Coordinator  
302-739-4403

For details about the Preliminary Assessment of the Inland Bays/Atlantic Ocean Basin, contact:

Ann Marie Townshend  
Inland Bays Team Leader  
302-739-5285

*Delaware's Good Nature Depends on You!*

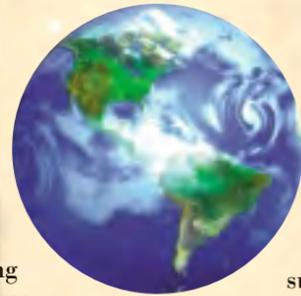


"When the world was created, it was woven like a blanket, its threads interlaced and tied together. Everything in the blanket of life is connected. When harm comes to a single strand, the entire fabric becomes frayed and damaged. We must learn to walk gently upon the blanket of life before it unravels at our feet in ruins."

— Charles Clark IV  
Assistant Chief, Nanticoke Indian Tribe

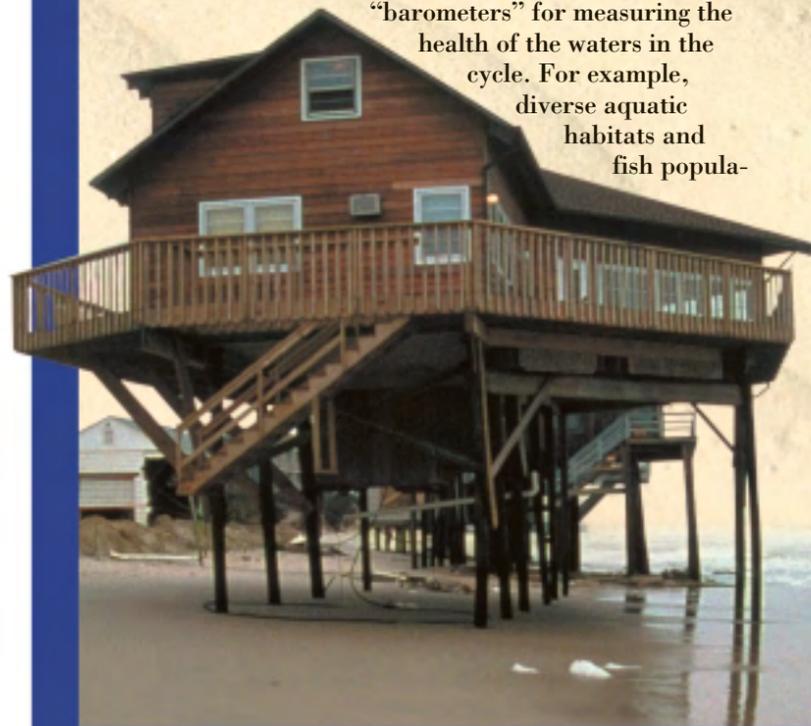
# Watershed Hydrology

**W**ater is Delaware's most valuable natural resource. It is critical to our existence, provides habitat for wildlife, and makes possible numerous recreational opportunities in the Inland Bays/Atlantic Ocean Basin. 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 runoff and ground water eventually reach a stream, bay, or other water body, and the water cycle begins all over again.

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 waters in the cycle. For example, diverse aquatic habitats and fish popula-



tions 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.

Rehoboth Bay, Indian River Bay, and Little Assawoman Bay are the major surface water bodies in the Inland Bays/Atlantic Ocean Basin. These estuaries provide important habitat for migrating birds, finfish, and shellfish. However, the bays are becoming increasingly urbanized with encroaching development.

In the sediments underlying the Inland Bays are several shallow *aquifers*, or water-bearing zones, which inexpensively provide 100% of the region's drinking-water and irrigation supplies. These aquifers also feed streams, rivers, and the bays themselves. The basin's ground water, generally available within 10 feet below the surface, is an invaluable asset to development and commerce. Yet the very availability of ground water and its continual movement through the water cycle make the basin's water resources extremely vulnerable to contamination.

