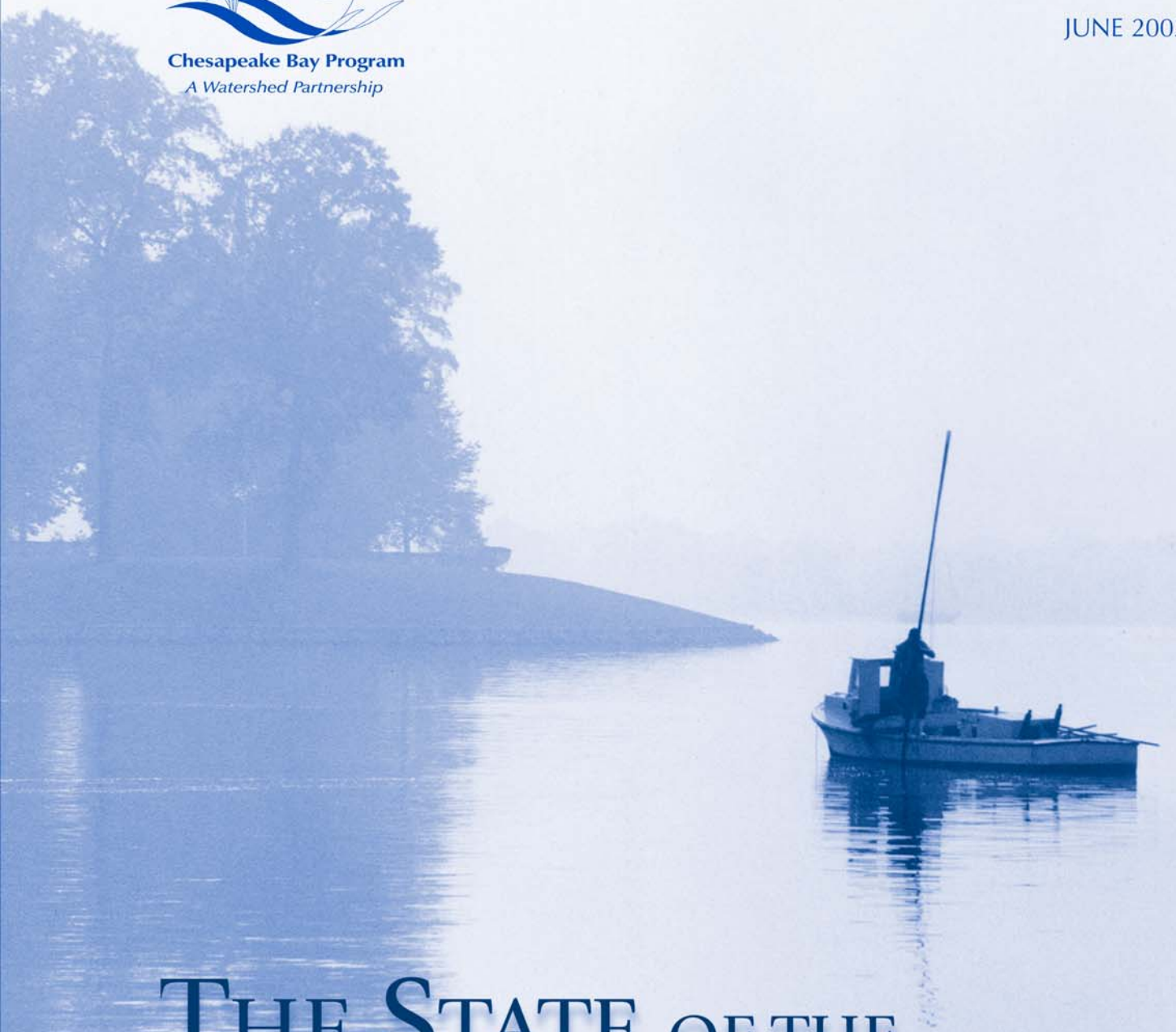
CBP/TRS 260/02
EPA 903-R-02-002

JUNE 2002

Chesapeake Bay Program
A Watershed Partnership



THE STATE OF THE CHESAPEAKE BAY

A Report to the Citizens of the Bay Region

The State of the Chesapeake Bay

A Report to the Citizens of the Bay Region

June 2002

Contents

Executive Summary 1

Introduction 3

A Watershed Partnership 5

Watershed Profiles

CHAPTER ONE: Life in the Bay 9

The Blue Crab 10

Striped Bass 12

Oysters 13

Exotic Species 15

BayScapes

Fish Passage and Shad 17

Fish Passage Designs • Bald Eagles

CHAPTER TWO: Vital Habitat Protection and Restoration 21

Underwater Bay Grasses 22

Wetlands 25

The Chesapeake Bay Small Watershed Grants Program

Watershed Management 27

Forests 28

CHAPTER THREE: Water Quality 31
Nutrients and Sediments 32
A Fish Eye's View 34
The Chesapeake Bay and TMDLs 36
The 2001 Storm Water Directive
Chemical Contaminants 38
Chemicals of Concern • Businesses for the Bay • 2001 Fish Advisory
Air Pollution and the Chesapeake Bay 42
Ammonia Emissions

CHAPTER FOUR: Sound Land Use 45
The Legacy of Sprawl 46
Vital Resource Lands 47
Chesapeake Bay Watershed Preserved Lands
A Booming Population 48

CHAPTER FIVE: Stewardship and Community Engagement 51
Bringing the Classroom to the Bay 52
Government by Example 54
Citizen Monitoring Program 54
The Chesapeake Bay Gateways Network

CHAPTER SIX: Looking Ahead 57

CONTACT INFORMATION 59

Charts and Maps

Chesapeake Bay Watershed Map 5
Trends in Blue Crab: Mature Females 11
Striped Bass Spawning Stock 12
Trends in Shellfish: Oysters 14
Stream Miles Opened to Migratory Fish 17
American Shad: Population Trends 19
Acres of Bay Grasses 22
Areas in Chesapeake Bay and Its Tidal Rivers with Notable Changes in Underwater Grass Beds . . . 23
Forest Buffers 29
Sources of Nitrogen and Phosphorus Loads to the Chesapeake Bay 33
Status of Chemical Contaminant Effects on Living Resources in the Chesapeake Bay's Tidal Rivers . . 39
Airshed and Watershed of the Chesapeake Bay 43
Chesapeake Bay Watershed Population 49

Executive Summary

Since 1983 the Chesapeake Bay Program has worked with federal, state and local governments; industry; farmers; environmentalists; conservation associations; citizen groups and interested individuals to restore the Bay's water quality by reducing pollution.

Clearly, significant progress has been made, but the job is not finished. With the signing of the new Bay agreement, Chesapeake 2000*, Bay Program partners have gained a powerful new tool to further the restoration effort.*

Chesapeake 2000—Guiding Restoration in the New Century

In *Chesapeake 2000*, Bay Program partners pledged to continue to restore, enhance and protect the Bay's living resources and their habitats. The Bay Program also inaugurated a new approach, one that embodies a fundamental shift in perspective. While continuing to focus on individual species and habitats that require specific attention, such as the blue crab, oyster reefs and shad, the new agreement also recognizes the intimate linkages among these systems and addresses their interdependence within the context of a single, broad ecosystem. This additional focus on multispecies management takes into account the relationships among many species that comprise the Bay's food web. *Chesapeake 2000* also expands the scope of earlier agreements by recognizing the vital importance of educating young people and adults in the watershed and by increasing opportunities for active community engagement in restoring and protecting the Chesapeake Bay.

In this publication, we report on the status of our progress toward the goals we set or renewed in *Chesapeake 2000*. Evaluating the condition of the Chesapeake Bay is a complex process that must include careful examination of the status

CONTINUED

and trends of numerous environmental indicators. The Bay Program uses these indicators to analyze the health of the Bay. Annual fluctuations may be caused by changes in seasonal weather patterns and other biological conditions, therefore it is imperative that we monitor progress over the long term. Here are some highlights of our current progress:

- **Underwater bay grasses:** The total acreage of bay grasses has increased since the low point in 1984 from 38,000 acres to more than 69,000 acres in 2000. The Bay Program's aim is to achieve 114,000 acres by 2005.
- **Nutrient progress:** A recent analysis revealed that between 1985 and 2000, phosphorus loads delivered to the Bay from all of its tributaries declined by 8 million pounds per year. Nitrogen loads declined by 53 million pounds per year. Unfortunately, baywide phosphorus reductions fell short of the 2000 goal by 2.3 million pounds per year, while nitrogen loads fell 24 million pounds per year shy as well. In areas where excessive nutrient loads most adversely affect the Bay (the Potomac River and points north), phosphorus goals were met. We expect to meet nitrogen goals for those areas once tributary strategies are fully implemented in 2003.
- **Fish passage:** In 2000 and 2001, an additional 87 miles of waterways in the Bay watershed were reopened to migratory fish. Our goal is to open 1,357 miles to migratory fish by 2003. A total of 849 miles were reopened between 1988 and 2001.
- **Oyster habitat:** As of December 2001, more than 50,000 acres were designated as oyster sanctuaries. Within those designated areas, more than 330 acres of oyster habitat have already been constructed.
- **Blue crabs:** The *2001 Chesapeake Bay Blue Crab Advisory Report* indicated that blue crab abundance is below average and has been in decline in recent years. In 2001, Bay jurisdictions adopted a baywide threshold for the blue crab stock, and agreed to a 15 percent reduction in harvest levels (based on a 1997–1999 average) over three years.
- **Chemical releases:** In December 2000, the Chesapeake Bay Program adopted the *Toxics 2000 Strategy*, which commits to meeting voluntary goals that surpass current regulatory requirements and strives to achieve "zero release" of chemical contaminants into the Bay. Between 1988 and 1998, industries have reduced chemical releases by 67 percent.
- **Water trails:** At present, 560 miles of water trails are located in the Bay watershed and more than 500 additional miles are under development. Bay Program partners agreed to "increase the number of designated water trails in the Chesapeake Bay watershed by 500 miles" by 2005.
- **Bald eagles:** Bald eagle counts from 2001 indicated the recovery of the bald eagle population in the Chesapeake Bay watershed has remained on track. A total of 618 active nests were counted in 2001 in Maryland, Pennsylvania, Virginia and the District of Columbia—up from 533 active nests the year before.
- **Waterfowl:** Data released in June 2001 show an increase in several species of waterfowl living in the Chesapeake Bay watershed, with 12 of 21 monitored species or species groups meeting year 2000 population goals.
- **Riparian forest buffers:** In 2001, 628.5 miles of riparian forest buffers were planted in the Chesapeake Bay watershed, including 255 miles in Maryland, 266 in Pennsylvania, 102.5 in Virginia and 5 miles on federal lands. This brings us to a total of 1,298 miles, or 65 percent of the Bay Program partners' goal of restoring 2,010 miles of streamside buffers in the watershed by 2010.

We are encouraged by these achievements, but much remains to be done. Thanks to the tremendous collaborative effort that yielded **Chesapeake 2000**, *we have a useful road map for current efforts and the next generation of issues.*

The Chesapeake Bay is a noble arm of the sea.

—Lord Morpeth, 1842

Introduction

The State of the Chesapeake Bay

The Chesapeake Bay is the largest and most productive estuary in North America. This vast body of water, in which salt and fresh waters mix, is one of the most biologically diverse environments in the world. Its intricate system of rivers and streams provides a fertile habitat for plant and animal life, a lifeline and livelihood for watermen, and is a source of spectacular natural beauty. The Bay embodies a rich heritage that many of us feel bound to bequeath, intact, to coming generations.

For all its obvious treasures, the Bay has struggled for more than a hundred years against an increasing tide of pressures, from pollutants to development, which have compromised its health and the survival of the plants and animals it shelters. The rapid growth in the human population during the 19th and 20th centuries, and the consequent industrialization along the Bay's 11,684-mile shoreline and throughout its 64,000-square-mile watershed, have left their mark.

For years the Bay was burdened by the over-harvesting of fish, crabs and oysters; the destruction of oyster reef habitat and loss of underwater grasses; the damming of its rivers and streams, which prevented the passage of migratory fish to their historic spawning grounds; and a flood of pollution caused by too much phosphorus, nitrogen, sediments, industrial toxics and boat waste in the water. By the 1970s, these and other factors appeared to hold the Bay in their grip; it appeared that the mark left by human habitation would become indelible.

CONTINUED

Bay studies undertaken during this time concluded that three areas required immediate attention: nutrient over-enrichment, dwindling underwater bay grasses and toxic pollution. In 1983 the Chesapeake Bay Program was formed and the first Chesapeake Bay agreement was signed. Four years later, the *1987 Chesapeake Bay Agreement* was signed, calling for the restoration of the Bay's "living resources"—its finfish, shellfish, underwater grasses and other aquatic life and wildlife. Fisheries and habitat restoration, nutrient and toxic reductions, and significant advances in estuarine science were among the Program's highest priorities.

Looking Back to the Future

In the 1950s, the water was clear enough in the Patuxent River for a certain fisherman to wade in up to his chest and still see his sneakers. By the 1970s, the same fisherman, then-Maryland state senator C. Bernard "Bernie" Fowler, would lose sight of his shoes long before he waded to that depth. Since 1988, Bernie Fowler Day has been held the second Sunday in June on the banks of the Patuxent, and his famous wade-in—attended by neighbors and friends, Bay Program participants and the press—has given us annual clues to our progress in cleaning up the water. Bernie's goal is to restore his sneaker visibility to chest depth—roughly five feet deep.

While it may not be possible to return the Bay to a largely theoretical, pristine condition, we are making continuous, if gradual, progress toward restoring the Bay's water quality and protecting those gains—and with it, restoring our collective heritage of a healthy and productive Bay system.

In this report, you will be reading the logic of the *Chesapeake 2000* agreement at work. We have organized each chapter around the new categories and goals in the agreement and we discuss the important shifts in perspective that underlie our commitments. The text is presented in sections, giving background on the subject, status and trends, information on what the Bay Program is doing, and useful tips on what you can do. At the end of the report, we include contact information.

A Watershed Partnership

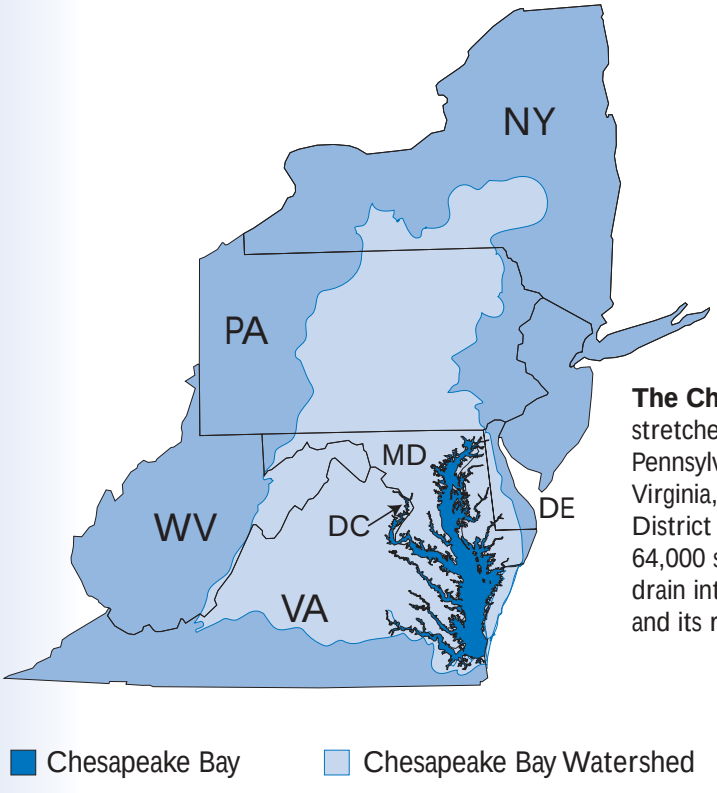
The land area through which water flows and drains to the lowest point, in a stream, river, lake or estuary, is known as a watershed. Watersheds collect precipitation and accumulate water into "flows" that course across the landscape. A watershed may be large or small, may occupy sloping, mountainous or nearly flat terrain and cover many landscapes, including forests, farmland, small towns and cities. Human activities in a watershed eventually affect the water quality downstream.

The Bay's Watersheds

More than 64,000 square miles of land drain into the Chesapeake Bay and its rivers. The Chesapeake Bay watershed stretches across New York, Pennsylvania, Maryland, Delaware, Virginia, West Virginia and the District of Columbia. Threading through the Bay watershed are many "subwatersheds," smaller systems that drain into the streams and rivers that flow into the Chesapeake.

Clean water is essential for life to occur and persist. Human activities on the land within the watershed in due course affect the quality of the Bay's water. By protecting the Bay's many subwatersheds, we not only preserve our heritage; we also protect the quality of the water that flows in local streams and rivers. Ultimately this ensures healthy drinking water for

CONTINUED



The Chesapeake Bay Watershed stretches across New York, Pennsylvania, Maryland, Delaware, Virginia, West Virginia and the District of Columbia. More than 64,000 square miles of land drain into the Chesapeake Bay and its rivers.

our homes; safe swimming, boating and fishing in rivers, streams and estuaries; and abundant wildlife and natural resources in and around our aquatic environments.

For years, water quality and habitat restoration approaches have isolated single problems and solved them in piecemeal fashion. *Chesapeake 2000*, however, tackles water quality and ecosystem problems by addressing them at the broader, watershed level. Within this larger context, we believe it then makes sense for local governments and community organizations to create subwatershed-level management plans. These plans can connect local communities with the Bay Program's commitments and efforts, so that forests, streams and wetlands can be restored and protected while the local culture and economy are preserved.

While the Bay Program maintains its individual commitments to protect and restore bay grasses, forests, wetlands and streams, the new focus on watershed management planning allows us to devise strategies to improve the local environment. Ultimately, this method best sustains our progress toward protecting the Bay's vital habitats.

Watershed Profiles is an innovative Web application that assembles maps, charts and information about the environmental condition of the Chesapeake's subwatersheds. The application operates at a variety of scales, providing data on the entire 64,000-square-mile watershed or on small tributary subwatersheds. Each profile includes information on landscape changes, areas to visit and current activities sponsored by the Bay Program and other organizations. All of the information is presented through easy-to-read charts, maps and tables, and interactive mapping is available using the Chesapeake Bay Program website's Bay Atlas.

To find out more about your watershed, enter your zip code in the Find Your Watershed box on the Chesapeake Bay Program's web page, at www.chesapeakebay.net. All profile information is presented in various degrees of detail to interest students, educators, government officials, private sector business groups and anyone who lives in the Bay watershed.

