

# Riparian Forest Buffers Linking Land and Water

*The conservation and restoration  
of streamside forests in the  
Chesapeake Bay watershed*





## About the Chesapeake Bay Program

The Chesapeake Bay Program is a unique regional partnership that has been leading and directing the restoration of the Chesapeake Bay since 1983.

The Chesapeake Bay Program partners include the states of Maryland, Pennsylvania, and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the U.S. Environmental Protection Agency (EPA), representing the federal government; and participating citizen advisory groups.

Since its inception, the Chesapeake Bay Program's highest priority has been the restoration of the Bay's living resources – its finfish, shellfish, other aquatic life, Bay grasses, and wildlife. Although much progress has been achieved, restoration goals are continually challenged by the needs of a growing human population. Because of this, the work of the Chesapeake Bay Program includes a growing emphasis on beneficial land use, such as riparian forest buffers.



Publication prepared by the Alliance for the Chesapeake Bay.  
Cover photo by Heather Richards, Potomac Conservancy.

July 2004

# Riparian Forest Buffers Linking Land and Water

*The conservation and restoration  
of streamside forests in the  
Chesapeake Bay watershed*

## Contents

Introduction .....	1
Functions & Benefits of Riparian Forest Buffers .....	2
The Chesapeake Bay Riparian Forest Initiative .....	6
Looking Forward .....	10