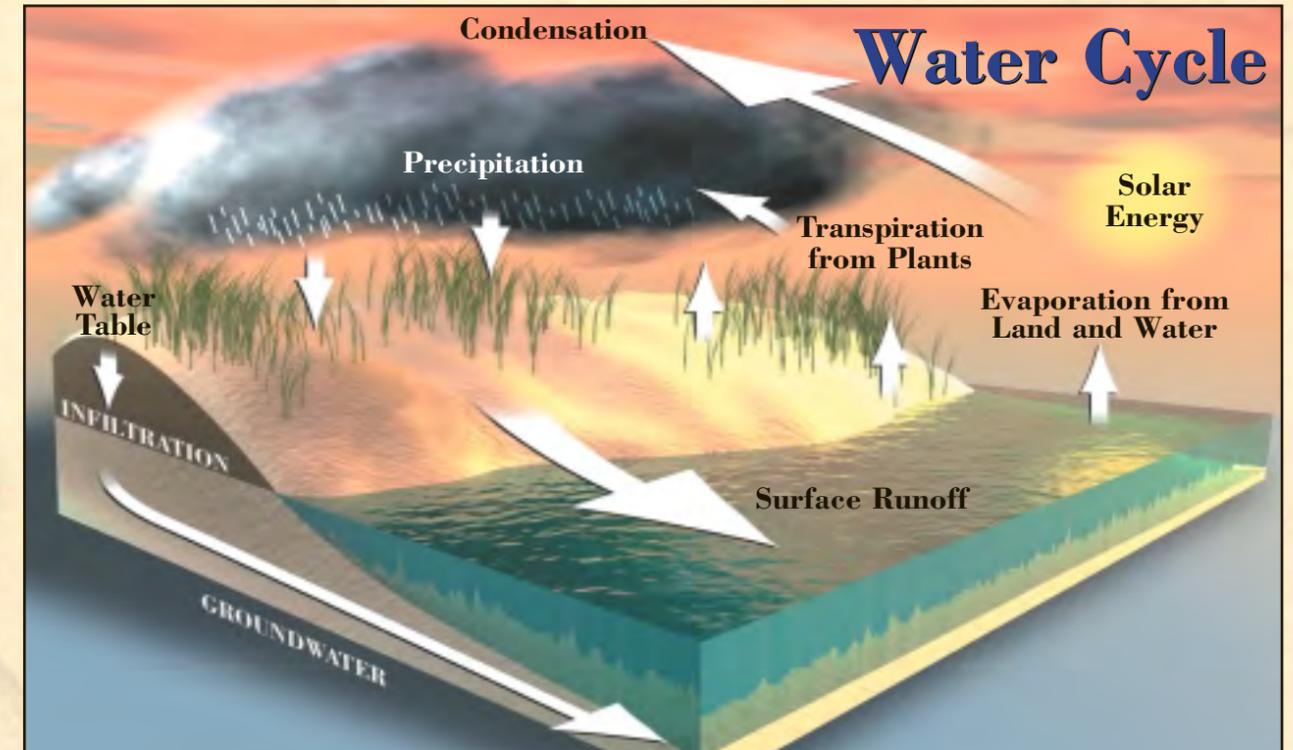
## SHORELINE

More than 11 miles of Delaware's ocean coast are developed with homes and businesses. The majority of them are located on the barrier island — the thin strip of land separating the ocean from the Inland Bays. Sea-level rise, storms, and other natural coastal transport processes are causing the barrier island system to migrate in a landward direction. The current rate of sea-level rise is 1 foot per century.

Keeping up with rising waters and storm effects requires continual vigilance and management. State efforts to maintain public beaches and dunes include planting beach grass, erecting sand fence, and repairing storm damage. Beach nourishment projects restore wide beaches for recreation and protect inland areas by replacing sand lost during storms.

Some communities have chosen to harden the shoreline by constructing bulkheads and other structures that provide localized wave protection;

*Delaware's coastline is steadily migrating landward due to sea-level rise, storms, and other natural processes.*



*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.*

however, they do not replace eroded sand. Strategic retreat, the relocation of waterfront structures inland, is practiced on a limited basis today to protect structures and help preserve the beach. The best option for treating *erosion* of a beach or land area often depends on the primary goal — preservation of the beach or property protection.

## DREDGING

As development continues around the Inland Bays, requests for new dredging projects increase along with the population. Dredging is the process of removing bottom sediments to create or maintain safe, navigable channels for recreational or commercial boating purposes. In Delaware, dredging also is used to obtain sand for beach restoration activities, to remove unwanted sediments and vegetation from state-owned ponds and lakes, and to control sediment deposits in inland waters.

Dredging physically alters the bottom and temporarily causes water *turbidity*, or cloudiness, and damage to plants and animals. Dredging of dead-end canal systems to allow access of pleasure boats to new developments results in stagnant water in the canals because there is little or no freshwater inflow

for flushing. Dredging the upper portions of tidal tributaries fosters the extended upstream progression of salt water from the Inland Bays into the upper tributaries. On the other hand, removing bottom sediments from navigational channels and existing marinas can be beneficial if the dredging helps to improve circulation patterns.

Two Department initiatives focus on ensuring that our dredging projects reflect the best technologies and methods to minimize adverse impacts: the "Statewide Dredging Activity Analysis and Management Project" and a review of the "Inland Bays Dredging Study."



*"Mother Earth is a living, breathing creature composed and formed like us. The land is her skin, draped over her rock and stone bones; the trees and grasses are her hair. Wind and breeze are our Mother's breath; the ocean and waters are her blood. As with us, her life-force is in constant motion and every drop is precious."*

— Charles Clark IV  
Assistant Chief, Nanticoke Indian Tribe

# Land Use & Population



Seasonal visitors with vacation homes and new permanent residents have fueled development along the Inland Bays, as this aerial view of Rehoboth Bay demonstrates.