In *Watershed Profiles*, you'll find information on:

- Population and landscape changes;
- Toxic releases through the EPA's Toxics Release Inventory;
- Businesses for the Bay;
- Watershed organizations;
- Public access sites;
- Submerged aquatic vegetation distribution;
- Water quality status and trends;
- Parks, forests and wildlife refuges; and
- Community resources and tools.

A Watershed Protection Approach

The Bay Program has learned, from nearly 20 years of restoration experience, that working at the watershed level yields definite results. It also requires us to set meaningful priorities. Experience has taught us that we must encourage a profound degree of involvement among all stakeholders and solicit their expertise and authority, and measure our progress through monitoring and other data collection. Using this approach we can:

- **Attain better environmental results**

  Because watersheds are defined by natural hydrology, they represent the most logical basis for managing water resources. The resource becomes the focal point, and managers are able to gain a more complete understanding of an area's overall conditions and the stressors that affect those conditions.

  Traditionally, water quality improvements have focused on specific sources of pollution, such as wastewater discharges, or on a specific part of a water body, such as a river segment or wetland. Such approaches often fail to address the more subtle and chronic problems that contribute to a watershed's overall decline. For example, pollution from a wastewater treatment plant might be reduced significantly after a new technology is installed, but those pollution reductions may not be enough. The local river may still suffer if other factors, such as habitat destruction or runoff, go unaddressed. Watershed management can uncover many stressors that affect a watershed.

- **Save time and money**

  Whether the task is restoring habitats, monitoring, modeling, issuing permits or reporting, a watershed framework can simplify and streamline the workload and save money. For example, synchronizing schedules so that all monitoring within a given area occurs simultaneously can reduce costs by eliminating duplication and unnecessary travel.

  A watershed protection approach also improves efficiency, by consolidating and coordinating the efforts of all partners, including federal, state, tribal and local agencies. These groups can complement and reinforce each other's activities, avoid duplication and leverage resources to achieve greater results.

  This approach also improves data collection. For example, states expand their own monitoring programs by factoring in the monitoring activities of the U.S. Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS) and the National Oceanic and Atmospheric Administration

(NOAA), as well as through citizen-based monitoring programs. In addition, permittees and other stakeholders that generate monitoring data can form basin-monitoring consortiums to pool resources and work consistently to collect and report data.

- **Increase Public Support**

Watershed protection also invites awareness and support from the public. Once individuals become interested in their watershed, they often participate in decision-making and even hands-on protection and restoration efforts. This process builds a sense of community, reduces conflicts, increases commitment to achieving environmental goals and, ultimately, improves our chances of success.

Watershed protection involves setting meaningful priorities, encouraging involvement, soliciting expertise and authority and measuring our progress.

The health and vitality of the Chesapeake Bay's living resources provide the ultimate indicator of our success in the restoration and protection effort.

– CHESAPEAKE 2000

CHAPTER ONE

Life in the Bay

The Chesapeake Bay is North America's most biologically diverse estuary, home to more than 3,600 species of plants, fish and animals. Approximately 348 species of finfish, 173 species of shellfish and more than 2,700 species of plants live in or near the Bay. The Bay also provides food and shelter for 29 species of waterfowl, and more than one million waterfowl winter over annually in the basin. The Bay is a major resting ground along the Atlantic Migratory Bird Flyway.

In *Chesapeake 2000* the Bay Program recommits to protect and restore the Bay's "living resources"—in particular, the Bay's fisheries and the plants and animals that sustain them and provide their habitat. The new goal is to "restore, enhance and protect the finfish, shellfish and other living resources, their habitats and ecological relationships, to sustain all fisheries and provide for a balanced ecosystem."

Balance is the key. To present a comprehensive report on the great variety of plants and animals that inhabit the watershed, or to try and cover all elements of the ecosystem, would be an impractical task. Instead, we chose to focus on three representative species—oysters, blue crabs and striped bass—that are not only among the most visible and commercially valuable species, but also are useful indicators of the health of the Bay system.

This chapter also includes our report on the issue of exotic species management and a discussion of recent accomplishments in fish passage construction for resident and migratory fish, such as shad, herring and striped bass. In the next chapter, Vital Habitat Protection and Restoration, we develop the information in a broader context, by reporting on the diverse habitats that exist in the Bay, species interactions and watershed protection.

the BLUE CRAB

As author William Warner demonstrated in the Pulitzer Prize-winning *Beautiful Swimmers*, there is a mythic language associated with the crab fishery, and questions still surround the behavior of the blue crab, *Callinectes sapidus*. This pugnacious, bottom-dwelling predator is the object of the most productive commercial and recreational fishery in the Chesapeake Bay. "Ain't nobody really knows about crabs," Warner quotes a waterman as saying in the early 1970s. Despite the crabs' persistent air of mystery, Bay scientists know considerably more today than they did 30 years ago.

Blue crabs are members of the swimming crab family. *Callinectes* (from the Greek, meaning "beautiful swimmer") *sapidus* ("savory") is a benthic or bottom-dwelling predator that feeds on other crustaceans, bivalves, fish, annelids (such as marine worms), plants, detritus and nearly any other food item it can find, including dead fish and decomposing plants.

The blue crab is one of the most important commercial species in the Chesapeake Bay and has the highest value of any commercial fishery, with landings in 2001 reaching 51.7 million pounds.

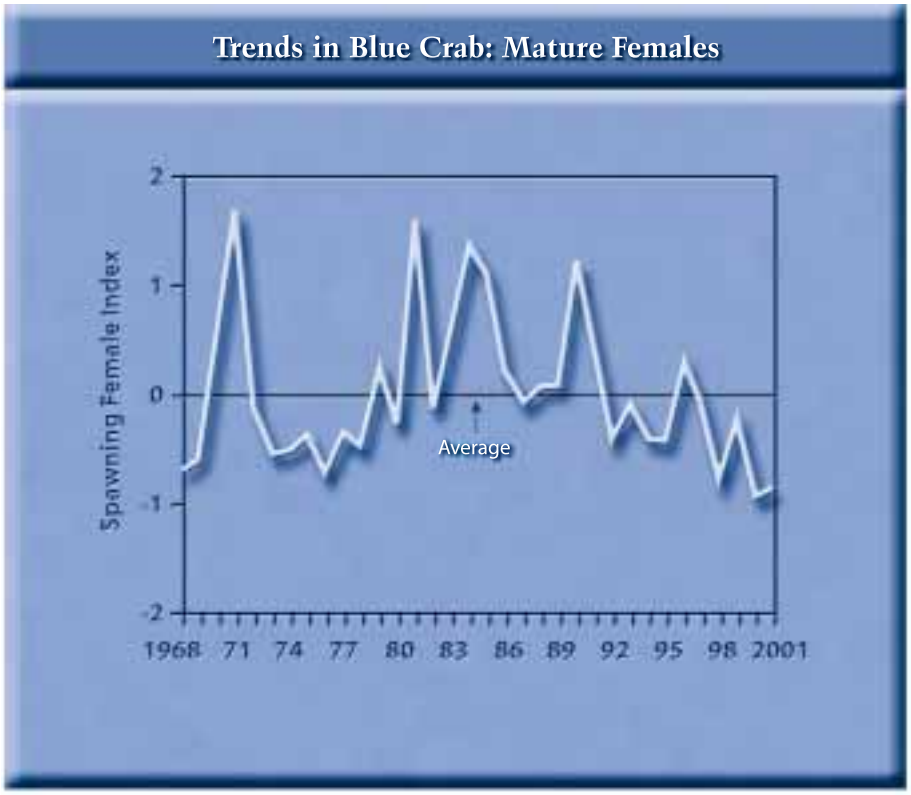
Crabs at Risk

During the 1970s and 1980s, the widespread disappearance of underwater grasses, also called submerged aquatic vegetation, or SAV, resulted in a severe loss of important crab habitat, primarily for juveniles and crabs in the molting stage. Although the blue crab can tolerate moderate amounts of certain types of pollution, it thrives in clean water and uses the entire spectrum of the estuary during its life cycle, from the deeper channels to the coastal shallows, or littoral zone.

Immediately after molting, crabs are vulnerable to predators because their new shells are still soft, so they often hide in bay grass beds for protection. Bay grass beds serve as nursery areas, and crabs of all sizes forage for food there. Bay scientists have found that 30 times more juvenile crabs were found in bay grasses than in areas without grass.

Male crabs prefer lower salinity areas in the upper Bay and tributaries. Females prefer the higher salinity of the lower Bay and the mid to lower tributaries, and most spend their winters in southern Bay waters.

Dwindling nursery habitat is not the only threat to the blue crab. Like other aquatic species, crabs are susceptible to summer's low oxygen conditions. Fueled by nutrient pollution from farms, wastewater treatment plants, homes and automobiles, enormous "blooms" of algae eventually deprive the water of its oxygen and drive crabs out. Crabs sometimes die from low oxygen levels when trapped in crab pots under these conditions.



Status and Trends

The abundance of mature female blue crabs in 2000 and 2001 is at or near historic lows. The *Chesapeake 2000* agreement commits to establish harvest targets for the fishery by 2001. Bay Program partners met this commitment when they agreed to increase spawning potential by reducing current harvests 15 percent by 2003.

What the Bay Program Is Doing

Bay Program partners have committed to restore, enhance and protect blue crabs and other shellfish, their habitat and their ecological relationships to provide for a balanced ecosystem. We have established new harvest targets for the blue crab fishery and are taking several other measures, including:

- Developing multispecies management plans to take into account the impact of other fish species on the blue crab;
- Protecting and restoring bay grasses in the Chesapeake, thereby restoring blue crab habitat; and
- Funding research efforts involving aging and migratory patterns of the crab within the Bay.

It may seem impossible to make a difference on an individual level, but you *can* help. **When you catch crabs:**

Remember that a single female blue crab can produce up to 8 million eggs in one mating season, so try to minimize their capture.

Keep only the crabs you are going to eat.

Don't leave crab pots unattended for long periods of time.

You can also contribute by participating in bay grass restoration projects and by limiting any activities that could compromise the growth or health of bay grasses.

STRIPED BASS

The striped bass, or rockfish, is a migratory fish that inhabits the salty waters of the Atlantic and uses the brackish waters of the Chesapeake Bay and its upstream tributaries as spawning and nursery areas. In early spring, adult striped bass begin their journeys up the Bay's tidal tributaries to spawn. By June the bass have moved into the deeper channels of the Bay and out to sea. In late autumn they begin returning to the mainstem of the Bay to spend the winter.

The Bay and its tributaries are the primary spawning and nursery area for between 70 and 90 percent of the Atlantic coast stock of striped bass. The year-round stock within the Chesapeake Bay is composed mainly of pre-migratory fish, ages five and younger, which move into the Atlantic as they mature into adults.

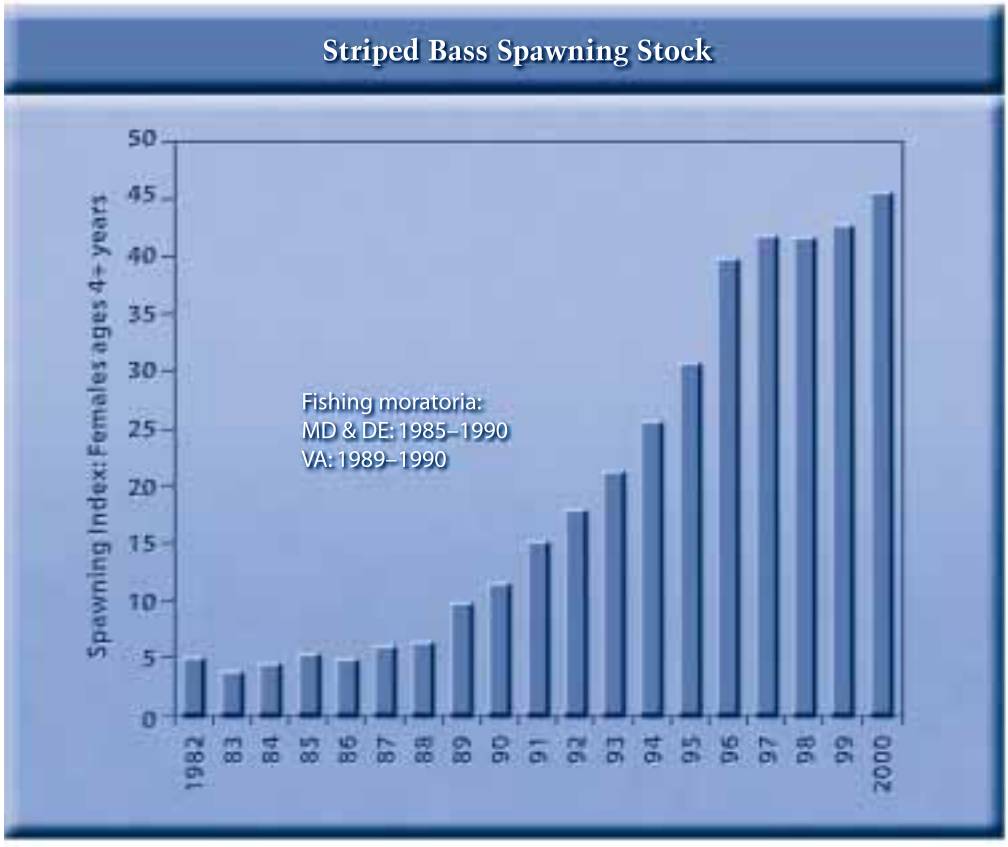
The striped bass is a crucial fish to study because of its relationships with other Bay species. A mature striped bass can weigh as much as 70 pounds and is one of the Bay's top predators. Mature adults consume large quantities of smaller fish, such as menhaden, but in their larval phase they feed on microscopic animals, or zooplankton. Their diet alters not only with age, but with shifts in season and Bay species.

What the Bay Program Is Doing

By the 1980s, over-fishing and degraded spawning habitat had reduced stocks of striped bass to a dangerously low level. Fisheries management measures first banned, then limited, striped bass fishing over the next 15 years. The striped bass responded to these restrictions, stocking measures and improved habitat conditions, and were declared "restored" on January 1, 1995. Since then, the Bay Program has continued to advocate protection measures that will ensure an abundance of striped bass in the Bay in coming years. We are encouraging a baywide striped bass harvest quota of 10.5 million pounds each season, and Bay scientists continue to study striped bass to determine the size of their populations in the Bay.

If you want to help conserve the Bay's stocks of striped bass, you can:

- Practice catch-and-release fishing. It's just as challenging and minimizes recreational fishing's impact on the Bay's fisheries.
- Use barbless hooks, circle hooks or other devices designed to reduce the damage to fish.
- Minimize the physical handling of fish and the time it spends out of the water.
- Use steel sinkers instead of lead, which is a toxic substance.



OYSTERS

The American oyster has long been considered one of the Bay's keystone species. This unusual-looking mollusk is valuable not only as a delicious food source, but for the role it plays in preserving the Bay's overall system.

Oyster reefs are complex structures created by colonies of oysters over time, which provide habitat for new oysters and many other aquatic species. The three-dimensional surface area of an oyster reef—up to 50 times the area provided by a flat surface—allows many other plant and animal species to use it as habitat.

Oysters feed by filtering the water for microscopic plants and animals, and in the process, filter nutrients, toxins and sediment from the water column. They are voracious feeders, each capable of filtering up to 50 gallons of water per day. It is estimated that at their peak abundance, the total population of oysters in the Bay could filter an amount of water equal to all the water in the Bay in three days. Today, due to decreased abundance, it takes a year for these animals to filter the same volume of water. Oyster restoration is paramount to improving the overall water quality of the Chesapeake Bay.

Status and Trends

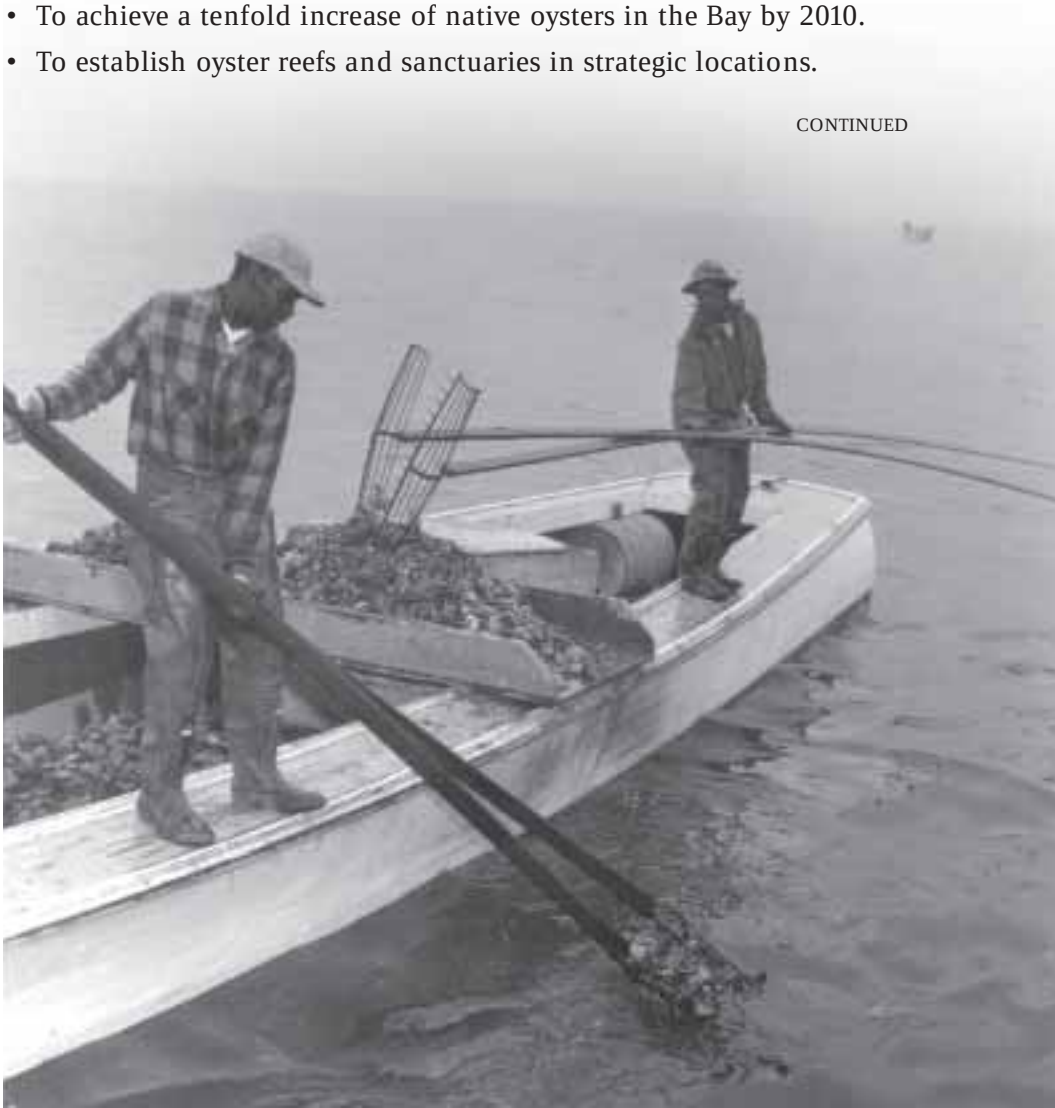
For more than a century, until the 1980s, the oyster constituted one of the Bay's most valuable commercial fisheries. Over-harvesting, dwindling habitat, pollution and diseases such as Dermo and MSX have caused a severe decline throughout the Chesapeake Bay. During the 1950s, approximately 35 million pounds of oysters were harvested annually. Since then, the catch has declined sharply, and current harvests have fallen below 3 million pounds. The current oyster harvest levels are approximately 8 percent of the harvest highs recorded in the 1950s.

What the Bay Program Is Doing

In keeping with our commitment to restore, enhance and protect Bay shellfish, their habitat and their ecological relationships to provide for a balanced ecosystem, the Bay Program is working on several strategies. In *Chesapeake 2000* we have committed:

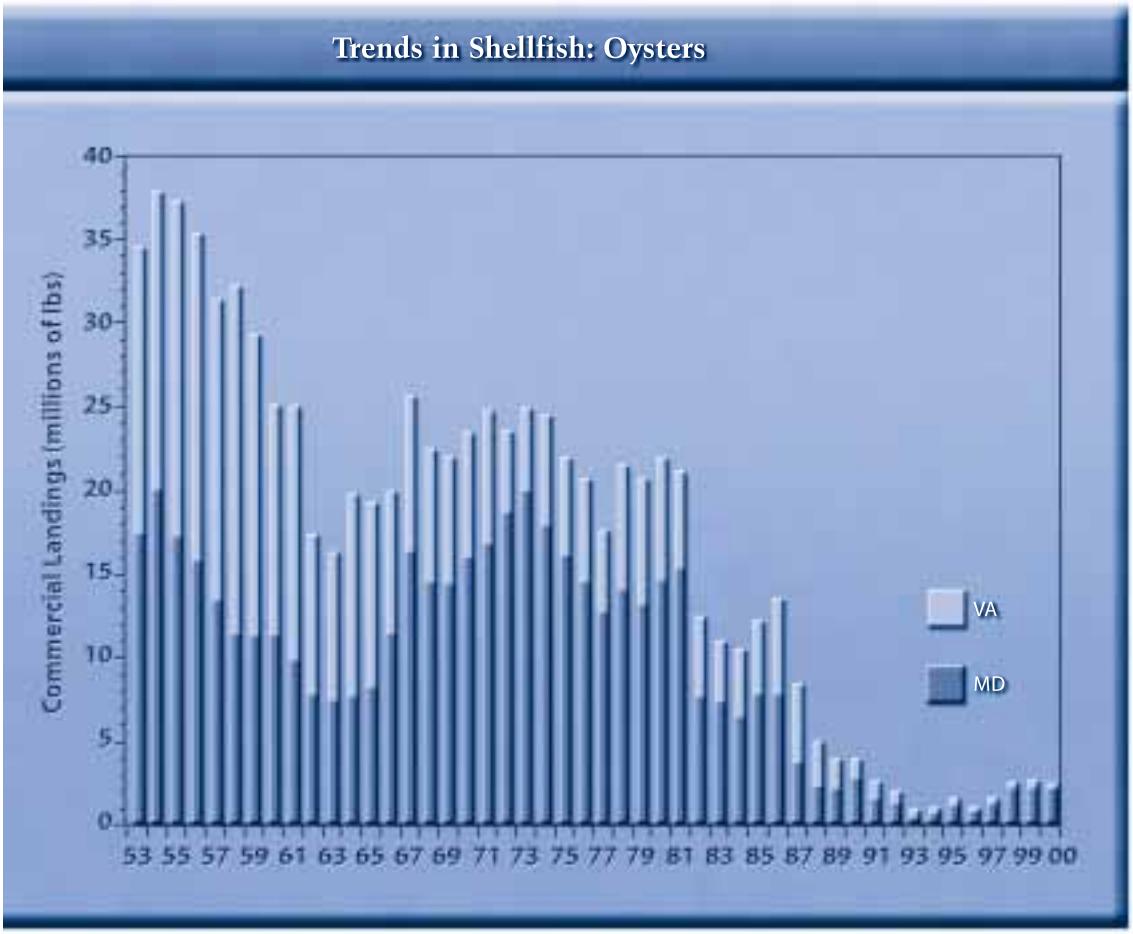
- To achieve a tenfold increase of native oysters in the Bay by 2010.
- To establish oyster reefs and sanctuaries in strategic locations.

CONTINUED



OYSTERS *continued*

- To study diseases and parasites such as MSX and Dermo to reduce oyster mortality.
- To develop multispecies management plans that benefit water quality and Bay habitats.



WHAT YOU can do

Work with organizations that raise native oysters for release on Bay oyster reefs or build oyster gardens.

Volunteer to help stock native oysters on reefs.

Encourage your local or state governments to construct additional protected reefs and to protect existing reefs.

Urge strong regulations on harvest.

EXOTIC SPECIES

Some plants and animals that currently live in the Bay haven't always been part of the Bay's balanced ecosystem. They either were brought here for a specific economic or aesthetic purpose, have entered the Bay in the ballast waters of ships or via storms or other accidental releases. These species are, by definition, living and reproducing outside their historic or native range.

We call plants and animals that are not native to their current habitat "exotic species." Today, approximately 50,000 exotics live in the United States, and this number constantly increases. The exotic plants and animals that now live in the Chesapeake Bay include mammals such as nutria; plants such as phragmites; birds such as mute swans; and other species such as the Asiatic clam, the rapa whelk and the tiger mosquito.

Some species, such as the Asiatic clam, entered the Bay in ballast water, but others were brought here intentionally. Nutria were introduced to enhance the fur industry, and smallmouth bass were imported for sport fishing. Mute swans, which consume enormous quantities of SAV and edge other waterfowl out of their habitats, were brought to the Hudson River Valley in the 19th century to ornament the estates of the wealthy, and eventually made their way south to the Chesapeake Bay.

Exotic species can become invasive by encroaching on habitat and food sources of native species. Invasive species such as phragmites or the mute swan can cost taxpayers in the United States hundreds of millions of dollars each year in major environmental damage and losses. Nationwide, about 42 percent of the plants and animals listed as threatened or endangered under the Endangered Species Act are at risk because of exotic species. But even introduced species that are not considered invasive have the potential to cause significant damage.

What the Bay Program Is Doing

Exotic species continue to enter the Chesapeake Bay region. Reducing those introductions has become a national priority. The National Sea Grant College Program has taken the lead in educating the public on exotic species in an effort to reduce unintentional introductions from all sources. Other organizations, such as the Smithsonian Environmental Research Center and the U.S. Coast Guard, are working to reduce ballast water invasions.

Maryland is actively managing nutria, phragmites and mute swans. Pennsylvania is managing exotic species through interjurisdictional programs such as the Chesapeake Bay Program, the Great Lakes Commission, the Council of Great Lakes Governors and the national Aquatic Nuisance Species Task Force. Virginia, Maryland, Pennsylvania, New York, Delaware and the District of Columbia all have active monitoring programs to monitor existing exotic species and new threats.

The *Chesapeake 2000* agreement commits to identify and rank exotic invasive species that are causing or have the potential to cause significant damage to the Chesapeake Bay. The Bay Program has successfully identified and ranked those species, and management plans will be written and implemented for those deemed most problematic to the Bay ecosystem's restoration and integrity.

CONTINUED

EXOTIC SPECIES

continued

As a private citizen, you can help prevent the spread of exotic species.

Always remove aquatic weeds, zebra mussels or other accidental hitchhikers from your boat, diving gear, jet-skis, trailers or other equipment.

Never dump the contents of your aquarium into a waterway or a drain, and do not try to establish a favorite fish, shellfish or plant species in a new body of water. Many exotic fish introduced into the Chesapeake Bay have come from private aquariums.

Consider landscaping your yard with native plant species. Check with your local nursery or the Department of Agriculture for information about what plants are invasive and not recommended for use.

When you fish, be certain that your bait is not an exotic species.

BAYSCAPES

If you are interested in creating a wild native habitat in your area or backyard, consider 'BayScaping'—creating landscapes that are designed to benefit people, wildlife and the Chesapeake Bay. The Alliance for the Chesapeake Bay and U.S. Fish and Wildlife Service's joint BayScaping program advocates a holistic approach to landscaping through principles inspired by relationships present in the natural environment. These low-input landscapes require less mowing, less fertilizer and fewer pesticides; help protect water quality; use beneficial native plants and reduce pollution; and provide diverse habitats for songbirds, small mammals and butterflies. You can BayScape in container gardens, schoolyards or your own backyard. For more information on BayScaping, turn to Contacts on page 59.

FISH PASSAGE AND SHAD

Many ocean fish species spawn and reproduce in salt water; some, however, migrate to their native brackish or fresh waters to spawn and then return to the ocean as adults. These anadromous migratory fish include herring, shad and one of the Bay's most important commercial species, striped bass or rockfish. Catadromous fish, such as American eels, reverse the process: they live in the brackish waters of the Bay and other rivers and streams around the world and return in a mass annual exodus to the salt waters of the Sargasso Sea to reproduce.

Populations of anadromous fish such as shad and herring have declined drastically due to overfishing and the damming of waterways that prevent them from returning to their spawning grounds. Currently there are more than 2,500 blockages in the watershed, including dams, road culverts and bridge aprons. In 1980 and 1994, Maryland and Virginia, respectively, placed moratoria on the baywide shad fishery, and restocking efforts are under way throughout the watershed.

Restoring Fish Passages

Removing stream blockages and opening spawning habitat are key components of restoration efforts with respect to shad and herring. In 1993, the Chesapeake Executive Council established fish passage goals to reopen 1,357 stream miles by 2003. Four of the largest dams in the Bay watershed, all located on the Susquehanna River, have been reopened to migratory fish, including the passage opened by the fish ladder at the York Haven hydroelectric dam. All five major dams on the James River have been breached, and with a fish ladder at Bosher's Dam, the river is now accessible from Richmond to Lynchburg. A fish passage at the fabri-dam in Sunbury, Pennsylvania, scheduled for 2003, will give shad access to the upper Susquehanna all the way to Binghamton, New York.

CONTINUED

FISH PASSAGE AND SHAD *continued*

Status and Trends

Recent efforts to reopen streams have been very successful. As of 2001, 849 miles of streams have been restored to anadromous fish, and an additional 143 miles to resident fish. Restoration efforts and current stream openings have led to greater numbers of shad and herring in the upper Chesapeake Bay and the Susquehanna. Since the late 1990s American shad migrations have steadily increased, with 194,000 documented as passing through Conowingo Dam in 2001. These numbers are very encouraging, however, much remains to be done.

FISH PASSAGE DESIGNS

The most effective means of restoring fish passage is to remove the blockage. When this is impractical, artificial fish passages are constructed. Five fish passage designs are used most frequently in the Chesapeake Bay watershed:

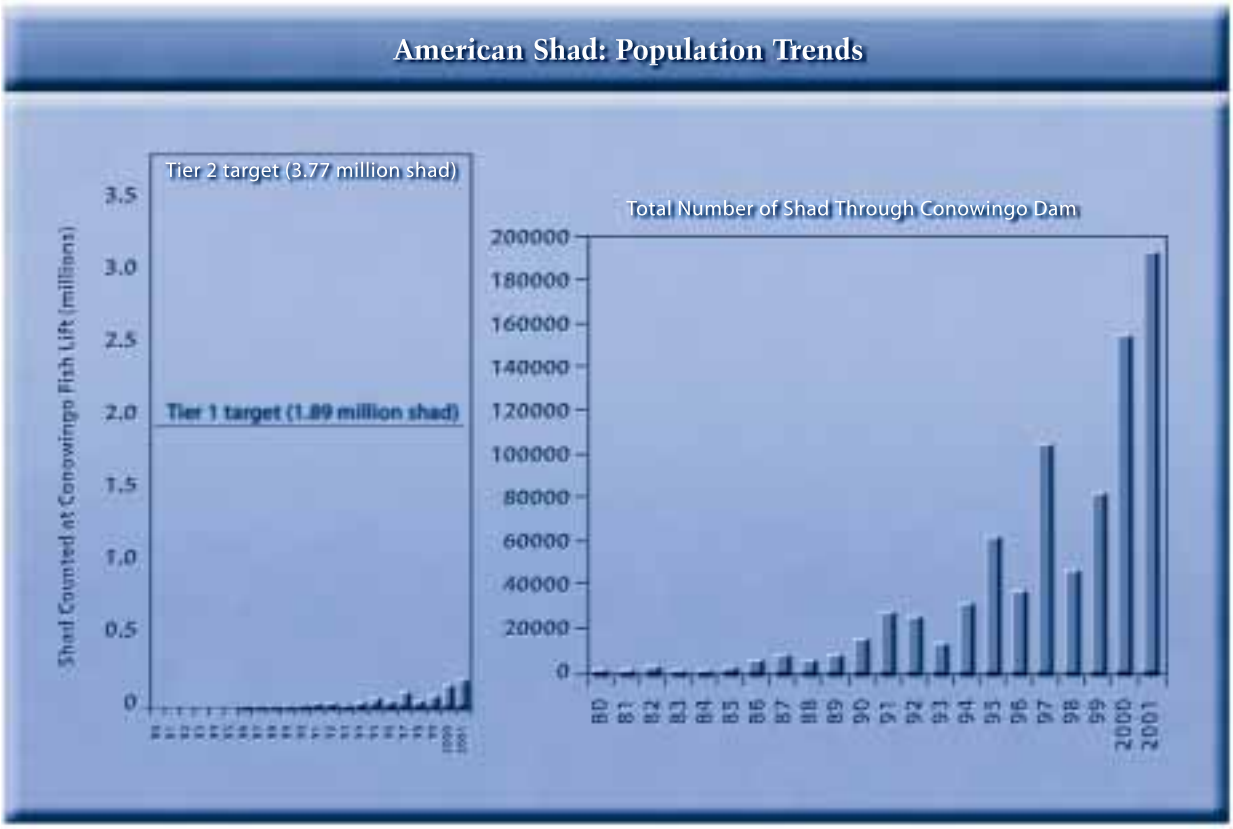
Denil: A series of sloped channels allowing fish to swim over the dam or obstruction. Wooden baffles are placed at regular intervals within the channels to slow water velocity. Resting pools between each section of the fishway help migrating fish conserve energy. Denil fishways are the most common design used in the Bay watershed.

Steeppass: Similar to the Denil, however it usually has only one sloping section and uses baffles of a different design. Steeppass fishways are used for relatively small blockages.

Pool and Weir: A series of pools in step formation that ascends the dam.

Vertical Slot: A variation on the pool and weir design, constructed as a series of pools, with two baffles placed at the entrance to each, leaving a narrow vertical slot for fish to pass through. It is important to consider the size of the fish prevalent at the blockage to ensure they will be able to fit through.

Fish Lift: Sometimes called a fish elevator, this passage is generally used only at very large obstructions, such as the 90-foot-high Conowingo hydroelectric dam on the Susquehanna River. An attractant flow of water guides the fish into a large hopper, which then raises the fish over the dam. At the top, the fish can either be released into the river or transferred into holding tanks to be transported to another tributary for stocking.



What the Bay Program Is Doing

To restore anadromous migratory fish species to their vital historical spawning grounds, the Bay Program is:

- Reopening 1,357 miles of streams by 2003 by removing dams and other man-made blockages and constructing fish passages.
- Monitoring fish passage at key locations to determine the success of our restoration strategies.
- Identifying and working to restore streams and riparian buffers near removed blockages.
- Assisting with stocking programs. As of 2001, nearly 320 million American shad fry and fingerlings were cultured and released in direct support of restoration programs in the Susquehanna, James, Pamunkey, Mattaponi and Potomac rivers, and several Maryland tributaries.

Work with your local watershed organization or tributary team to identify migratory fish blockages in nearby streams and for help and funding to remove those blockages.

Participate in existing efforts, such as the Chesapeake Bay Foundation's "Schools in Schools" program.

Encourage your local or state government to open blocked fish passages and remove low-head dams.

BALD EAGLES

Getting Better All the Time

Recent data compiled by the Bay Program report that bald eagle populations have reached a 24-year high in the Bay watershed. Results from the annual baywide bald eagle population count indicated that greater numbers of eagles were living throughout the Bay watershed, with 618 active nests fledging 908 eaglets—a 16 percent increase from the previous year's 533 active nests and 813 young eagles.

Bay scientists credited the increase to the resurgence in bald eagle populations specifically in Maryland and Virginia. In Virginia, 300 active nests produced 446 young, while in Maryland, 297 active nests produced 432 eaglets. Pennsylvania is home to 20 active nests and 29 young, and, for the second consecutive year, an active nest and youngster has been documented in the District of Columbia near the confluence of the Anacostia and Potomac Rivers. This nest, first documented in the 2000 survey, marks the first time an eaglet had been born in the District since the 1940s.

The Chesapeake may once have provided habitat for as many as 3,000 pairs of breeding bald eagles. The population declined dramatically over the past 300 years, due to habitat destruction and contamination by DDT and other chemicals. It reached a low of 72 breeding pairs in 1977. In 1972, the use of DDT was banned in the U.S., and in 1973, the bald eagle was listed as endangered in the lower 48 states except for Michigan, Minnesota, Wisconsin, Washington and Oregon, where it was listed as threatened. After the DDT ban, the population slowly began to increase, and in 1995 the U.S. Fish and Wildlife Service reclassified the bald eagle as threatened throughout the lower 48 states.