Sussex is Delaware's fastest growing county. Most of the development pressure centers on the Inland Bays/Atlantic Ocean Basin. Two very different land-use activities — poultry farming and second-home residential development — thrive in the basin.

Since the 1960s, a massive influx of people from neighboring states has continued to swell the basin's seasonal and permanent populations. At the same time, the poultry industry has experienced enormous growth. Some perceive the two as incompatible land uses; ironically, the rapid growth of both activities has contributed to dramatic changes in land use and degradation of the basin's land and water resources.

Sussex County's population is approximately 140,000. More important is the apparent rate of growth: between 1990 and 1999, the county experienced a 23% population increase; between 1990 and 2020, it's anticipated that the county will experience a 55% population increase. This rapid growth and the seasonal population swing — which can swell by more than 200% on summer weekends — make it difficult to maintain or expand the infrastructure at

an affordable level for the permanent population. Controversy, including court action over sewer rates, reflects this difficulty. In addition, as the year-round population and tourist industry grow, so does the number of automobiles. At times, highways in parts of the basin are so clogged that emergency vehicles have trouble maneuvering.

Urban land use now covers about 17% of the basin. From 1992 to 1997, residential and general commercial urban land use expanded by 3%. If this rate of urban growth continues to 2020, approximately 29% of the basin, excluding open water, will be in urban land uses. During the same five-year period, agricultural land decreased by about 2,327 acres and forest cover by about 3,200 acres. Most of the new urban growth has been along Route 1 near Rehoboth Beach and Lewes and in the Long Neck area.

Land-use planning and zoning authority rests with the municipalities and Sussex County government. The Coastal Zone Act prohibits new heavy industry and offshore bulk-product transfer facilities and requires state permits for new manufacturing plants in the basin prior to construction.

Sussex County has developed a comprehensive land-use plan for the non-incorporated portion of the basin, which addresses conservation, transportation, and economic issues. The plan also includes a growth management strategy that encourages new development in designated growth areas, most of them concentrated in the eastern portion of the basin.

In the past few years, some land along Route 113 has been down-zoned from commercial to agriculture. The state comments on proposed new facilities and most developments in the basin through the Land Use Planning Act (LUPA).

## SHAPING DELAWARE'S FUTURE

In response to growing concerns about the viability of comprehensive planning to direct and manage new development and make land-use decisions, the Delaware General Assembly enacted Senate Bill 116 in June 1995. The Act, known as "Shaping Delaware's Future," sets forth 10 goals to improve the effectiveness of land-use decisions. Recently, the goals were modified, and there are now 11. Those most applicable to the Inland Bays/Atlantic Ocean Basin include the following:

1. Direct investment and future development to existing communities, urban concentrations, and designated growth areas.
2. Protect important farmlands and critical natural resource areas.
3. Encourage redevelopment and improve the livability of existing communities and urban areas, and guide new employment into under-used commercial and industrial sites.

In December 1999, the Governor's Cabinet Committee on State Planning Issues adopted the report, "Shaping Delaware's Future: Managing Growth in 21st Century Delaware, Strategies for State Policies and Spending." This report notes that lands near the Inland Bays, "an area of unique and sensitive resources, are experiencing a variety of environmental problems because of significant development pressure." Three of the five management strategies listed below are prefaced in the report as follows:

"In these coastal areas, the state, county and local governments will work to cooperatively pursue creation of land-use techniques and development and infrastructure investment phasing agreements that:

1. Meet the need to provide necessary sewer and transportation improvements to achieve water-

quality objectives and provide safe, efficient transportation while ensuring the protection and enhancement of the bays' fragile resources and retaining the character and integrity of the area. Implement ordinances, as recommended in the Comprehensive Conservation and Management Plan for the Inland Bays, that promote environmentally sensitive development; include design, density, or process incentives for such development; and incorporate zoning classifications and development standards (setbacks, buffers, tree protection, impervious cover limitations, etc.) to ensure environmentally sound land use.

2. Further the protection of important agricultural lands in the Inland Bays Watershed outside of the designated developing area through Transfer of Development Rights programs, Purchase of Development Rights programs, zoning, or other methods.
3. Protect areas designated as particularly critical or valuable natural resources or habitats."

On January 1, 2000, Gov. Thomas R. Carper signed a letter endorsing "Shaping Delaware's Future: Managing Growth in 21st Century Delaware." The Cabinet Committee on State Planning Issues has requested that state agencies review their regulations and policies to bring them into compliance with the management initiative.

*"One must cultivate a loving relationship with Mother Earth to be considered a true human being. That relationship should include respect, reverence, and care; it must acknowledge that every inch of her is sacred and irreplaceable, and that all things upon her are connected."*

— Charles Clark IV  
Assistant Chief, Nanticoke Indian Tribe

# Contaminants

Inland Bay waters are highly enriched with the nutrients nitrogen and phosphorus, the *contaminants* having the greatest impact on the surface and ground water of the Inland Bays/Atlantic Ocean Basin. While nitrogen and phosphorus are essential for plant and animal growth, when excess amounts enter the bays, water quality can deteriorate as aquatic plant growth accelerates and the level of oxygen is reduced. This process of over-enrichment is called *eutrophication*.