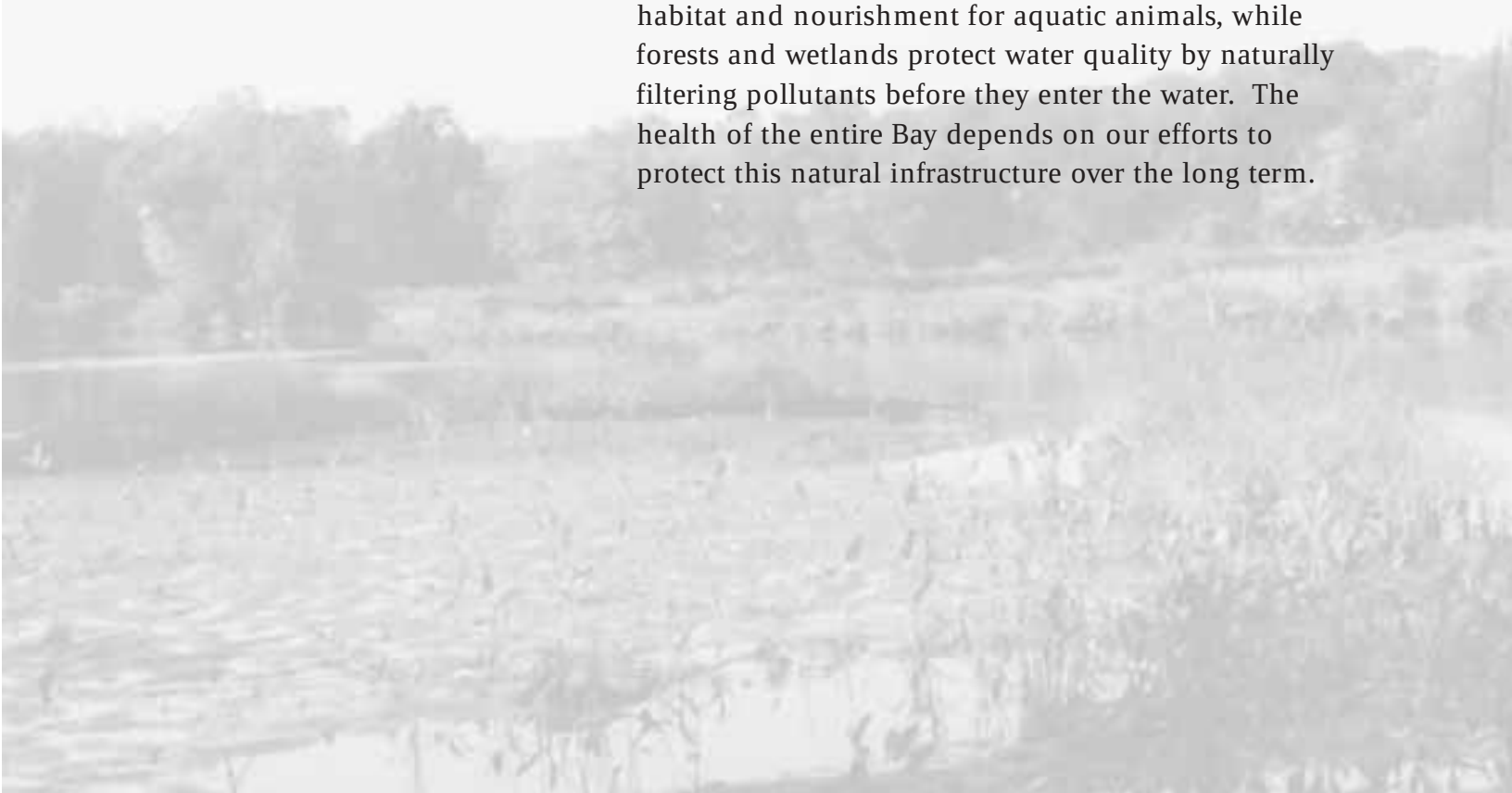
Preserve, protect and restore those habitats and natural areas that are vital to the survival and diversity of the living resources of the Bay and its rivers.

—CHESAPEAKE 2000

CHAPTER TWO

Vital Habitat Protection and Restoration

The Chesapeake Bay's natural infrastructure is composed of an intricate system of terrestrial and aquatic habitats, encompassing thousands of miles of rivers and streams that interconnect the land, water and living communities of the Bay watershed. These vital habitats—which include open water areas, underwater grasses, marshes, wetlands, streams and forests—support the plants and animals that populate them by providing food and places to live and breed. For example, underwater grasses, also called submerged aquatic vegetation, reduce shoreline erosion, and provide shelter, nursery habitat and nourishment for aquatic animals, while forests and wetlands protect water quality by naturally filtering pollutants before they enter the water. The health of the entire Bay depends on our efforts to protect this natural infrastructure over the long term.



UNDERWATER BAY

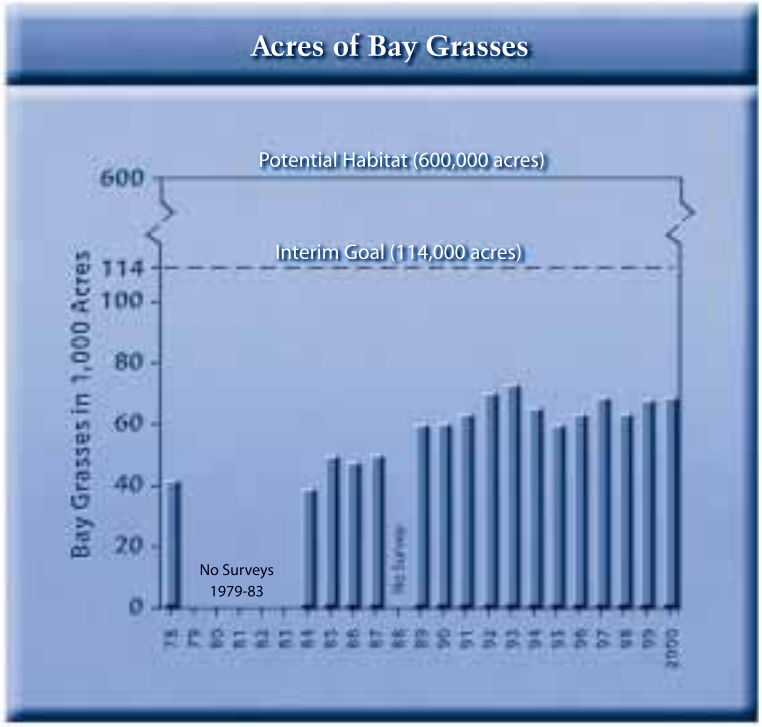
Underwater bay grasses serve the overall health of the Chesapeake Bay by producing oxygen, nourishing a variety of animals, providing shelter and nursery areas for fish and shellfish, reducing wave action and shoreline erosion, absorbing nutrients such as phosphorus and nitrogen and trapping sediments. Recent improvements in water quality are a contributing factor in bay grass resurgence.

Like all plants, bay grasses need light to grow. The clarity of the water determines whether or how much light will reach the grass. Too much sediment or algae caused by too many nutrients decreases water clarity.

Status and Trends

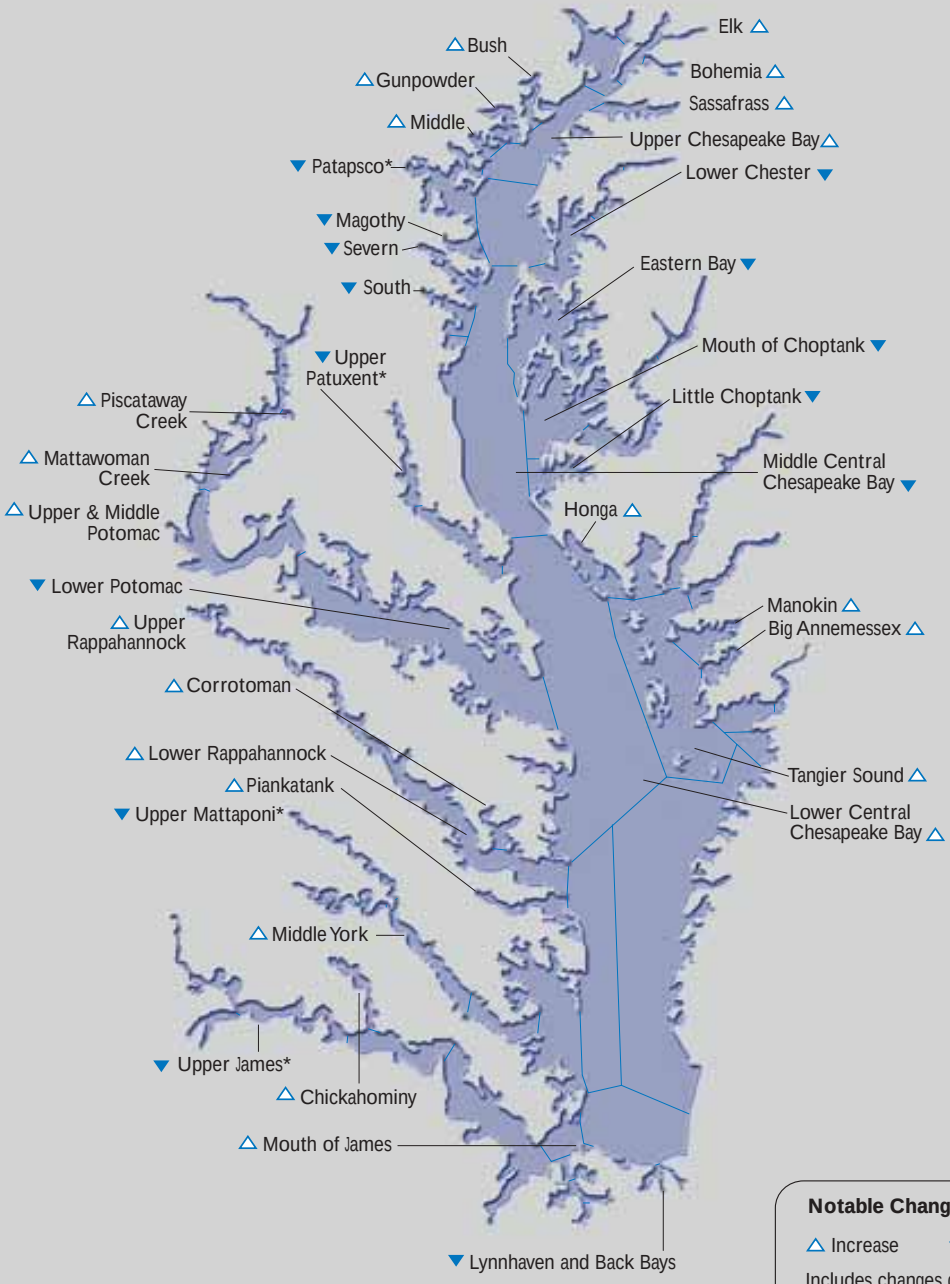
In 2000, according to survey data, the distribution of Chesapeake Bay SAV increased to 69,126 acres baywide, from its low point in 1984 of 38,000 acres. Acreage increases in the upper and lower portions of the Bay were mostly offset by the loss of bay grasses in the middle portion, resulting in a 1 percent baywide increase over previous measurements.

The analysis reveals that total bay grass acreage in the upper Chesapeake Bay (south from the Susquehanna River to the Chester and Magothy rivers) increased by 36 percent, to 14,814 total acres. In the lower Bay, which includes areas south to the Bay's confluence with the Atlantic Ocean, acreage increased by 5 percent to 20,847 total acres. Data for the Middle Bay, which extends from the Bay Bridge south to the Rappahannock River and Pocomoke sound, show a net loss of 9 percent, to 33,465 total acres. Scientists say that the middle Bay losses are likely due in part to a large-scale algae bloom known as "mahogany tide" that occurred in the spring of 2000. Such large-scale blooms block sunlight from reaching grass beds and sharply inhibit their growth.



GRASSES

Areas in Chesapeake Bay and Its Tidal Rivers with Notable Changes in Underwater Grass Beds, 1999-2000



Notable Change 1999-2000

△ Increase ▼ Decrease

Includes changes greater than or equal to 17% and 12 acres

* Areas marked with an asterisk show comparision of 1998 and 2000 data (where 1999 was not mapped)

There are several important actions most of us can take to help protect bay grasses.

Curtail the amount of fertilizers you use on your lawn and garden.

Plant trees and vegetation to reduce shoreline erosion.

Boaters should observe the no-wake laws and steer clear of shallow water grass beds.

Several organizations offer restoration projects in which the public can participate. The Chesapeake Bay Foundation offers restoration activities, including efforts to plant bay grasses, at many different locations. The Alliance for the Chesapeake Bay and the Maryland Department of Natural Resources also sponsor events and educational programs and projects to promote SAV restoration.

What the Bay Program Is Doing

The *Chesapeake 2000* agreement commits to protect and restore the Bay's vital habitats, and recommits to achieving a goal of 114,000 acres of bay grasses in the Chesapeake Bay.

We gather our data on bay grass distribution annually by analyzing more than 2,000 black-and-white aerial photographs taken by Bay Program scientists and partners between the months of May and October. The 2000 data is the result of 173 flight lines covering 2,340 miles of Bay and tributary shoreline.

To help restore SAV, Bay Program partners are working to improve water clarity by reducing the amount of nitrogen, phosphorus and sediment that enters the Bay and its tributaries.

WETLANDS

Wetlands are areas where the frequent and prolonged presence of water at or near the surface of the soil influences the kinds of soils that form, the plants that grow, and the fish and wildlife that inhabit them. In addition to functioning as habitat, freshwater and estuarine wetlands help maintain freshwater flow and quality by moderating the effects of floods and droughts and by filtering out nutrients and sediments. By performing these functions, tidal and non-tidal wetlands play a critical role in the Chesapeake Bay ecosystem. It is essential that we maintain existing wetlands and restore wetland acreage and function, in order to sustain habitats for breeding, spawning, nesting and overwintering animals, including species that are vital to the regional economy.

Status and Trends

More than 1.5 million acres of wetlands exist in the Chesapeake Bay watershed. This number represents about 4 percent of the 64,000-square-mile basin—about one and a half times the size of Delaware or one-fourth the size of Maryland. Most of our wetlands—about 1.3 million acres—are inland freshwater forests or marshes, with only 200,000 acres of estuarine wetlands. About 40 percent of the watershed's wetlands occur in Virginia, with another 27 percent in Maryland. The tidally flooded lowlands and relatively flat coastal plain landscape in the eastern portion of these states favor the formation of wetlands and result in significant wetland acreage in these states. New York and Pennsylvania account for another 11 and 14 percent of the watershed's wetlands, respectively. Delaware and West Virginia, combined, contribute about 7 percent.

While recent emphasis on wetland protection and restoration has reduced the rate of wetland loss considerably and even resulted in annual net gains in wetlands in some areas, all states in the watershed remain far below their historic, pre-colonial, levels. Maryland has lost 73 percent of its original 1.13 million acres, Delaware 54 percent of its original 480,000 acres, Virginia 42 percent of its original 1.85 million acres, West Virginia 24 percent of its original 134,000 acres and Pennsylvania lost 56 percent of its 1.13 million acres.

CONTINUED

WETLANDS *continued*

Protect and preserve existing wetlands on your property.

Involve your local community watershed organization in locating and studying wetlands within your watershed, and help them develop a wetland protection plan.

Adopt a wetland on your own or with a local school. For more information on how to participate, call the U.S. Environmental Protection Agency's Wetlands Help Line. See Contacts on page 59.

What the Bay Program Is Doing

Through the *Chesapeake 2000* agreement, Bay Program partners have committed to achieving a no-net loss of existing wetland acreage and to restoring an additional 25,000 acres of tidal and non-tidal wetlands by 2010. To meet these ambitious goals we are:

- Establishing a wetland restoration tracking system;
- Promoting wetland protection and restoration through the Chesapeake Bay Small Watershed Grants Program;
- Developing tools and information resources for local governments and groups in order to include wetlands protection and restoration in local planning; and
- Including wetlands status and trends analysis in an overall land cover mapping initiative.

The Chesapeake Bay Small Watershed Grants Program

This program promotes community-based efforts to develop conservation strategies to protect and restore the Bay and its watershed. It gives grants to local governments and organizations working to improve the condition of their local watersheds, while building citizen-based resource stewardship. The program aims to:

- Support communities in developing and implementing watershed management plans;
- Encourage innovative local programs or projects that improve water quality and restore important habitats in the Chesapeake Bay basin;
- Develop the capacity of local governments, citizen groups and other organizations to promote community-based stewardship and enhance local watershed management;
- Promote a greater understanding of the Chesapeake Bay and the connections between the health of the Bay and the condition of local watersheds; and
- Strengthen the links between communities and the Chesapeake Bay Program.

The program awards modest grants, however, when combined with the contributions of other partners, these funds make possible projects that can make a measurable contribution in communities. In its first five years, the program awarded $3.5 million to communities throughout the Bay watershed. The program is administered jointly by the National Fish and Wildlife Foundation and the Chesapeake Bay Program. For more information, turn to Contacts on page 59.

WATERSHED MANAGEMENT

When we talk about watershed management, we're referring to efforts to coordinate and integrate the programs, tools, resources and needs of groups operating within a watershed, in order to help them conserve, maintain, protect and restore the habitat and water quality of the watershed. Groups that have a stake in planning the future of a watershed (community organizations, local governments, business leaders and environmental organizations) often will produce a watershed management plan with a detailed vision and strategy, usually at the local level, to manage their small watershed. These plans incorporate information on the biological, economic and cultural resources of the watershed, and reflect the issues that stakeholders believe are important and will benefit habitat and water quality within their watershed.

Many environmental, economic and social decisions must be made at the local level. Through the *Chesapeake 2000* agreement, the Bay Program partnership has committed to "work with local governments, community groups and watershed organizations to develop and implement watershed management plans in two-thirds of the Bay watershed."

What the Bay Program Is Doing

Our role is to support community watershed organizations and local governments in developing informed watershed management plans by providing tools, funds and information to these groups. Our activities include:

- Funding the Chesapeake Bay Small Watershed Grants Program to help existing community watershed organizations and to establish new ones.
- Running a community watershed organization listserv to allow the Bay Program to communicate its efforts and help watershed organizations communicate with each other.
- Creating a community environmental assessment handbook that helps citizens, local governments and watershed groups assess their watersheds—a valuable first step in watershed management planning.
- Designing the Clearinghouse of Community Resources—a Web-based catalog of tools and literature that helps watershed organizations find the information they need.

In addition, Bay Program states are developing strategies to promote watershed management to local governments and community watershed organizations.

Work with your local community watershed organization (or if one does not yet exist in your area, help get one started) to develop a watershed plan.

Participate in activities that help protect and restore your local streams, rivers, lakes and wetlands, and the land that surrounds them.

FORESTS

Almost four centuries have passed since the first European colonists arrived on the shores of the Chesapeake Bay and began exploring the vast forest that covered nearly 95 percent of the watershed, stretching from what is now Virginia to New York. These forested acres generally were seen as a boundless obstacle to overcome. The newcomers did not understand the role forests play in regulating the environment and controlling the flow of water and nutrients from the headwaters of the region's rivers to the Chesapeake Bay. Dramatic changes followed the colonists' arrival, and forests were gradually cleared for fuel and to make way for farms and a growing population. By the mid-1800s, less than 40 percent of the original forests remained.

Forests are resilient, and by the early 1900s many had re-established themselves or were replanted. Since the 1970s, unfortunately, many of these forests are again being lost to development or are being converted to agricultural lands and pastures, at a rate of 100 acres per day. The greatest losses are occurring in areas closest to the Bay, due to suburban development spurred on by population growth. Today's forest landscape has become an increasingly fragmented mosaic of land uses.

Status and Trends

Forests are the primary land cover in the Chesapeake Bay watershed, encompassing nearly 24 million acres or 58.5 percent of the land area. Recent studies of forest trends reveal, undeniably, that forest loss and fragmentation is increasing and may have adverse ecological and economic consequences.

Watershed health in urban and developing areas is seriously threatened by the increased runoff and fragmentation or destruction of habitats that occur when forests are cleared to make way for sprawling growth. It's likely that forests will continue to be cleared daily to yield ground to new homes and developments, but how that land is developed can make a difference. Communities can conserve forests and protect green infrastructure if they plan with natural resources in mind. Foresters and conservation groups in the Bay area have made it their priority to help communities assess the linkage, extent and condition of their forests and to integrate this information in local planning and decision-making.

Trees are as essential today as they ever were for maintaining water quality and quality of life. Forests are directly linked to the health and resilience of our rivers and streams, and ultimately, to the health of the Bay. Acting as living filters, forests capture rainfall, reduce storm water runoff, protect soil from erosion, trap nutrients and stabilize

stream banks. Studies demonstrate that forests are the most beneficial land use for clean water. Also, through a complex food web, trees are intimately connected to our living resources, providing food for aquatic insects and diverse aquatic habitats, on which many fish depend. Millions of people in the Bay watershed also depend on forests to protect their drinking water supplies. Besides preventing erosion and cleaning our air and water, forests also provide special places for recreation and the raw materials for many of the products we use every day.

Riparian Forests: Linking the Land and Water

Although the loss of any forest land causes concern, we pay particular attention to forests that grow along the shoreline and stream banks of the Bay and its tributaries. These are called riparian forests. When they are conserved and managed as "buffers," riparian forests can help dramatically to reduce the effects of adjacent, potential harmful, land-use activities. Trees that grow alongside a stream help to filter runoff and groundwater by removing nutrients, sediment and pesticides. Streamside forests also reduce the downstream effects of flooding, and help create shade, thus moderating temperatures and oxygen levels for fish and other wildlife. In urban areas, forests help reduce storm water runoff, and riparian corridors can determine whether a stream can support aquatic life.

In 1996, the Chesapeake Executive Council adopted the *Riparian Forest Buffer Initiative*, a baywide set of goals and recommendations aimed at conserving and restoring these critical forests. Overall goals to protect existing buffers and to restore 2,010 miles of riparian forests by 2010 are some of the most aggressive in the nation. We've made dramatic progress toward the 2,010 goal, with an estimated 1,298 miles restored through October 2001, and efforts are under way to reevaluate and potentially increase this target.

In 2000, Pennsylvania and Virginia became participants in the Conservation Reserve Enhancement Program, to which Maryland already belonged. The conservation program matches federal funds with state and private investments, and has proved to be a powerful tool for restoring riparian buffers, particularly for owners of crop and pasture land. It allows landowners to share costs with the government when they install buffers, and provides them with an annual rental payment to compensate for loss of agricultural commodities yielded by the land. This is truly a collaborative effort, combining the work of federal and state agencies and non-profit groups. With hundreds of miles of streamside being protected from livestock and crop production, water quality and fish habitat are being reclaimed.

FORESTS *continued*

To help protect and restore forest areas in the Bay watershed, you can:

Plant native trees on your property, especially along waterways.

Organize or volunteer for streamside forest restoration and stream monitoring projects in your community.

Encourage your local government to incorporate forest conservation and stream corridor protection in local land use planning and zoning.

Call your state forestry agency or the U.S. Forest Service if you have questions about forests in your area.

What the Bay Program Is Doing

The *Chesapeake 2000* agreement addresses forest loss and fragmentation due to growth and development, while renewing previous commitments to riparian forest restoration and conservation. The agreement pledges:

- By 2002, to ensure measures are in place to meet our riparian forest buffer restoration goal of 2,010 miles by 2010. By 2003, establish a new goal to expand buffer mileage.
- To conserve existing forests along all streams and shorelines.
- To promote the expansion and connection of contiguous forests through conservation easements, greenways, purchase and other land conservation mechanisms.

The Bay Program and its partners are working toward these goals through several other measures:

- The Chesapeake Bay Commission, U.S. Forest Service, state forestry agencies, the Environmental Law Institute and forestry leaders in the Bay region completed an analysis of programs, laws and regulations affecting forest lands in the Bay states. In addition to leading to changes in land use law, taxation and incentive and regulatory programs, the *Forests for the Bay* report will help shape future changes in forest conservation.
- In 2000 the Potomac Watershed Partnership of the U.S. Forest Service convened state and regional groups in one of 15 Forest Service-sponsored, large-scale watershed restoration efforts. The effort focuses on four Potomac River tributaries most in need of restoration—the Monocacy River, Antietam Creek, and the north and south forks of the Shenandoah—and expands collaborative relationships among relevant agencies and community groups. One of its chief objectives is to accelerate wetland and riparian buffer restoration, as well as other forest stewardship efforts in the Potomac River Basin. For more information on this effort, see Contacts on page 59.
- Through a grant from the U.S. Forest Service, in 2001 the Maryland Department of Natural Resources Forest Service completed a major study of riparian forest buffer restoration that reviewed all the forest buffers planted over the past five years or more, to determine if and how well the trees survived. Overall, the buffers have been successful and are growing, although it will take at least 10 years to see the true effects provided by a mature forest.

Achieve and maintain the water quality necessary to support the aquatic living resources of the Bay and its tributaries and to protect human health.

—CHESAPEAKE 2000

CHAPTER THREE

Water Quality

When we talk about restoring and protecting the Chesapeake Bay, we're really talking first about addressing the resource that lies at the heart of the Bay: the quality of its water. After all, water is the element that gives life to the ecosystem and to the plants, animals and humans that draw from it.

Excess nutrients and sediment can travel from as far away as New York and West Virginia through streams and tributaries to affect dissolved oxygen, water clarity and algal blooms in the tidal waters of the Chesapeake Bay. Toxics or chemical contaminants differ from nutrients in the way that they affect the Bay system, but their influence can be just as harmful. Air pollution contributes to both of these problems, either depositing pollutants directly into the water or onto the surrounding watershed.

NUTRIENTS AND SEDIMENTS

Throughout the 1980s and 1990s, we made real progress toward our goals of improving the Bay's water quality and reducing pollution. A recent analysis revealed that between 1985 and 2000, phosphorus loads delivered to the Bay from all of its tributaries declined by 8 million pounds per year. Nitrogen loads declined by 53 million pounds per year. Unfortunately, baywide phosphorus reductions fell short of our year 2000 goal by 2.3 million pounds per year, while nitrogen loads fell 24 million pounds per year shy as well. In areas where excessive nutrient loads most adversely affect the Bay (the Potomac River and points north), phosphorus goals were met. We expect to meet nitrogen goals for those areas once tributary strategies are fully implemented in 2003.

Nutrients from Point Sources

A point source is a specific location or point of entry, such as a pipe, where nutrients enter waterways. Point sources account for 20 percent of the total load of nitrogen and phosphorus to the Bay. Industrial point sources in the Chesapeake Bay watershed are making progress in reducing nutrients by taking pollution prevention measures, and wastewater treatment plants are implementing nutrient removal technology, such as biological nutrient removal. Nitrogen loads delivered to the Bay from point sources declined by 31 percent between 1985 and 2000, and we could see an additional 11 percent reduction by 2010 from planned treatment facility upgrades. Phosphorus loads delivered to the Bay from point sources declined by 52 percent between 1985 and 2000 due to improved treatment capability and the implementation of phosphate detergent bans from the mid-1980s to 1990.

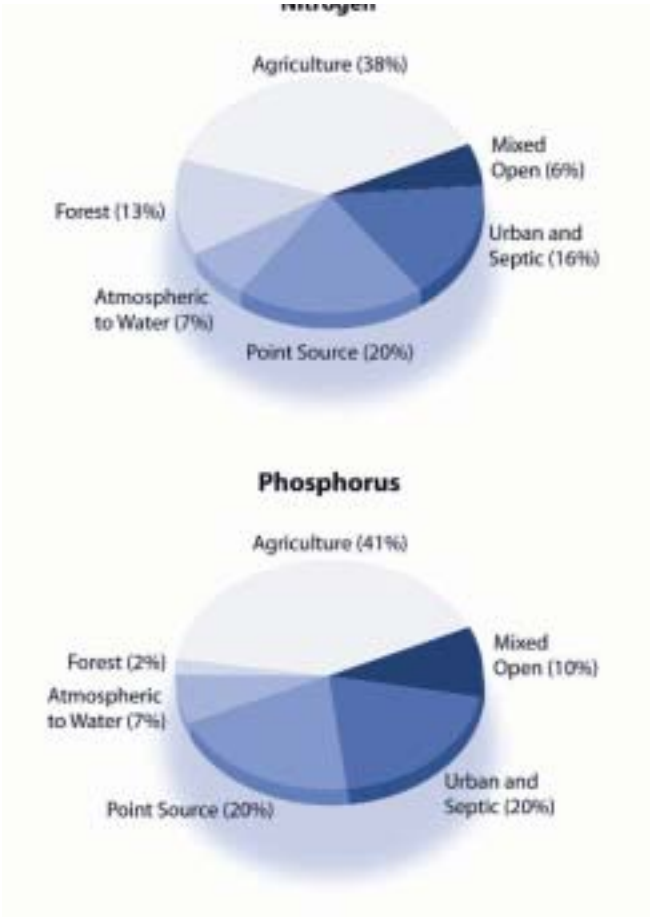
Today, 73 of the 305 significant municipal wastewater treatment plants in the Bay watershed operate using nutrient removal technology. By 2010, that number is likely to increase to 153 facilities, or almost 80 percent of the collective flow. Exponential advances in the development of nutrient removal technology in recent years, along with performance levels beyond what was traditionally expected, have clearly shown the potential for this technology to achieve much lower levels of nitrogen in discharges than the traditionally accepted performance level. At present, plants are operating nutrient removal technology to achieve an effluent concentration of 8 mg/L total nitrogen; with additional funding, the potential exists for this number to decrease to 3 mg/L. Indeed, even today, the Blue Plains Wastewater Treatment Plant in the District of Columbia, which is by far the largest point source discharger in the Bay watershed, has been operating at average effluent levels of 5.5 mg/L of total nitrogen. In the past five years Blue Plains has reduced its direct discharge of nitrogen into the Potomac by 6 million pounds per year.

Industrial nutrient reduction efforts have yielded encouraging results as well. For example, two major chemical manufacturing facilities located on the

James River in Virginia have collectively reduced their nitrogen load by almost 8 million pounds per year since 1985, due primarily to pollution prevention measures. In addition, three chicken processing plants in the Bay watershed have collectively reduced their nitrogen-delivered loads by 361,000 pounds per year. While this is a smaller reduction than other, larger industries, because these facilities are located in smaller watersheds, this still provides a significant benefit to local waterways. To date, 12 of the 49 significant industrial nutrient dischargers located in the Bay watershed are practicing some form of nutrient removal, and we expect that number to increase to 16 by 2010. Significant progress could be made if more of these industries implemented nutrient reduction technology.

As we have noted, these point sources collectively have achieved a 52 percent reduction in phosphorus loads and a 31 percent reduction in nitrogen loads since 1985, despite the 15 percent increase in population since then. But because the watershed's population is expected to increase by an additional 14 percent by 2020, we must do more to encourage the implementation of nutrient removal technology in all our facilities, while simultaneously reaching for greater performance levels.

Sources of Nitrogen and Phosphorus Loads to the Chesapeake Bay



Nonpoint Source Nutrients

Nonpoint source pollution is the largest contributor of nutrients to the Chesapeake Bay and is particularly difficult to prevent and measure. The term refers to pollution that stems from no clear single source, but is diffuse, such as runoff that enters waterways from agricultural lands and lawns. This runoff also includes nutrients that enter waterways from air pollution and groundwater sources, including septic systems.

Throughout the watershed, runoff is increasing due to the development of forested and agricultural lands. Runoff from farms is generally declining as farmers adopt nutrient management and runoff control techniques, but also because the overall amount of farmland is declining.

Bay Program partners are using several techniques to control nonpoint source pollution in the Chesapeake Bay watershed:

- Nutrient management plans are being developed to balance crop need with nutrient applications. The plans take into account the crops being grown, the residual nitrogen and phosphorus in the soil, the nutrient content of manure and soil productivity. Nutrient management plans consider nutrient applications from all sources, including commercial fertilizer. In 2000, 2.3 million acres of land in the Chesapeake Bay basin were protected under nutrient management plans.
- Farm plans, which combine field-specific conservation practices to reduce soil erosion while maintaining soil productivity and crop yields, are being used in areas throughout the Bay basin. Such plans combine all engineering and agronomic practices applied to all fields on each farm to meet the objective. In 2000, 3.7 million acres of all agricultural lands, including crop, hay and pasture lands, were covered under farm plans.
- Streambank fencing is used along pasturelands to control pollution where cattle cross streams. Fences prevent the direct deposition of nutrient-laden manure to streams and controls damage to streambanks, which can increase sediment deposition. They are usually installed in conjunction with other techniques to protect stream crossings and watering facilities. In 2000, 801 miles of streambank fencing were installed throughout the Chesapeake Bay basin.

A FISH'S EYE VIEW

The *Chesapeake 2000* agreement shifts the focus of our efforts to improve the quality of the Chesapeake Bay's water systems in important ways. Instead of concentrating chiefly on categories of pollutants in an effort to control and reduce them, we are developing new criteria based on the diversity of what are called designated uses, or habitat zones, which provide food and shelter for different organisms during different times of the year. Bay Program partners

also have begun working with the headwater states of Delaware, New York and West Virginia to further reduce the amount of nutrients and sediments flowing into the Bay. The Bay Program is essentially moving toward a "fish's eye view" of the Bay, and we are adjusting our plans accordingly.

The new approach considers what a restored Chesapeake Bay would look like from the perspective of the plants and animals that inhabit it—including finfish, crabs, oysters, underwater grasses, even bottom-dwelling worms. Consider the diversity of habitat that the Bay offers: shallow areas necessary for spawning, underwater grasses that serve as nursery areas for juvenile fish and shellfish, open waters where adult fish and their young feed on fish or plankton, and deep waters, where many fish find refuge during winter months.

In past years, water quality goals for reducing harmful nutrients and sediment were based on the best scientific estimates available at the time. Current science enables us to base reduction goals specifically on the needs of the plants and animals that use the Bay as habitat. By focusing on their seasonal needs, we will be better able to determine the necessary levels of nutrient and sediment reductions.

A series of designated uses have been identified, along with water quality conditions, or criteria, that are required to protect and sustain aquatic life in those habitat zones. These designated uses and their respective criteria will be adopted as legally binding water quality standards by the partner jurisdictions that contain tidal waters: Virginia, Maryland, Delaware and the District of Columbia.

New Water Quality Criteria

Prior to 2000, the water quality criteria that applied to the Chesapeake Bay did not take into account the natural variability of the Bay's waters. The new Bay criteria will vary based on the needs of a healthy ecosystem. Scientists will analyze the relationships among these criteria and thus be able to better understand and monitor the ecosystem's health.

The new water quality criteria that the states and the District are considering for the Bay and its tidal tributaries include:

- **Water clarity**, which ensures that enough sunlight reaches underwater bay grasses that grow on the bottom in most shallow areas.
- **Dissolved oxygen**, which ensures that enough oxygen is available at the right time during the right part of the year, to support aquatic life, including fish larvae and adult species.
- **Chlorophyll** *a*, the pigment contained in algae and other plants that enables photosynthesis. In the Bay the optimum level would reduce blooms of harmful algae while promoting beneficial algae growth, to support the base of the Bay's food chain.

Designated Uses

The habitat zones, which we now call designated uses, take into account the Bay's varied uses as habitat for aquatic plants and animals during many stages of life, as well as navigational, agricultural, recreational and industrial uses. To support the states and the District of Columbia in adopting new water quality standards based on the needs of the Bay's living resources, the Bay Program is developing five new designated uses for the Chesapeake Bay—shallow water, open water, deep water, deep channel and migratory finfish spawning and nursery areas.

Water Quality Criteria + Designated Uses = Water Quality Standards

New Water Quality Standards

To attain the new water quality standards, significant reductions in sediment and the harmful nutrients such as phosphorus and nitrogen will be required. Even so, meeting this goal would not return the Bay to its "pristine" condition, or to the state in which Captain John Smith is thought to have found it in 1607. However, we will be closer to a realistic, shared vision of a restored Bay, one that contains high-quality habitats in all zones, from the shallows to the deep waters.

Current state water quality standards require 5 milligrams per liter (mg/L) of dissolved oxygen throughout the Bay's tidal waters, from the deeper channels to the shallows at the head of the Bay. But scientists believe that, due to natural conditions, some sections of the Bay, such as the deep trench in the middle of the Bay, have never achieved that standard during the summer. Scientists also believe that other areas, such as spawning habitats, require higher levels than 5 mg/L to sustain new life. In addition to dissolved oxygen, other impairments in the Chesapeake Bay include reduced light conditions (which negatively affect the growth of SAV) and an overabundance of algae.

Meeting the new water quality standards also would mean a reduction of the damaging algal blooms that deplete the water of oxygen and could increase coverage of the Bay's underwater grasses to hundreds of thousands of acres.

THE CHESAPEAKE BAY AND TMDLS

In 1998 the Chesapeake Bay and many of its tidal tributaries were placed on the federal List of Impaired Waters. This action, prescribed by the federal Clean Water Act, is normally followed by the development of a "total maximum daily load" (TMDL) through a regulatory process. A TMDL is the maximum amount of a pollutant that a water body can receive and still meet water quality standards. It is calculated by totaling the allowable loads of a single pollutant entering a body of water from all contributing point and nonpoint sources.

The *Chesapeake 2000* agreement sought to achieve the same water quality improvements before a baywide TMDL would need to be established. The new water quality approach will incorporate elements found in the regulatory TMDL process, such as criteria, standards and load allocations, but it would be developed and applied through a cooperative process involving all the Bay Program partners and involved citizens.

According to the standard regulatory approach, TMDLs would need to be completed for the Bay and its tidal tributaries by 2011. Typically, the TMDL process requires a strict implementation plan, and it is unlikely that innovative or untested solutions would be approved.