The primary activities accelerating eutrophication in the Inland Bays are urbanization and agricultural activities. Contamination of the basin's ground water by excess nitrogen is critically important because ground water supplies 100% of the basin's drinking water.

## NITROGEN AND PHOSPHORUS

Phosphorus enters the bays primarily through soil erosion and runoff. Nitrogen enters through a

variety of pathways such as *point source* discharges, *atmospheric deposition*, erosion, runoff, and ground-water discharge. As much as 25% of the total nitrogen entering the bays is estimated to be deposited from the atmosphere, while point sources such as wastewater treatment facilities with discharge pipes to *surface waters* account for less than 4%. The remaining nutrient loading comes from land-use activities and is transported by erosion, runoff, and ground-water discharge.

The drinking water standard for nitrate (as nitrogen) is 10 milligrams per liter (mg/l). In the Inland Bays, nitrate concentrations in the ground water vary from less than 0.5 mg/l in wooded or natural areas to greater than 100 mg/l in areas with historically intensive poultry production. More than 23% of all wells in the basin have nitrate levels that exceed the drinking-water standard.



Erosion and stormwater runoff contribute many of the nutrients that reach the Inland Bays. An overload of nutrients to the bays decreases oxygen levels in the aquatic system, threatening marine life.



## URBAN NUTRIENT SOURCES

Numerous urban sources of nutrients are transported to the Inland Bays through erosion, stormwater runoff, and leaching from soils to the ground water. The sources include discharges from on-site *septic systems* and domestic sewage treatment plants as well as fertilizers applied to private and commercial landscapes, nutrient-rich sediments from construction activities, exhaust emissions, and open burning.

Discharges from septic systems contribute the greatest urban loading of nutrients to the bays. More than 18,000 septic systems are permitted in the Inland Bays/Atlantic Ocean Basin, discharging as much as 480,000 pounds of nitrogen and 250,000 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 ultimately the bays or their tributaries.

Many older homes near the bays are on small lots with sandy soils, and some still have substandard on-site wastewater disposal systems like cesspools or seepage pits. As many as 50% of the septic systems in the Inland Bays/Atlantic Ocean Basin would not meet current regulations for on-site wastewater disposal systems for a variety of reasons including inadequate lot sizes and system capacities.

Sussex County has created three regional sewer districts that apply wastewater onto agricultural lands through spray irrigation, which utilizes the nutrients in wastewater as fertilizer to grow crops. This has eliminated more than 14,000 septic systems in the basin.

Inland Bays Septic Systems	
YEAR	NEW CONSTRUCTION
1997	439
1998	488
1999	306

## AGRICULTURAL NUTRIENT SOURCES

Agricultural settings contribute significant amounts of nitrogen and phosphorus via field applications of manure, litter, and chemical fertilizers that are ultimately transported to the water. Agriculture is the largest land use in the

basin, accounting for 32% of the land. In 1997, more than 70 million chickens — 25% of the total raised annually in Delaware — were raised in the basin, generating more than 90,000 tons of manure and litter that typically are applied to the land. Most of the cropland is devoted to growing corn and soybeans. If nutrients are overapplied, the excess may be transported to surface waters.



Of the 241 poultry operations in the basin, over half now have manure storage facilities.

Implementation of comprehensive nutrient management plans can significantly reduce nutrient impacts from agricultural activities. Delaware lawmakers, working with farmers, drafted and passed legislation in June 1999 requiring farmers to develop nutrient management plans to prevent nutrient loss from agricultural sites. Of the 241 poultry operations in the basin, over half now have manure storage facilities. State and federal cost-share funds, as well as low-interest loans, are available to farmers who wish to install manure storage sheds and dead-bird composters. Research is under way to reduce phosphorus levels in manure through modifications in poultry feed.

## NON-NUTRIENT SOURCES OF CONTAMINANTS

Non-nutrient sources include *hazardous waste* facilities, state and federal Superfund sites, air emissions, and solid waste landfills. The Department's Division of Air and Waste Management actively monitors these emissions and facilities.



*“Who would allow their mother’s blood to become sick and tainted or to bring about its destruction? Only a people who have forgotten their connection to her, only spoiled children undeserving of her love.”*

— Charles Clark IV  
Assistant Chief, Nanticoke Indian Tribe

# Water Quality



The Inland Bays/Atlantic Ocean Basin's many streams, wetlands, and tidal rivers and bays support a diversity of fish and wildlife and provide abundant recreational opportunities. Delaware's Inland Bays are the crown jewel of an exceptional beach recreational industry that draws thousands of visitors to enjoy the sun, sand, water, and natural resources of Rehoboth, Indian River, and Little Assawoman bays.