However, due to the success of the Bay Program's partnership over the past 20 years, the partners have agreed to implement a cooperative approach to remove water quality impairments by 2010. This approach will allow the states and the District of Columbia more flexibility in deciding how to reduce pollutant loads. The tidal and non-tidal states are jointly developing the new water quality criteria, designated uses and cap load allocations required to restore the Bay's water quality. These load reductions will be allocated to the nine major tributaries and then apportioned by jurisdiction.

The 2001 Storm Water Directive

On December 3, 2001, the Chesapeake Executive Council signed a directive designed to manage storm water runoff on state, federal and District-owned lands and facilities. The storm water directive (Directive 01-1) addresses the commitment in *Chesapeake 2000* in which we promise by 2001 to "develop an Executive Council Directive to address storm water management to control nutrient, sediment and chemical contaminant runoff" from these lands. The new directive commits Bay Program partners to the following:

- **Regions of Concern.** By 2008, to achieve at least a 30 percent reduction of chemicals of concern found in storm water sources from public lands in the three Regions of Concern—the Anacostia River, Baltimore Harbor and the Elizabeth River.
- **Create an inventory of target public lands.** By 2002, we will inventory all public lands and facilities within the Bay basin that are owned by the signatories. We will then identify target lands for enhanced storm water management.
- **Demonstrate how to manage storm water.** The Bay Program commits to lead others in preventing and managing storm water runoff on lands developed or redeveloped, and on roadways.
- **Analyze the economics and effectiveness of demonstration projects.** We commit to evaluate progress regularly and to share information and lessons learned with other landowners.
- **Educate others on how to manage storm water.** We commit to set an example for local governments, businesses and the public through demonstrations of effective storm water management.
- **Develop innovative storm water technologies.** We commit to develop economically and environmentally sustainable storm water management technologies.
- **Coordinate with communities and local governments.** This commitment addresses the need to participate in small watershed planning efforts and to encourage local governments and communities to undertake measures to control storm water runoff from their lands.

CHEMICAL CONTAMINANTS

Toxic chemicals, or chemical contaminants that harm plants, animals and humans, contribute significant stress to the Chesapeake Bay ecosystem. The nature, extent and severity of toxic effects vary widely throughout the watershed. Three Regions of Concern, the Anacostia River, Baltimore Harbor and the Elizabeth River, bear the most serious regionalized problems, but other areas show potential for toxic effects as well.

The *Chesapeake 2000* agreement recommits to the following goal:

> *A Chesapeake Bay free of toxics by reducing or eliminating the input of chemical contaminants from all controllable sources to levels that result in no toxic or bio-accumulative impact on the living resources that inhabit the Bay, or on human health.*

The Bay Program's *Toxics 2000 Strategy* is a watershed-wide plan to achieve that goal. The strategy targets chemicals that pose risks to the Bay's plants and animals, human health, geographic areas where contaminants are problematic and areas that are at risk of becoming affected.

To achieve our goals, the Bay Program partners commit to voluntary efforts that reach beyond compliance with existing federal and state programs in hopes of avoiding costly regulations and future cleanup efforts. The Bay Program will implement a four-pronged approach:

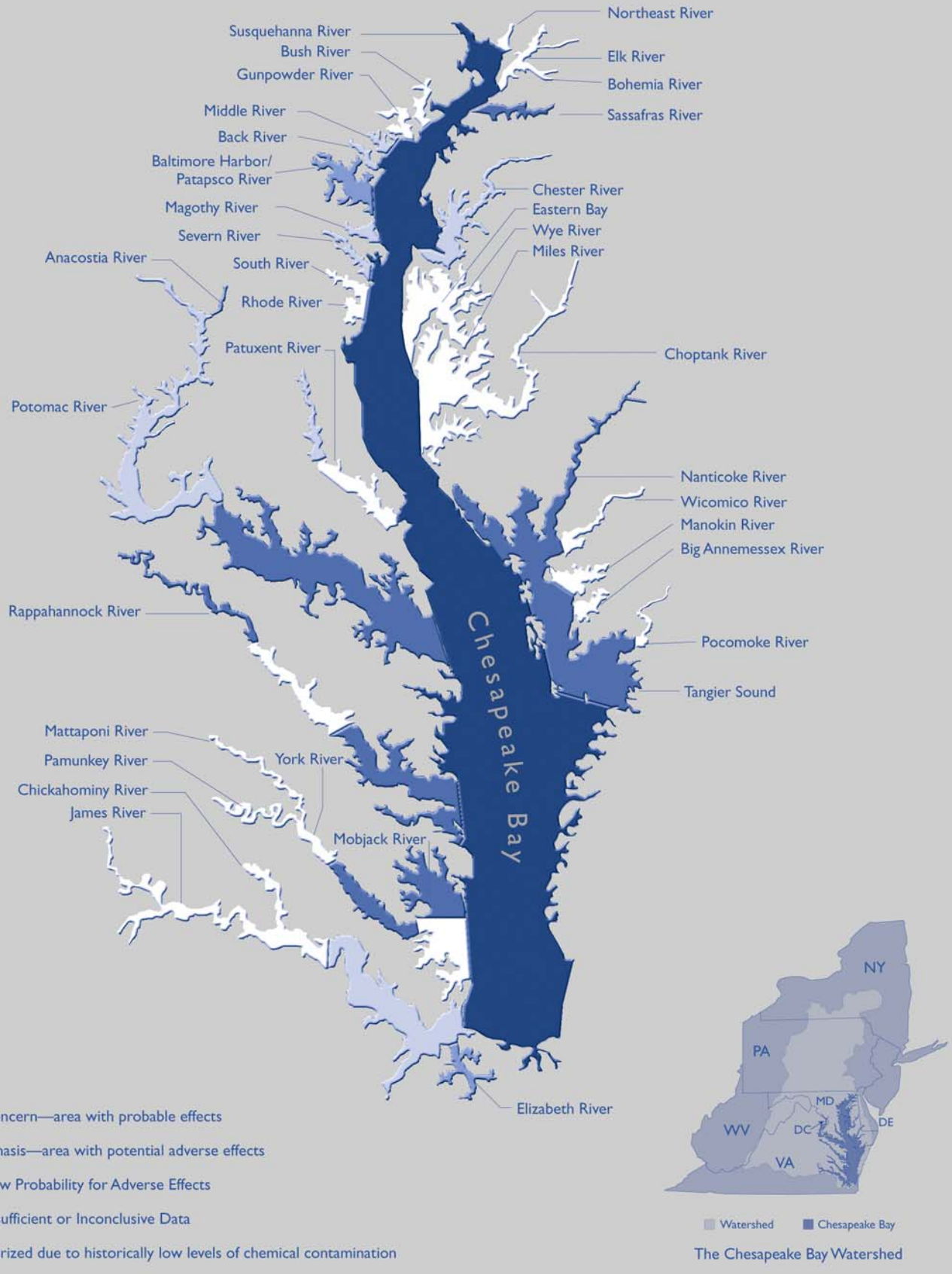
- Undertaking restoration, protection and prevention activities;
- Addressing point sources;
- Addressing nonpoint sources; and
- Conducting monitoring, assessments and research activities.

Chemicals of Concern

In the *Toxics 2000 Strategy*, the Bay Program identified what we call the chemicals of concern for the Chesapeake Bay. These are contaminants that have been determined to exist in the waters within the Chesapeake Bay watershed at levels that can negatively affect living resources. Chemicals of concern include:

- Chemical contaminants identified in the *1999 Toxics Characterization* whose levels may have toxic effects on Bay plants and animals;
- Chemical contaminants whose presence in particular water bodies qualifies the latter to be listed in their jurisdictions as impaired or threatened;
- Chemical contaminants responsible for finfish and shellfish consumption advisories.

Status of Chemical Contaminant Effects on Living Resources in the Chesapeake Bay's Tidal Rivers



Chesapeake Bay Program's CHEMICALS OF CONCERN

Antimony	Dieldrin	Nickel
Arsenic	Dioxin	PAHs
Cadmium	Kepone	PCBs
Chlordane	Lead	Selenium
Chlorpyrifos	Lindane	Silver
Chromium	Malathion	TBT
Copper	Mercury	Zinc
DDT	Mirex	

- Chemicals of concern include chemicals that are currently being used and those that were used historically, were discontinued, but persist in the environment at levels that pose risks to life.

The chemicals listed will be targeted for reduction and prevention actions. However, not all chemicals are considered damaging throughout the Chesapeake Bay watershed. Therefore we will focus our management efforts only on those chemicals that pose risks for particular areas in particular watersheds. We anticipate that the lists will change as new data become available.

Sources of Chemical Contaminants

Although point sources are subject to regulatory controls, the Bay Program partners have committed to taking additional voluntary steps to further reduce and prevent point source contaminants from entering the Bay. The *Chesapeake 2000* agreement commits to work toward zero release of chemical contaminants from point sources, including the following actions:

- By 2010, to phase out mixing zones for persistent or bio-accumulative chemical contaminants through pollution prevention and other voluntary measures. Initial plans emphasize phasing out mixing zones in affected and at-risk areas.
- By 2005, to reduce by at least 20 percent the 1998 Toxics Release Inventory chemical releases and off-site transfers for treatment and disposal from 1998 levels by working with treatment plants and industries.
- Treatment plants will work with the Bay Program to encourage industries and watershed residents to reduce their chemical contaminant loads to the treatment plants.
- *Businesses for the Bay* participants will prevent at the source, or recycle, a total of one billion pounds of hazardous substances between 1999 and 2005.

Zero release is a goal that we believe can be achieved principally by voluntary pollution prevention measures. Many success stories already exist in the Bay watershed. Several companies have achieved the complete elimination of certain contaminants from their waste discharge streams, while others have eliminated the waste stream altogether.

The zero release concept can be implemented in many different ways, and we welcome as many variations on this theme as can be engineered. A voluntary phase-out of point source mixing zones is a prime example of working toward zero release. Mixing zones allow the discharge of pollutants that exceed a

stream's water quality requirements, on the theory that the water body will dilute it by the time it reaches the predetermined edge of the mixing zone. However, because the waters in the mixing zone have a lower level of protection, there is a growing national movement to find ways of eliminating mixing zones altogether, and the Bay Program has committed to achieving this by 2010.

Nonpoint sources of chemical contaminants consist of agricultural, urban or suburban storm water runoff, atmospheric deposition and groundwater loadings. Estimates reveal that some nonpoint sources such as urban storm water runoff can represent a substantial load of chemical contaminants to the watershed. Our strategy aims for "zero-release of chemical contaminants from nonpoint sources." *Chesapeake 2000* commits to:

- By 2010, to reduce nonpoint sources of chemicals of concern to the Regions of Concern by at least 30 percent through implementing pollution prevention and other voluntary nonpoint source programs.
- By 2010, to achieve a no-net increase of chemical contaminants from developing lands by using a combination of pollution prevention, sound land use practices and innovative technological solutions.

Businesses for the Bay brings together businesses, industries, government facilities and others within the Bay watershed committed to implementing pollution prevention in their daily operations and reducing the release of chemical contaminants and other pollutants into the Chesapeake Bay. The group's mission is to build support for pollution prevention among businesses throughout the watershed.

Businesses for the Bay's more ambitious goal is to contribute to the long-term improvement of quality of the Bay and its rivers through widespread, voluntary implementation of pollution prevention practices.

New members to the program can choose how their company will contribute, either as a member, mentor, partner, or as all three. Members develop a set of annual pollution prevention goals, and report on those activities annually. Mentors go further to provide assistance and expertise to other businesses on pollution prevention and related environmental issues. Partners are generally larger organizations such as trade associations, civic groups, chambers of commerce or environmental groups which voluntarily promote *Businesses for the Bay*, advocate pollution prevention on a larger scale or recruit new members.

The Chesapeake Bay Program accelerated efforts to expand membership in 2001, with Pennsylvania quadrupling its membership to 101, including its first local government members. Maryland membership has grown to include 112 businesses, while Virginia membership has increased to 226. The District of Columbia is home to 23 members.

Benefits to participating businesses include:

- Cost savings through pollution prevention;
- Positive publicity and recognition for the business;
- Access to the *Businesses for the Bay* mentor program; and
- Ultimately, a cleaner, healthier Bay.

2001 Fish Advisory

The EPA and individual states publish fish consumption advisories designed to protect residents from the risk of eating contaminated fish and shellfish. The Maryland Department of the Environment posted its latest advisory in December 2001. To view the latest information on the Chesapeake Bay fish advisories, go to the Chesapeake Bay website (www.chesapeakebay.net) and click on Bay Pollutants, or see Contacts on page 59.

AIR POLLUTION AND THE CHESAPEAKE BAY

To restore the Chesapeake Bay, we must also clean up the air. Air pollution is a major stressor on the Bay's ecosystem. Airborne nitrogen and chemical contaminants deposit directly into the waters of the Bay and the land. The sources of airborne pollution include automobile emissions, power generating facilities, industries and agriculture. Natural sources, such as lightning and forest fires, also contribute to air pollution.

It is important to determine how and where emissions of pollutants are changing over time because the resulting deposition can have a direct effect on water quality. With this connection in mind, resource managers are beginning to factor air pollution into their decisions about water quality improvements.

Status and Trends

The Bay Program uses computer models to identify the relative contribution of nitrogen loads to the Bay from each source. Their percentages are estimates; the computer models are only as good as the information put into them. Therefore, continuous research and monitoring are necessary to improve and update the models.

Recent Bay Program model estimates for the year 2000 indicate that approximately 32 percent of the total nitrogen load to the Bay comes from atmospheric deposition. Of that number, 7 percent falls directly onto Bay tidal waters, and 25 percent comes from the land, via runoff and groundwater flow, after the nitrogen has deposited from the atmosphere.

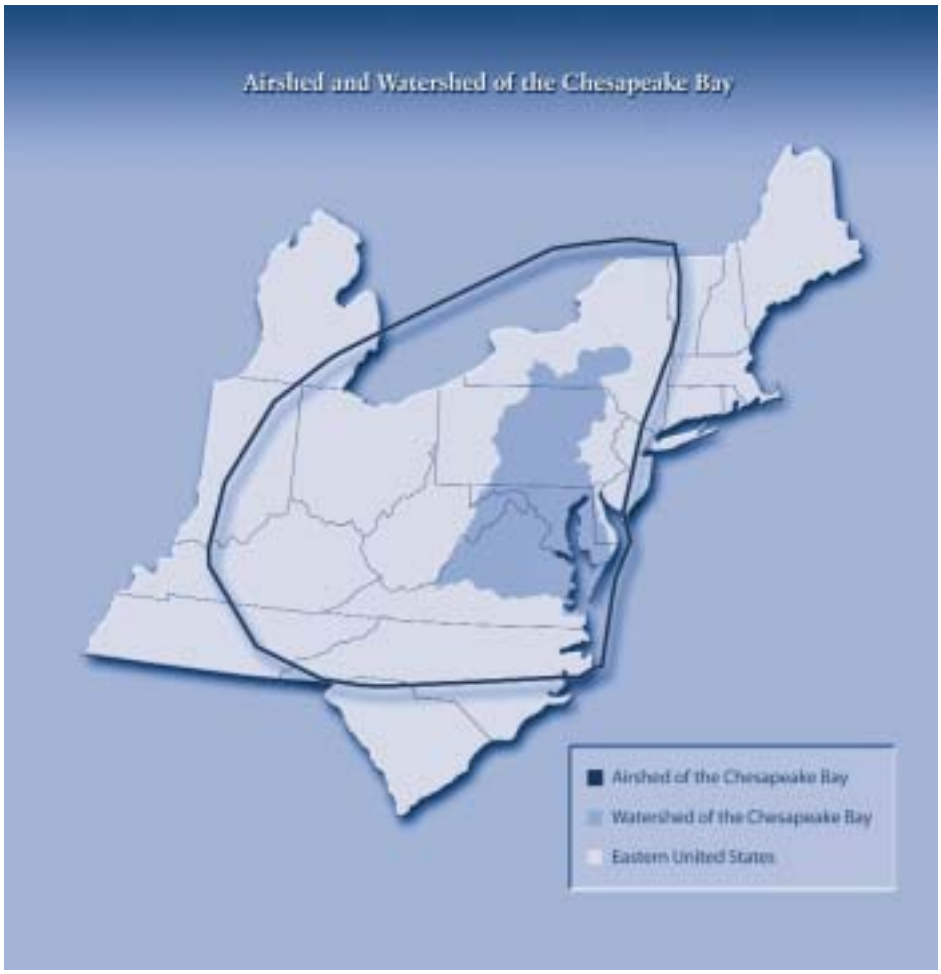
What the Bay Program Is Doing

One of the *Chesapeake 2000* agreement's commitments is to decrease the total load of nitrogen from all sources, including atmospheric, point and nonpoint sources. The agreement addresses air pollution in the context of water quality restoration and protection:

> *By 2003, to assess the effects of airborne nitrogen compounds and chemical contaminants on the Bay ecosystem and help establish reduction goals for these contaminants.*

The role of atmospheric deposition also is addressed under the chemical contaminant section, which requires that we use a watershed-based approach to "go beyond" traditional point source controls, including nonpoint sources such as groundwater discharge and atmospheric deposition.

These commitments reflect the necessity of integrating air quality into all components of the Bay's restoration, rather than treating it as a separate issue. The Bay Program is making strides in incorporating air deposition into pollution prevention management efforts. Managers are using advanced computer model simulations to measure the benefits from air pollution regulations included in the 1990 Clean Air Act Amendments. In addition, the Bay Program continues to track the effects of voluntary emissions controls, as they too benefit the Bay.



To help decrease air pollution, you can:

- ✓ Organize a carpool, telecommute, use public transportation, ride a bike or walk. This will directly reduce the amount of nutrients and toxic substances that enter the watershed.
- ✓ If you must drive, plan your trips carefully. Combine your errands to reduce the number of miles you drive each day.
- ✓ Use electric lawn mowers and tools instead of gas-powered ones. These tools have inefficient engines that produce more pollution per hour than cars.

Ammonia Emissions

Recent studies conducted in several coastal waters, including the Chesapeake Bay, indicate that ammonia emissions are a significant source of nutrient loadings to land and water ecosystems. Ammonia is a gas that reacts quickly with other pollutants in the air to form fine particulate matter. These particles can adversely affect human health when they are inhaled and can create a regional haze. Small particles of ammonia can be transported short or long distances through the air before falling onto the surrounding land and water.

In the Bay watershed, ammonia emissions are estimated to come primarily from animal agriculture. However, more study is needed to define all the primary sources of ammonia.

The nitrogen part of the ammonia deposition, in the short term, acts as a fertilizer to the terrestrial landscape and influence the growth of forests, for example, but over the long term it may prove detrimental by contributing to acidification and the saturation of soils with nitrogen. Increased soil acidity can decrease the availability of good nutrients, such as calcium and magnesium, and can increase toxic aluminum, which kills plants and can be detrimental to aquatic life. Soils that are nitrogen-saturated, particularly forest soils, eventually will leach their nutrients into surface and groundwater, which eventually drains into the Bay.

What the Bay Program Is Doing

In November 2000, the Bay Program joined NOAA's Air Resources Laboratory, the EPA Great Waters Program and the Mid-Atlantic Regional Air Management Association to conduct the third workshop in a series on airsheds and watersheds, entitled "The Significance of Ammonia to Coastal and Estuarine Areas." The workshop focused on the effects of ammonia on the environment, and included discussions on primary emission sources and the atmospheric transport and fate of ammonia on a local and regional scale.

In addition, an ammonia airshed for the Bay region recently has been determined. The airshed, which is 4.5 times the size of the Bay's watershed, represents the areas where ammonia emission sources have the greatest potential for depositing nitrogen to the watershed. Given the size of the airshed, it is important to consider local ammonia sources, as well as sources beyond the watershed.

Collaboration among air quality, water quality and agricultural agencies is fundamental to dealing with the ammonia issue. Another pressing need is for better emissions data, to determine the causes and extent of fine particulate air pollution and regional haze.

Enhancing, or even maintaining, the quality of the Bay while accommodating growth will frequently involve difficult choices.

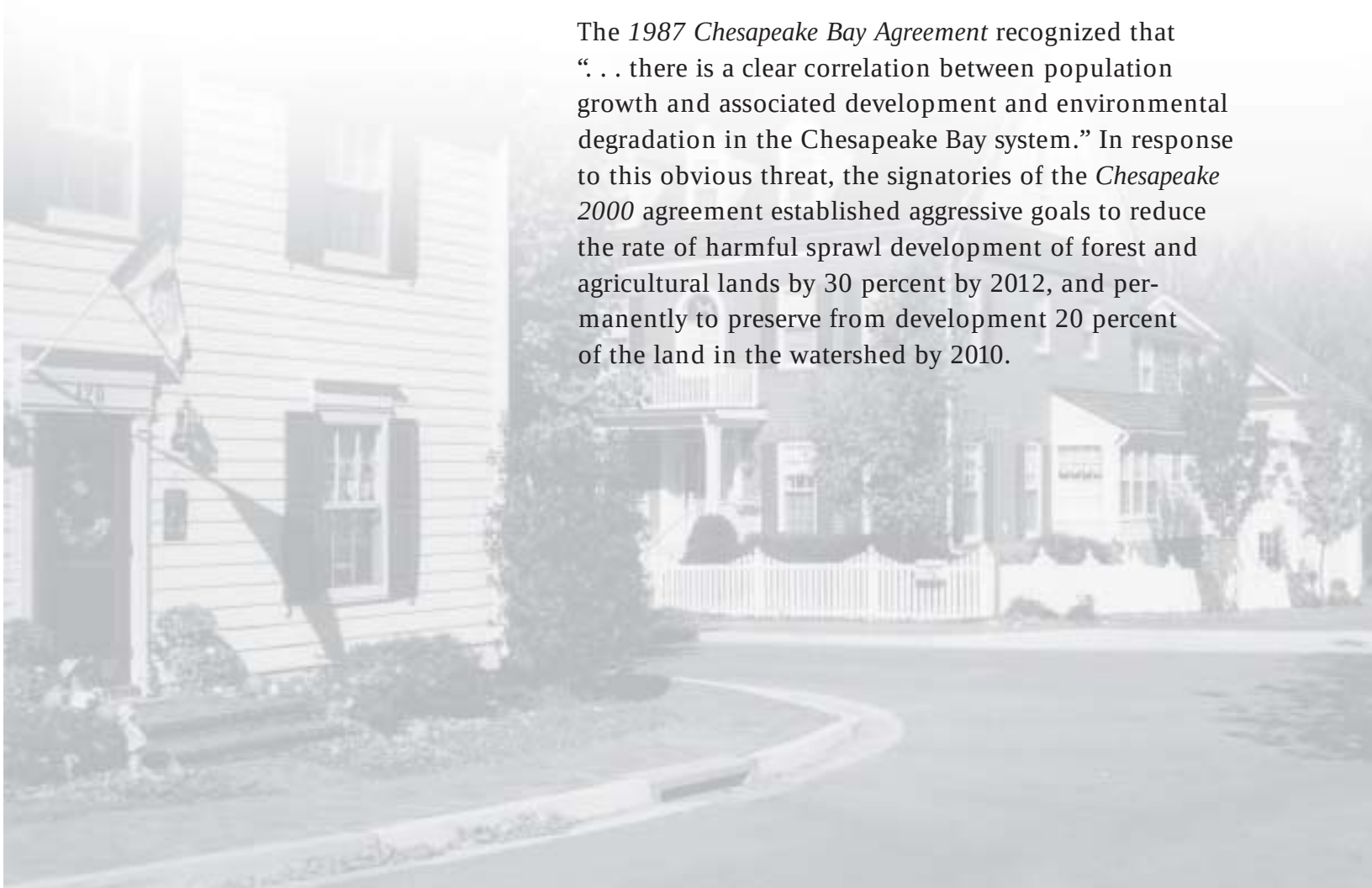
—CHESAPEAKE 2000

CHAPTER FOUR

Sound Land Use

The historical landscape of the Chesapeake Bay evokes for some the image of meandering streams, lush green forests, sweet-smelling farms and sun-dappled open waters. This vision has receded in recent years, at an alarming rate: there is now compelling evidence that the entire landscape and character of the Chesapeake Bay watershed is being threatened by the harmful effects of sprawl development. In fact, poor land use practices may undermine almost 20 years of restoration efforts in the Bay, if current trends continue.

The *1987 Chesapeake Bay Agreement* recognized that ". . . there is a clear correlation between population growth and associated development and environmental degradation in the Chesapeake Bay system." In response to this obvious threat, the signatories of the *Chesapeake 2000* agreement established aggressive goals to reduce the rate of harmful sprawl development of forest and agricultural lands by 30 percent by 2012, and permanently to preserve from development 20 percent of the land in the watershed by 2010.



THE LEGACY OF SPRAWL

The harmful effects of sprawl are associated with low-density development that stretches beyond the edge of services and employment. Sprawl can drive a wedge between where people live and where they shop, work, play and go to school, and force the population to rely chiefly on the automobile to get around. It is also associated with increased air and water pollution; the loss of farmland, open fields, forests and wetlands; increased flooding and traffic congestion; and longer commutes.

Harmful effects of sprawl lead to specific environmental consequences, including:

- **Air pollution:** While today's automobiles produce fewer emissions, more cars are driving more miles, which offsets the gains we have made in emission controls.
- **Water pollution:** Development has increased impervious surfaces such as roads, parking lots and rooftops. Runoff from moderate and heavy rains cannot be absorbed into the soil through these surfaces; instead, chemical contaminants and excessive nutrients drain into local water bodies and then into the Bay, degrading water quality and damaging aquatic plants and animals. According to the Center for Watershed Protection, more than 30 different studies have documented that streams, lakes and wetland quality decline sharply when the area of impervious surfaces located in upstream watersheds exceeds 10 percent of total land area.

- **Flooding:** The rapid expansion of impervious surfaces in the Bay watershed increases the velocity of the water and inhibits rainwater from recharging the groundwater.

The Transportation Connection

Development patterns in the Bay watershed have changed significantly since World War II. Today, thanks to the automobile and the interstate highway system, people have far greater access to outlying, previously undeveloped areas. More homeowners live on larger lots (known as low-density development), travel greater distances by car to reach their schools, services and businesses and to go to work. Traffic congestion has increased; so has airborne pollution, which eventually enters the Bay. In many areas, the car is the only means of transportation to work, school and shopping.

VITAL RESOURCE LANDS

Resource lands, including forests, wetlands and farmland, are fundamental to the health of the Bay. The Chesapeake Bay watershed contains two of the top-10 most-threatened farmland areas in the United States, including the Piedmont region of Maryland, Pennsylvania and Virginia and the mid-Atlantic coastal plain in Maryland and Delaware. Maryland, Virginia and Pennsylvania rank among the top-10 states in terms of production per acre of farmland. Unfortunately, harmful sprawl development is consuming some of the nation's best agricultural lands. In the Bay watershed, 1.12 million acres of agricultural land were lost between 1985 and 2000.

Local governments increasingly are realizing the growing economic and social costs of sprawl. The U.S. Forest Service studied the cost of community services and found that open space and farmland save local governments money. On average, a residential landowner requires $1.14 in services for every $1 paid in taxes—services that include schools, utilities, water, wastewater treatment, and police and fire protection. By contrast, farmland and forests only require about $.42 in services for every dollar paid.

Chesapeake Bay Watershed Preserved Lands

Chesapeake 2000 pledges to permanently preserve from development 20 percent of the land area in the watershed (approximately 7.8 million acres) by 2010. According to the July 2000 baseline, 6.7 million acres already have been preserved in Maryland, Pennsylvania, Virginia and the District of Columbia portions of the watershed. An estimated 1.1 million more acres need to be preserved to reach the *Chesapeake 2000* goal.

A BOOMING POPULATION

In 1970, the Bay watershed's population was 11,342,157; by 2000, that figure had grown to 15,710,840. Between 1970 and 2000, the Bay watershed's population grew by 38 percent. In Loudoun County, Virginia, 30 miles northwest of the District of Columbia, the population increased 96.8 percent from 1990 to 2000. The Bay watershed population is expected to increase to 17.8 million by 2020. This means that the watershed's population is growing by about 300 new residents every day, and more homes will need to be built. If current development patterns remain constant, many of these new homes will be located at a distance from schools and shopping, requiring people to drive more miles.

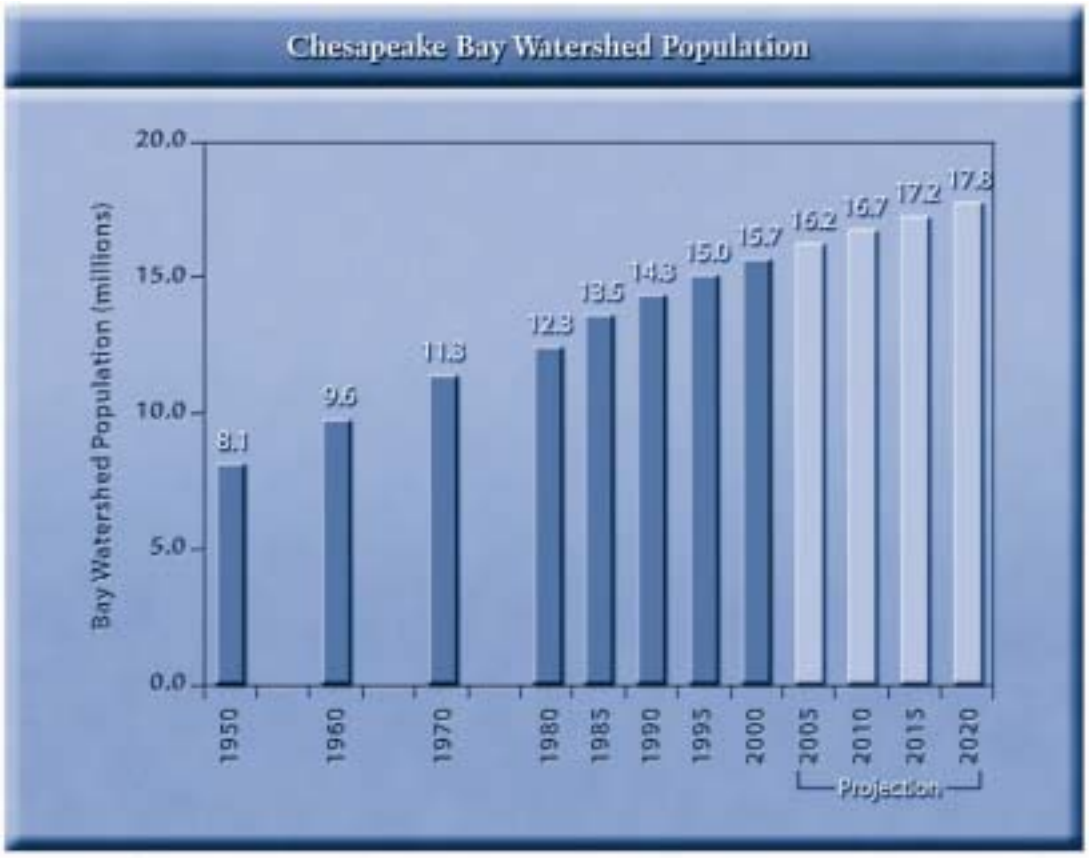
Housing Units and Lot Sizes

A total of 1.7 million new homes are projected to be built in the watershed by 2020, potentially consuming more than 600,000 additional acres of forest and farmland. It's expected that larger homes will be constructed on larger lots. The average size of new single-family homes grew 37 percent, from 1,645 square feet in 1975 to 2,250 square feet in 1999. Lot sizes increased too: in Maryland, average lot size increased 36 percent between 1985 and 1993.

Vehicle Miles Traveled

The Bay Program projects an additional 32 percent increase in vehicle miles traveled by 2010. This dramatic increase is related to development patterns that locate services such as shopping and schools away from residences.

The good news is that clean car technologies led to an 18 percent decrease in nitrogen oxide (NO_x) emissions between 1985 and 1997, despite a 41 percent increase in vehicle miles traveled. However, the increasing popularity of less fuel-efficient automobiles such as sport utility vehicles, combined with the increase in vehicle miles traveled, may offset the gains we have made through increased emission controls.



What the Bay Program Is Doing

Two of the Bay Program's principal sound land use goals are to:

- permanently preserve from development 20 percent of the land area in the watershed by 2010, and
- by 2012, to reduce the rate of harmful sprawl development of forest and agricultural land in the Chesapeake Bay watershed by 30 percent.

To this end, the Bay Program funds projects that promote and support low-impact design and smart growth, including training workshops for local governments on practical site and watershed planning, and on "green design." The program also produced *Visual Planning Tools*, a handbook for local communities, which illustrates environmentally sensitive development techniques, and offers an internet-based document, the *Environmentally Sensitive Development Practices Database*.

To achieve the sound land use goals established in the *Chesapeake 2000* agreement, local governments and watershed organizations must encourage low-impact development and work to change the public attitudes that drive harmful development. There are several ways you can help.

✓ Get involved in local land use decisions to promote environmentally sensitive development. Attend planning commission meetings and help educate local leaders about the economic, social and environmental costs of poor land use decisions. Excellent resources are available to support sustainable development in communities, including:

- *Better Site Design: A Handbook for Changing Development Rules in Your Community*; the Center for Watershed Protection.
- CITYgreen Program, sponsored by American Forests, maps urban ecology and measures economic benefits of trees, soils and other natural resources.
- The Low Impact Development Center provides information on protecting the environment and our water resources through proper site design techniques that replicate pre-existing hydrologic site conditions.

In addition, you can:

✓ Use porous surfaces, such as pavers that allow water to filter into the soil, for parking areas and driveways, instead of asphalt and other impervious materials. Redirect downspouts to gardens or rain retention barrels to decrease nonpoint source pollution.

✓ Encourage new developments close to transit stops. Support other forms of transportation, such as walking and biking, by developing bike lanes, bike paths and sidewalks.

✓ Drive fewer miles every week. Driving less reduces nutrients and chemical contaminants entering the watershed. Consider telecommuting.

Some families take their commitment a step further, by moving to or remaining in a traditional town or community, many of which were designed with pedestrians in mind, within walking distance to schools and shops.

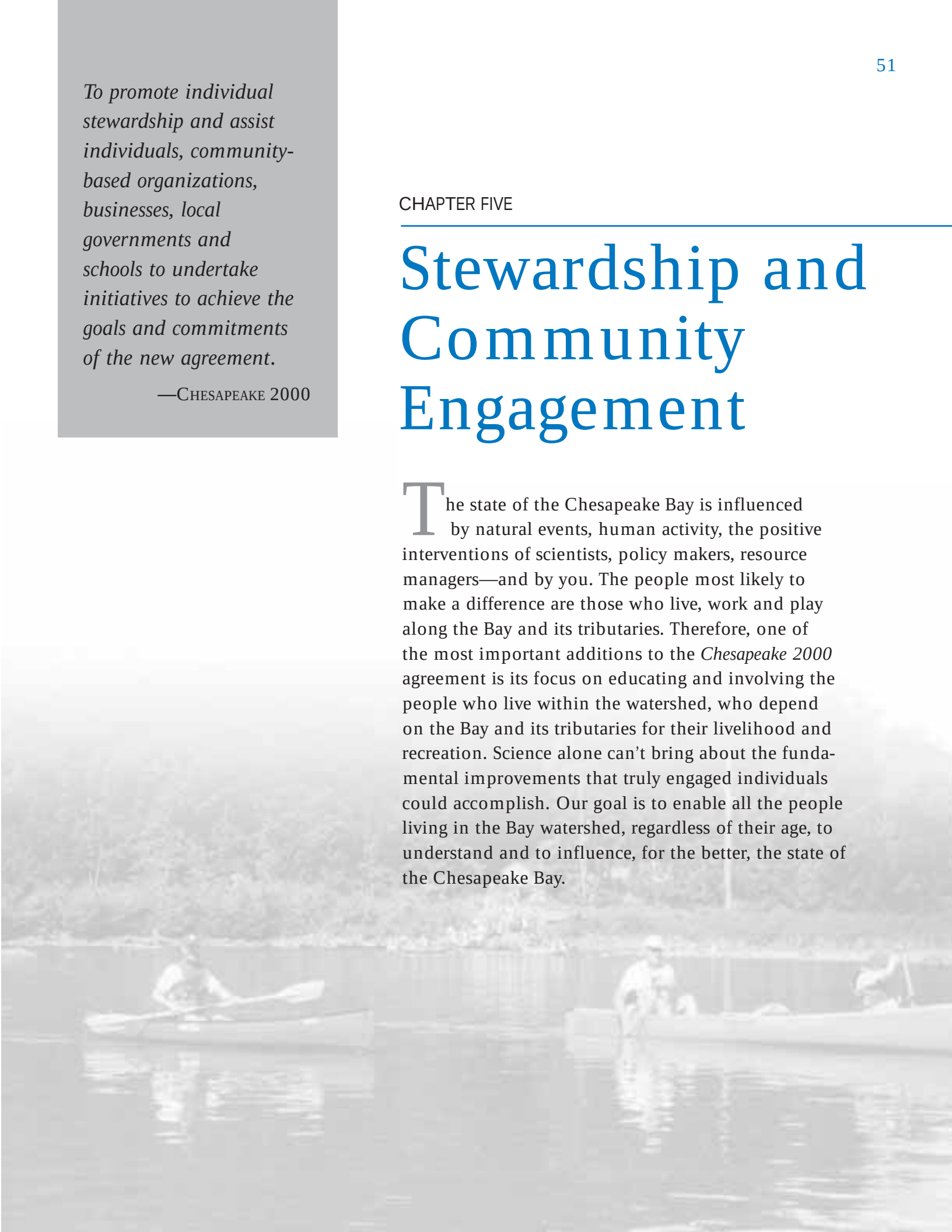
To promote individual stewardship and assist individuals, community-based organizations, businesses, local governments and schools to undertake initiatives to achieve the goals and commitments of the new agreement.