As recently as 1975, Delaware routinely experienced serious water pollution and public health problems as a result of the discharge of untreated

sewage. Since then, localized improvements in water quality have been achieved through voluntary efforts, regulatory actions, and significant private and public investments in wastewater treatment facilities. However, the need for additional cleanup and pollution prevention continues.

The focus of water-quality management has expanded from point source discharges to decreased stream flows and *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 bay waters for recreation, and unhealthy conditions.

## WATER RESOURCES ISSUES

A number of water resource issues have arisen in the Inland Bays/Atlantic Ocean Basin over the past several years, from how to address habitat loss, to concerns about toxic outbreaks of *Pfiesteria*.

The Inland Bays are suffering from excessive nutrients (eutrophication) that cause unwanted algal blooms, including *Pfiesteria* and red and brown tides. The algal blooms block sunlight from reaching the bottom of the bays and cause the level of dissolved oxygen to decrease.



Excess nutrients in some estuaries are believed to help trigger the toxic form of *Pfiesteria*, which attacks bait fish.

These changes in environmental quality have led to fish kills, loss of desirable submerged aquatic vegetation (SAV) or sea grasses, and declines in desirable finfish and shellfish habitat.

In the past two decades, a marked resurgence of sea grass has occurred in Delaware's coastal bays with the exception of Delaware's Inland Bays. Recent attempts to reestablish eelgrass in the Inland Bays have been plagued by excessive algal growth, hurricanes, and human impacts. However, one recent success in the reproduction and establishment of viable eelgrass beds has occurred in Indian River Inlet, where ocean-influenced water quality is sufficient to support growth.

A preliminary assessment of water-quality data, completed in 1999 for the Inland Bays Basin, confirmed a decline in water quality. The study characterized the existing water quality conditions of the basin and identified potential problems. These problems include excessive nutrient levels, declining trends of some key water-quality indicators such as dissolved oxygen, and frequent violations of water-quality standards.

Delaware will continue to focus on point source and nonpoint source pollution problems such as urban and agricultural runoff, erosion and sedimentation, and ground-water contamination. The Department has adopted *Total Maximum Daily Load* (TMDL) regulations for nitrogen and phosphorus for Indian River, Indian River Bay, and Rehoboth Bay, which set watershed-wide pollution reduction targets. Pollution control strategies are being developed to help reach these targets. Additional research and assessment efforts will be necessary to better understand how this complex aquatic system responds to certain pollutants.

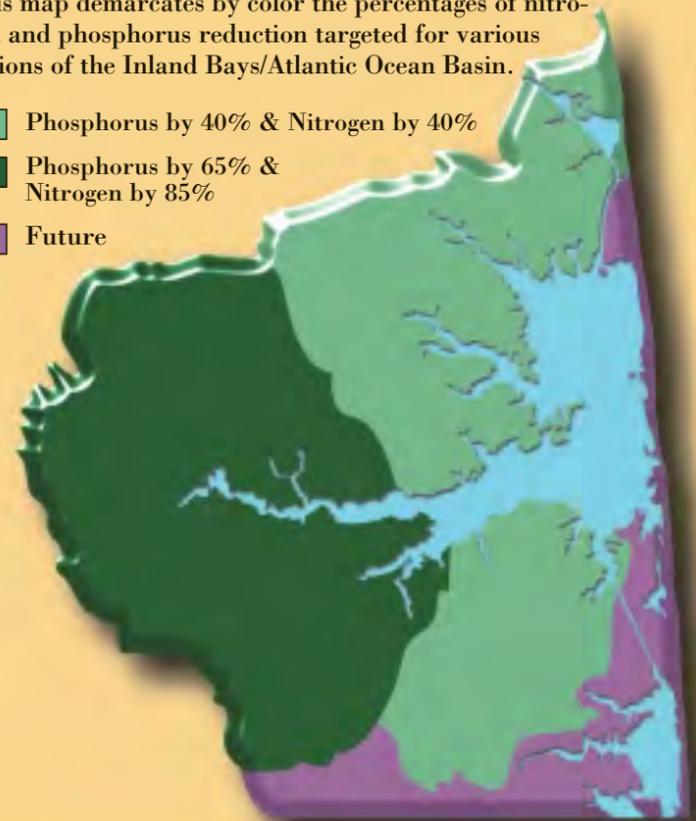


Excess nutrients in the Inland Bays have helped fuel the overgrowth of certain kinds of aquatic vegetation such as sea lettuce.

## INLAND BAYS/ATLANTIC OCEAN BASIN WATERS TARGETED FOR NUTRIENT REDUCTION

This map demarcates by color the percentages of nitrogen and phosphorus reduction targeted for various regions of the Inland Bays/Atlantic Ocean Basin.

- Phosphorus by 40% & Nitrogen by 40%
- Phosphorus by 65% & Nitrogen by 85%
- Future



## Recreational Shellfish Waters

LOCATION	PROHIBITED	TOTAL
Rehoboth Bay	2,470.1 acres	9,994.7 acres
Indian River Bay	4,145.0 acres	9,957.2 acres
Little Assawoman Bay	933.7 acres	2,277.2 acres

“When is a waterway really ‘wild’? When it runs clear and pure and is filled with life, or when life itself runs away from its embrace? Mother Earth and her two-leggeds are three-quarters water; even our salt content is the same. We are like her because we come from her. What we do to her, we do to ourselves. We two-leggeds must control our appetites and actions before all of Mother’s waters are rendered wild.”

— Charles Clark IV  
Assistant Chief, Nanticoke Indian Tribe

# Living Resources



Wetlands constitute more than 39% of the Inland Bays/Atlantic Ocean Basin. These lush areas provide habitat for a variety of wildlife, from egrets to diamondback terrapins.

The living resources of the Inland Bays/Atlantic Ocean Basin are both extremely valuable and extremely vulnerable. The basin's forests, wetlands, and beaches shelter a variety of wildlife. The basin provides habitat for major fisheries and is a seasonal stopover for neotropical songbirds. Rare reptiles, birds, shellfish, mammals, and insects live here — from the diamondback terrapin to the tiger beetle. However, the basin's wildlife habitat is dwindling as human activity increases.

## PRIORITY COMMUNITIES

Mature forests provide diverse habitat for many species of native mammals, invertebrates, amphibians, reptiles, and birds, including migratory songbirds. Of the less than 60,000 acres of forests remaining in the basin, most are privately owned.

Forests of the basin include coniferous, hardwood, and mixed woodlands with a variety of woody and grassy understory plants. Though longevity is desirable in forests — with minimal human disturbance favoring these natural communities — virtually all basin forests have been harvested at least twice since the arrival of European settlers. With most of the basin's land area cleared and

drained for agriculture and increasingly subject to residential development, human impact on basin plants and animals has been profound.

Wetlands serve a variety of ecological functions: they filter nutrients, sediments, and toxic chemicals from water; they minimize storm and tidal flooding; and they slow erosion by providing a buffer against tides and waves. Wetlands also serve as habitat for a variety of animal and plant species.

Constituting more than 39% of the basin, wetlands support Delaware's most diverse freshwater, brackish, and saltwater ecological communities. Although saline and brackish marshes may be most recognizable to the beach-goer, boater, or casual observer, this basin includes significantly more nontidal, freshwater wetlands. Arguably the rarest and most diverse freshwater wetlands in the state, acidic sea-level fen wetlands and interdunal swale wetlands are only found in Delaware in this basin.

Historically, the Inland Bays portion of the basin has lost substantial wetlands acreage due to development and agricultural land conversion. Although the rate of wetland destruction in the basin and statewide has slowed in recent years, an estimated 54% of Delaware wetlands has been lost since 1780.

## PRIORITY SPECIES

Neotropical migrant songbirds breed in North America and migrate to the tropics each autumn. The coastal maritime forests and scrub shrub communities in the basin provide important habitat for migrating birds.

The beaches and dunes along Delaware's Atlantic Coast provide critical habitat for beachnesting birds, including the piping plover, least tern, common tern, black skimmer, and American oystercatcher, which are ranked as rare by the Delaware Natural Heritage Program. The piping plover is also federally listed as threatened. While these birds resided in healthy numbers in the 1960s, their numbers have declined in recent years. The Division of Parks and Recreation closes nesting beaches seasonally to reduce human disturbance.

The diamondback terrapin is a small- to medium-sized turtle that lives in estuarine marshes and bays. Although this reptile is still common in the basin, potential human impacts merit attention. Bulkheads and riprap make it difficult for females to find nesting sites. Turtles attempting to cross Route 1 in search of nesting habitat often are killed by automobiles. Commercial crab traps also pose a threat.

The Inland Bays/Atlantic Ocean Basin has a history of robust osprey populations. However, several factors have lowered their productivity, including



A great blue heron hunts for bait fish in a tidal creek along the Inland Bays.

lack of safe nesting sites, changes in local fish populations, and human disturbance.

Two rare species of tiger beetle are found in the basin. These species — the beach dune tiger beetle and the little white tiger beetle — inhabit open dune habitats and have only been found in Cape Henlopen State Park. They are good indicators of the ecological integrity of beach and dune communities.



Many shorebirds depend on Delaware's Inland Bays for nesting habitat.

The Delmarva fox squirrel is found in mature hardwood and loblolly pine forests along streams and bays. Population declines due to loss of habitat caused this squirrel to be placed on the Federal Endangered Species list in 1967. The species was reintroduced to the Inland Bays/Atlantic Ocean Basin, but their numbers remain low.

Freshwater mussels live in the bottom sediments of freshwater streams, rivers, and ponds. They are the most endangered family of animals in the United States. Of the 13 species that occur in Delaware, 11 are rare or extremely rare. Freshwater mussels are important monitors of water quality.