—CHESAPEAKE 2000

CHAPTER FIVE

Stewardship and Community Engagement

The state of the Chesapeake Bay is influenced by natural events, human activity, the positive interventions of scientists, policy makers, resource managers—and by you. The people most likely to make a difference are those who live, work and play along the Bay and its tributaries. Therefore, one of the most important additions to the *Chesapeake 2000* agreement is its focus on educating and involving the people who live within the watershed, who depend on the Bay and its tributaries for their livelihood and recreation. Science alone can't bring about the fundamental improvements that truly engaged individuals could accomplish. Our goal is to enable all the people living in the Bay watershed, regardless of their age, to understand and to influence, for the better, the state of the Chesapeake Bay.



There may be no greater goal in the *Chesapeake 2000* agreement than to continue to unite individuals, businesses, schools and universities, communities and governments in this effort. To succeed we must share our vision of a restored, healthy Bay—a system with abundant, diverse populations of plants and animals, fed by healthy streams and rivers, sustaining strong local and regional economies and the watershed's unique quality of life.

More than 15 million people live on the land that drains into the Chesapeake. In order to restore it, we must educate each one of those people about the Bay, and show how their actions directly affect the quality of local waters and eventually the entire Bay system. Restoring the Bay is not only up to government; we need everyone living in the watershed to do their part to protect and restore the estuary.

To meet our *Chesapeake 2000* commitments, we focus on four avenues of action:

- Education and outreach
- Community engagement
- Government by example
- Strengthening current partnerships while forging new ones

BRINGING THE CLASSROOM TO THE BAY

Individual and community stewardship of the Bay includes restoration, protection and conservation. Protecting and conserving the Bay's resources is clearly less expensive and more effective than restoring a degraded ecosystem.

Chesapeake 2000 focuses on involving individuals and groups in undertaking initiatives to help meet our goals. To encourage a sense of individual stewardship—developing an abiding interest in and responsibility toward the future of the Bay—we developed two primary objectives:

- Beginning with the class of 2005, to provide a meaningful Bay or stream outdoor experience for every school student in the watershed before graduation from high school.
- To give students and teachers alike opportunities to participate directly in local restoration and protection projects, and to support stewardship efforts in schools and on school property.

To develop a rich understanding of the watershed and its needs requires that people experience, first-hand, the Bay's importance to their way of life and the problems that beset it. The Bay Program recently developed a set of criteria that

enable jurisdictions to create widespread programs to educate students about the Bay. This required us to define a "meaningful" Bay or stream outdoor experience. Each experience should be:

- Investigative or project-oriented.
- Richly structured and based on high-quality instructional design.
- An integral part of the instructional program.
- Part of a sustained activity.
- Based on the watershed as a system.

Experiences should also:

- Involve external sharing and communication.
- Invite the expertise of natural resources personnel.
- Interest and inform all students.

Prevent pollution from entering the Bay and rivers by planting trees, especially along streams and shorelines.

Conserve electricity and water and reduce the number of miles you drive.

Plant native vegetation that requires the use of less fertilizer, pesticides and water.

Limit your use of fertilizer and apply at appropriate times.

Use safer, nontoxic alternatives for cleaning and controlling pests and weeds.

Properly dispose of household hazardous waste, antifreeze, oil and boat waste.

Prevent pollution by reducing, reusing and recycling.

Get involved in community groups and watershed organizations to develop and implement watershed management plans.

As part of the strategy, the Bay Program is analyzing each jurisdiction to determine how many students are currently receiving such Bay experiences, and which curricula include them. Then we will begin to implement more such programs across the Bay watershed, to ensure that all students can become stewards of the Bay's precious resources.

GOVERNMENT BY EXAMPLE

It often seems easier to insist on high standards from others than to demand it of oneself. It is essential, however, that we set the standard, not fall beneath it. The *Chesapeake 2000* agreement contains several commitments that focus on ensuring that the signatory governments maintain policies that are aligned with our new commitments for restoring and protecting the watershed. The signatories agreed that by 2002 they would ensure that all properties they owned, managed or leased would be developed, redeveloped and used in a manner consistent with all the agreement's relevant goals, commitments and guidance. They also pledged to ensure that the design and construction of signatory-funded development and redevelopment projects remain consistent with the agreement.

Signatory partners also pledged to use clean vehicle technologies and fuels on the basis of emission reductions, so that a significantly greater percentage of their respective fleet of vehicles use some form of clean technology. They further committed to develop an Executive Council directive to address storm water management to control nutrient, sediment and chemical contaminant runoff from state, federal and District-owned lands, and this directive was completed (see page 37).

CITIZEN MONITORING PROGRAM

The Bay Program works with the Alliance for the Chesapeake Bay's Citizen Monitoring program, a regional network of more than 145 trained volunteers who perform weekly water quality tests that help track the condition of waters flowing toward the Chesapeake Bay. These dedicated volunteers monitor rivers across the Chesapeake region in Pennsylvania, Maryland and Virginia. Some have worked with the Alliance for more than ten years, watching their rivers through the seasons and regularly submitting the valuable data they collect. For more information on how to participate in this program, go to the Chesapeake Bay Program website ("Get Involved"), and see Contacts, page 59. The website also contains other extensive tips for people from all walks of life on how to participate in other monitoring, protection and restoration activities.

Bernie Fowler's 2001 "Sneaker Index"

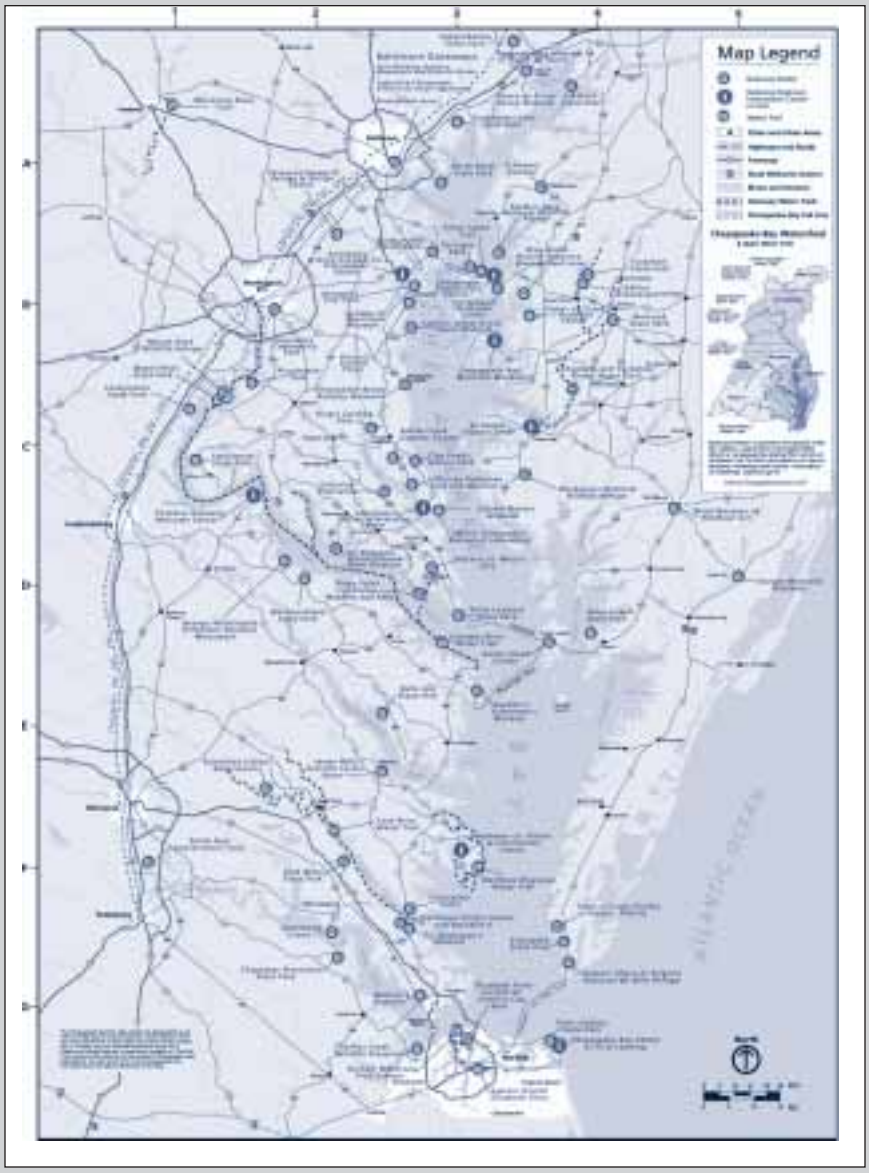
Bernie Fowler Day has been held the second Sunday of June since 1988. On this day, former Maryland state senator C. Bernard Fowler wades into the Patuxent River at Broomes Island, Maryland, to see how deep he can walk and still see his white sneakers. During the 1950s and 1960s, Bernie could see his sneakers with the water up to chest or shoulder depth, but has been unable to do so for many years.

The Bernie Fowler's "Sneaker Index," it turns out, has proved useful; in part because it makes an important concept related to water quality understandable to a wide audience, and there's excellent anecdotal and historic data based on Bernie's experience.

Bernie Fowler commenting on his "Sneaker Index."

Citizens wade into the Patuxent River during the 2001 Bernie Fowler Wade-In.

The Chesapeake Bay Gateways Network



The Gateways Network was formed by the Chesapeake Bay Initiative Act of 1998, which calls for the National Park Service to work with state and local governments, the private sector and other federal agencies to build a partnership network of gateways and water trails in the Chesapeake Bay watershed. Planning for the Gateways Network began in late 1999. The first Gateways were designated in summer 2000; more are being added regularly. The network is designed to:

- Help visitors better understand the Chesapeake by embracing a common cause of developing new and better ways of communicating coordinated messages to the public through enhancing placed-based interpretation and education about the Bay watershed's special places and stories.
- Facilitate both information and physical access to the Bay through a system of Gateways, land and water routes.
- Help Bay watershed residents and visitors appreciate their role in the Bay's survival, and learn how they can become involved in conserving and restoring the natural, cultural, historical and recreational resources of this national treasure.

Gateways are primary destinations where people can access, experience, learn about and contribute to specific Bay-related resources. They are divided into four categories: sites, water trails, regional information centers and hubs. Gateways include parks and wildlife refuges, historic sites, outdoor museums, and other natural, cultural, historic or recreational resources. New sites are continually being added through a nomination and designation process. For more information on the Gateways Network, see the Bay Program website or turn to Contacts on page 59.

We must manage for the future. We must have a vision for our desired destiny and put programs into place that will secure it.

—CHESAPEAKE 2000

CHAPTER SIX

Looking Ahead

The Bay Program partnership has come a long way since the first Chesapeake Bay agreement was signed in 1983, combining the efforts of Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission and the EPA. Today, the Chesapeake Bay Program serves as a national and international model of successful estuarine restoration.

Expanded monitoring efforts have given Bay scientists a better understanding of the Bay's ecosystem. Improved computer modeling programs have allowed us to target nutrient reduction efforts and track their progress with greater accuracy throughout the entire 64,000-square-mile watershed. Innovative technologies have enabled partners to accelerate efforts to reduce pollutants entering the Bay and its tributaries. Recent policies have targeted Bay watershed regions in need of the most help, while expanded outreach efforts have sought to involve more people in the fight to restore and protect the Bay.

Bay Program partners also recognize, however, that these efforts may not be enough. Consequently they have turned upstream to Delaware, New York and West Virginia for help in reducing the amount of nutrients and sediments flowing into the Bay. We believe these new relationships will lead to an enriched watershed partnership that will keep the Bay Program on the cutting edge of estuary management.

As growth and development expand throughout the watershed, we must meanwhile redouble efforts to minimize their impact on local streams and rivers. New technologies reducing nutrients from wastewater treatment plants must be installed. Agricultural lands must be wisely managed. Ecologically important lands must be targeted and preserved. Innovative pollution reduction strategies must be developed and implemented, and new resource management plans must be adopted and followed. These are not easy tasks to complete, but as in the past, Bay Program partners will rise to the challenge.

The cost of solving the Bay's problems will be significant—but the cost of failing to do so will be significantly higher. New ways of funding Bay restoration programs must be found. In an era of shifting national and regional priorities, we must not allow the plight of the Chesapeake to be forgotten.

There is hope. The Bay and the plants and animals that inhabit it may appear slow to respond, but many critical species and vital habitats have begun to show signs of recovery. Bay grasses have increased 45 percent from the all-time low. Rockfish have reached their highest populations since the 1950s. The number of shad returning to the Bay's tributaries is increasing by leaps and bounds. Each of these achievements points to a brighter future for the Bay.

If we are to succeed in restoring the Bay, we will need help from everyone who lives and works in the Bay watershed. Through the Bay Program partnership, plans will be developed; through the efforts of citizens and stakeholders, consensus will be formed; through federal, state and local governments, programs will be implemented—and through all of these efforts, the Chesapeake Bay will be restored.

Contact Information

For more information about the Chesapeake Bay and its rivers contact:

Chesapeake Bay Program
410 Severn Avenue, Suite 109
Annapolis, MD 21403
(800) YOUR BAY / (410) 267-5700
www.chesapeakebay.net

D.C. AND STATE GOVERNMENT AGENCIES

Delaware Department of Natural Resources and Environmental Control
(302) 739-4403
www.dnrec.state.de.us

District of Columbia
Department of Health, Watershed Protection Division
(202) 535-2240
dchealth.dc.gov

Maryland Department of the Environment
(800) 633-6101
www.mde.state.md.us

Maryland Department of Natural Resources
(877) 260-8DNR / (410) 260-8100
www.dnr.state.md.us

New York Department of Environmental Conservation
(518) 402-8233
www.dec.state.ny.us

Pennsylvania Chesapeake Bay Education Office
(717) 545-8878
www.pacd.org

Pennsylvania Department of Conservation and Natural Resources
(717) 787-9306
www.dcnr.state.pa.us

Pennsylvania Department of Environmental Protection
(717) 783-2300
www.dep.state.pa.us

Virginia Department of Conservation and Recreation
(804) 786-1712
www.dcr.state.va.us

Virginia Department of Environmental Quality
(800) 592-5482 / (804) 698-4000
www.deq.state.va.us

Virginia Department of Game and Inland Fisheries
(804) 367-1000
www.dgif.state.va.us

West Virginia Department of Environmental Protection
(304) 558-2107
www.dep.state.wv.us

FEDERAL AGENCIES

Chesapeake Bay Environmental Enforcement Coalition
(800) 377-5879

National Oceanic and Atmospheric Administration
Chesapeake Bay Office
(410) 267-5660
http://noaa.chesapeakebay.net

National Park Service
Chesapeake Bay Gateways Network
(800) YOUR BAY / 410-267-5700
www.baygateways.net

Natural Resources Conservation Service
Maryland Office
(410) 757-0861
www.md.nrcs.usda.gov

U.S. Army Corps of Engineers
District Office – Baltimore
(410) 962-7608
www.nab.usace.army.mil

U.S. Army Corps of Engineers
District Office – Norfolk
(757) 441-7500
www.nao.usace.army.mil

U.S. Army Environmental Center
(410) 436-7113
http://www.hqda.army.mil/acsimweb/env/cbi/

U.S. Forest Service
(410) 267-5706
www.fs.fed.us

U.S. Environmental Protection Agency—Chesapeake Bay Program Office
(800) YOUR BAY
www.chesapeakebay.net

U.S. Environmental Protection Agency—Region III
(800) 438-2474 / (215) 814-2020
www.epa.gov/region3

U.S. Environmental Protection Agency Wetlands Information Hotline
(800) 832-7828

U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
(410) 573-4500
www.fws.gov/r5cbfo

U.S. Geological Survey
(410) 238-4200
http://chesapeake.usgs.gov

COMMISSIONS AND INTERSTATE AGENCIES

Chesapeake Bay Commission
(410) 263-3420
www.chesbay.state.va.us

Interstate Commission on the Potomac River Basin
(301) 984-1908
www.potomacriver.org

Metropolitan Washington Council of Governments
(202) 962-3200
www.mwcog.org

Susquehanna River Basin Commission
(717) 238-0423
www.srbc.net

ACADEMIC ORGANIZATIONS

Chesapeake Bay Research Consortium
(410) 798-1283
www.chesapeake.org

Cornell Cooperative Extension (New York)
(607) 255-2237
www.cce.cornell.edu

Maryland Sea Grant
(301) 405-6371
www.mdsg.umd.edu

Pennsylvania State University
Cooperative Extension Service
(814) 863-3438
www.extension.psu.edu

University of Delaware
Cooperative Extension
(302) 856-2585
http://ag.udel.edu/extension

University of the District of Columbia
(202) 274-5000
www.wrlc.org/udc.htm

University of Maryland
Maryland Cooperative Extension
(301) 405-2907
www.agnr.umd.edu/mce

University of Maryland
Center for Environmental Science
(410) 228-9250
www.umces.edu

Virginia Cooperative Extension Office
(540) 231-6704
www.ext.vt.edu

Virginia Institute of Marine Science
(804) 684-7000
www.vims.edu

Virginia Sea Grant
(434) 924-5965
www.virginia.edu/virginia-sea-grant/

Virginia Tech
(540) 231-6000
www.vt.edu

West Virginia University
West Virginia Extension Service
(304) 293-4221
www.wvu.edu/~exten/

NONPROFIT ORGANIZATIONS

Alliance for the Chesapeake Bay
(410) 377-6270
www.alliancechesbay.org

Center for Watershed Protection
(410) 461-8323
www.cwp.org

Chesapeake Bay Foundation
(888) SAVE BAY / 410-268-8816
www.cbf.org

Low Impact Development Center
(301) 982-5559
www.lowimpactdevelopment.org

National Fish and Wildlife Foundation
(202) 857-0166
www.nfwf.org

U.S. Environmental Protection Agency
Chesapeake Bay Program Office
410 Severn Avenue, Suite 109
Annapolis, MD 21403
1-800-YOUR BAY
www.chesapeakebay.net

Report written by Robin Herbst

Recycled/Recyclable—Printed with vegetable-oil-based inks on
recycled paper (30% postconsumer)

Printed by the U.S. Environmental Protection Agency for the Chesapeake Bay Program.