Surf clams are commercially important clams that are found in the ocean surf to a depth of about 140 feet. Overharvesting led to a decline of this species along the Delaware coast, and there are concerns about recovery of surf clam populations. The sandy ridges that surf clams prefer are used as borrow sites for beach nourishment activities.

*“Mother Earth has many children whom she loves and provides for equally. The four-leggeds, the winged beings, those who live and swim in Mother's blood, are brothers and sisters to the plant nations, the creepy-crawlies, the life too small to see, and us. We two-leggeds must consider the rest of our family in all of our thoughts and deeds.”*

— Charles Clark IV  
Assistant Chief, Nanticoke Indian Tribe

# Recreation



The Inland Bays and their watersheds are a major provider of tourist-based income and recreation. Many thousands of visitors enjoy going to the beach, fishing, pleasure boating, clamming, crabbing, hunting, and other recreational pursuits. The adjacent public lands are used for hiking, hunting, wildlife watching, and other outdoor activities, as well as a means of gaining access to the bays themselves. The Inland Bays/Atlantic Ocean Basin contains four state parks, two state wildlife areas, two state fishing areas, eight public boat launches, and one publicly-owned marina.



Studies have shown that the wide Atlantic coast beaches and outdoor recreation are the primary reasons tourists visit coastal Sussex County.

Studies have shown that the beaches and outdoor recreation are the primary reasons tourists visit coastal Sussex County. The four state parks in the area — Delaware Seashore, Fenwick Island, Holts Landing, and Cape Henlopen — comprise about 8,100 acres. This is approximately 43% of the acreage in Delaware's state park system, taking in more than 14 miles of Delaware's Atlantic coast. Cape Henlopen and Delaware Seashore are the two most visited parks in the state park system. Most of the visitors come from Maryland, Pennsylvania, and New Castle County.



Recreation and tourism in the Inland Bays area accounts for more than \$250 million a year.

The recreation and tourism that surround Delaware's Inland Bays account for more than \$250 million annually. Decline in water quality can threaten the area's tourism industry, as fish stocks become depleted, odors from decaying sea lettuce fill the air, and threats of *Pfiesteria* loom. Improving the water quality of the Inland Bays is vital to maintaining the county's booming tourism industry and recreation along Delaware's beaches.

## COMMUNITY-BASED RECREATION

In addition to the state recreation areas and beaches that draw tourists to the Inland Bays/Atlantic Ocean Basin, the basin's year-round residents have a need for close-to-home recreational opportunities. While Sussex County government provides no recreation services or facilities for its residents, several municipalities within the basin operate parks that help to meet the recreation needs of their residents.

Within the Inland Bays/Atlantic Ocean Basin are more than 100 acres of municipal parkland,



Delaware Seashore (shown above) and Cape Henlopen are the two most visited parks in Delaware's state park system. Most visitors come from Maryland, Pennsylvania, and New Castle County.

providing playgrounds, picnic areas, ball fields, and other recreational amenities to residents. Though these parks provide recreational opportunities for residents, they do not meet all of the basin's community recreational needs.

In Delaware's 1996 Statewide Comprehensive Outdoor Recreation Plan (SCORP), several needs were consistently reflected throughout the state. These include historic and nature education; programs for people with disabilities, teens, and seniors; public swimming pools; playgrounds and tot lots; trails and pathways; and camping areas. In addition to these statewide needs, residents of the Inland Bays/Atlantic Ocean Basin expressed a need for ball fields, fishing and boating access, and organized sports leagues.

The SCORP research showed that Sussex County residents have the greatest need for outdoor recreation facilities and programs in the state. One of the issues identified in the 1996 SCORP is the lack of recreational facilities available to Sussex County residents. At this time, Sussex County government has no plans to begin providing these services for its residents.



Studies indicate that Sussex County residents have the greatest need for outdoor recreational facilities and programs in the state.



*"Everything we need to live comes from Mother Earth, including our humanity, happiness, and joy. If we take care of the blanket of life, she will continue to provide and care for us. But if we destroy it and our connection to her, we will lose our humanity in the process."*

— Charles Clark IV  
Assistant Chief, Nanticoke Indian Tribe

# Efforts Under Way

As noted throughout this report, a number of serious environmental challenges face Delaware's Inland Bays/Atlantic Ocean Basin, from an overload of nutrients, to a steady loss of habitat for the unique wildlife that depends on the bays for survival.

Currently, a number of efforts are under way in the basin to help improve and protect the environment. These initiatives involve a

number of partners, including the Center for the Inland Bays, the Department of Natural Resources and Environmental Control, and several other state and non-profit agencies.

## CENTER FOR THE INLAND BAYS

The Center for the Inland Bays, the smallest of the 28 National Estuary Programs, was established in 1994 by the Delaware legislature. The Center's mission is "to oversee the implementation of the Inland Bays Comprehensive Conservation and Management Plan and to facilitate a long-term approach for the wise use and enhancement of the Inland Bays watersheds by conducting public outreach and education, developing and implementing conservation projects, and establishing a long-term process for the preservation of the Inland Bays watersheds."

## TRIBUTARY TEAMS

A Tributary Strategy Program was initiated during autumn 1998 by the Center for the Inland Bays. Local stakeholders from each of the Inland Bays watersheds were organized into three Tributary Actions Teams, which provide guidance and direction to the Center in its mission to reduce nutrient contributions and restore habitat in the bays.

Since January 1999, the teams have been involved in a coordinated effort with the Department of Natural Resources and Environmental Control to develop pollution control strategies (PCS) to meet the required total maximum daily loads (TMDLs) for nitrogen and phosphorus in the Inland Bays.

The teams developed an issue brief and began public deliberations on pollution strategies in February 2000. Deliberations will continue throughout spring 2000.



State natural resource staff plant eelgrass in Rehoboth Bay. Restoring the Inland Bays' once-abundant sea-grass beds is important to the health of the bays. The aquatic grass provides food and habitat for fish and other marine life.



Several initiatives are under way to address the nutrient overloading that has caused declines in water quality in the Inland Bays.

## HOUSE RESOLUTION 32

In June 1999, the Delaware House of Representatives passed House Resolution 32, establishing a working committee comprised of Sussex County Council, the Department of Natural Resources and Environmental Control, the Office of State Planning Coordination, the Department of Agriculture, the Sussex County Association of Towns, and the Center for the Inland Bays.

The committee is assessing progress toward implementation of the Land-Use Action Plan of the Inland Bays Comprehensive Conservation and Management Plan (CCMP) and identifying areas where successful implementation has not been achieved. The committee's role also is to recommend changes to Sussex County's Comprehensive Plan and implement ordinances such as zoning and subdivision, which will lead to water-quality improvements by achieving TMDLs for the Inland Bays and their tributaries.

Issues under consideration, which may ultimately result in recommendations from the committee, include changes to the requirements for septic systems and holding tanks within the Inland Bays watersheds, and requiring environmental impact assessments for land-use projects above certain thresholds; for example, acreage, number of units, square footage, intensity of use, and buffers on developable lands.

## 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 problem of nutrients entering the Inland Bays with a comprehensive program addressing not just agricultural sources, but the whole spectrum of nutrient contributions, including golf-course landscape operations, residential inputs, and residential and commercial fertilizers.

# What Can We Do?

There are lots of ways that each of us can contribute to the improvement of Delaware's Inland Bays/Atlantic Ocean 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 beachgrass is planted annually in March. The program is coordinated by the Division of Soil and Water Conservation, Department of Natural Resources and Environmental Control. For information, please call (302) 739-4411.

## CLEAN UP THE COAST

An annual cleanup of Delaware's coast has been under way for 13 years as part of the Delmarva Coastal Cleanup. Volunteers join in a cooperative effort with other groups on the Delmarva Peninsula to pick up debris along the coast as well as collect data for the Center for Marine Conservation. Call the Department of Natural Resources and Environmental Control for information, (302) 739-6324.

## MONITOR BAY WATER QUALITY

Volunteers have been taking water samples on a regular basis along the Inland Bays since 1991 to measure important water-quality characteristics, from dissolved oxygen levels to water clarity. Training is provided by the University of Delaware Sea Grant College Program, which manages the Inland Bays Citizen Monitoring Program with support from the Division of Water Resources, Department of Natural Resources and Environmental Control. For more information, call (302) 645-4250.

## HELP OUT AT THE JAMES FARM PRESERVE

Volunteers are always needed and welcome at the James Farm Ecological Preserve. The preserve, located on Cedar Neck Road in Ocean View, is managed by the Center for the Inland Bays. If you are interested in volunteering for projects such as trail maintenance, tree planting, mowing, and other activities, call the Center at (302) 645-7325.

## 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, (302) 739-3197.

## 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 the cleanup of our waters. We must also be mindful not to add hazardous, toxic, or unnecessary materials to increase the burden on wastewater systems. Here are some tips for reducing household impacts.

- ◆ Use non-phosphate laundry detergents. Phosphates may overstimulate 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 the Delaware Solid Waste Authority's Sussex County facility the first Saturday in February, June, and October. The Southern Solid Waste Management Center is located along Route 20, Jones Crossroads. Hours are 8 a.m. to 3 p.m. 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, polish removers, perfumes; disinfectants; drain cleaners; floor wax; mercury thermometers; moth balls; oven cleaner; smoke detectors; spot remover; toilet cleaner.

*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 Cherry Island Landfill for a fee. Call 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 aquatic algae growth.

- ◆ 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 pesticides are used, 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 overwater 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

- ◆ 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 line.
- ◆ 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, washing 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

- ◆ 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.

*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 FOR RISK ASSESSMENT

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.

### 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.

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

**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.

**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.