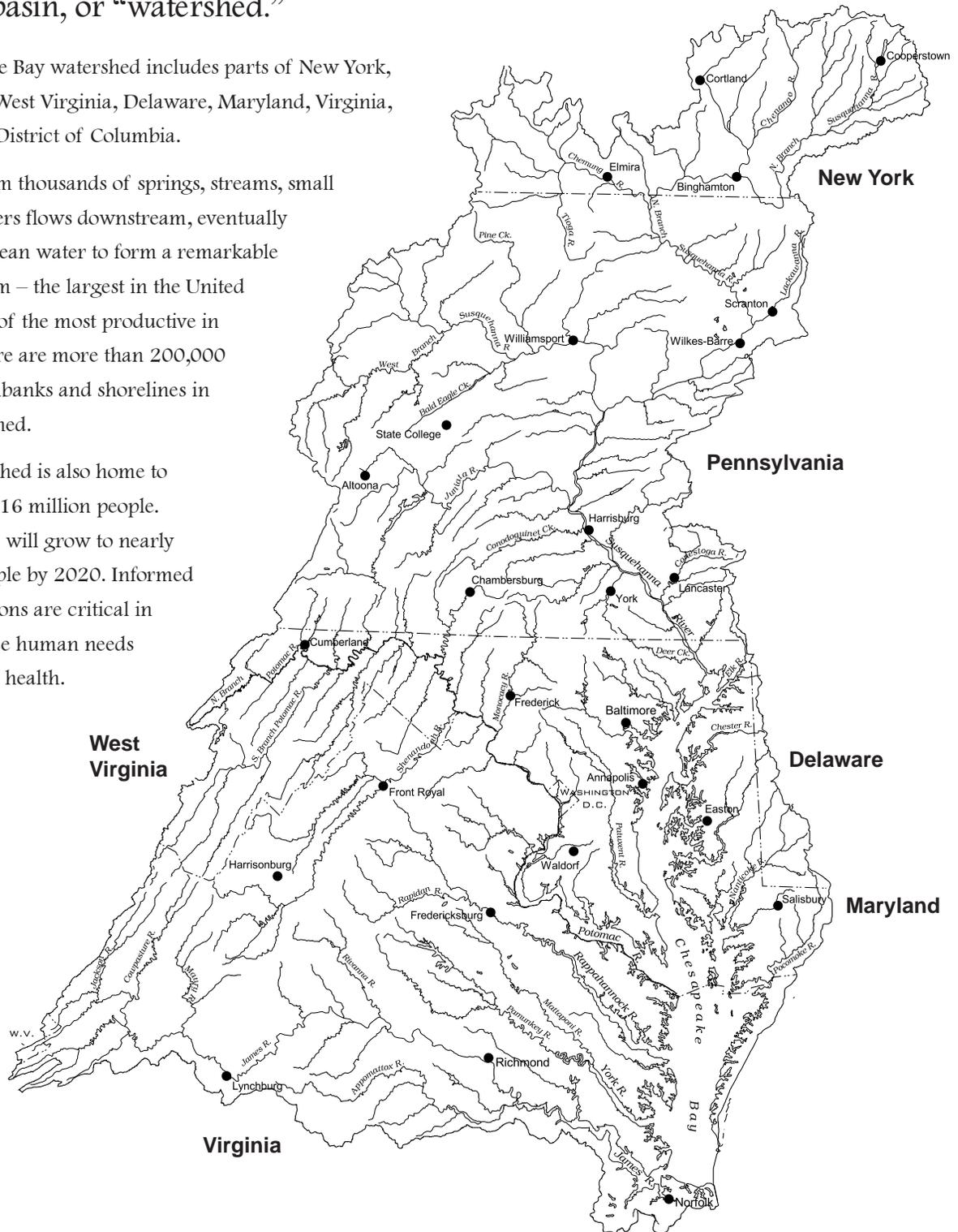
# The Chesapeake Bay Watershed

The Chesapeake Bay receives its water from a 64,000 square-mile drainage basin, or “watershed.”

The Chesapeake Bay watershed includes parts of New York, Pennsylvania, West Virginia, Delaware, Maryland, Virginia, and the entire District of Columbia.

Freshwater from thousands of springs, streams, small creeks, and rivers flows downstream, eventually mixing with ocean water to form a remarkable estuarine system – the largest in the United States and one of the most productive in the world. There are more than 200,000 miles of streambanks and shorelines in the Bay watershed.

The Bay watershed is also home to approximately 16 million people. The population will grow to nearly 18 million people by 2020. Informed land-use decisions are critical in order to balance human needs with ecological health.



Everyone in the Chesapeake Bay watershed lives just a few minutes from one of the many streams and rivers that drain into the Bay.

“It is a beautiful and  
delightful land with  
clear rivers and brooks  
running into a  
faire Bay ... there is  
little grass, but for that  
which grows in the  
marshes, for this  
country is completely  
overgrown with trees.”

— Captain John Smith  
1607



Photo: Sally Claggett, US Forest Service

## Introduction

**F**OUR CENTURIES AGO, Europeans arrived on the shores of the Chesapeake Bay to find a vast forest covering the land. This forest was an important regulator of the Bay’s environment—a “living filter.” The forest was dense, varied, and filled with wildlife. Trees lined nearly every stream and shoreline from the northern boundary, which would become New York State, to the southern edge, in present-day Virginia. This landscape was destined for dramatic change.

In the centuries following European arrival, agriculture expanded. Towns and cities flourished. The many demands of a growing population strained the Bay’s resources and depleted its forests. Today, less than 60 percent of the watershed is forested, and much of the remaining forest is highly fragmented. Meanwhile, the population continues to grow, putting additional development pressure on forestlands.

The decline in forest coverage is related to the decline of water quality in the Bay itself. The most critical connection between the two can be found in “riparian areas”—land that stands at the water’s edge.

Riparian lands provide a wealth of ecological benefits. For example, trees along the shoreline help to filter pollutants and sediment from runoff and groundwater before they enter the waterways. Trees also provide important habitat benefits for aquatic creatures. Fallen leaves and branches offer food and

**riparian area** • the land adjacent to a body of water, such as a stream, river, marsh or shoreline; forms the transition between the aquatic and terrestrial environments

shelter, while shade helps to regulate water temperature and keep oxygen in the water.

When riparian forests help to protect the streams and rivers in the Bay watershed, these benefits are realized downstream in the Chesapeake Bay. With more than 200,000 miles of streambanks and shoreline in the Bay watershed, riparian forests are vital for the success of the Bay restoration effort. Without them, the Bay and its rivers are increasingly susceptible to decline.

Since 1996, the Chesapeake Bay Program has been actively pursuing the restoration and protection of riparian forests in the Bay watershed. Working across state boundaries, this effort has set and achieved numerous restoration goals and developed innovative programs providing landowner incentives, outreach, education and training, and community partnerships. Maintaining this progress is critical. Today, the Chesapeake Bay Program is working toward an expanded set of goals that will further strengthen the quantity and quality of forest buffers and help protect Bay resources for future generations.

# Functions & Benefits of Riparian Forest Buffers

**I**N RECENT YEARS, scientists in the Chesapeake Bay region and elsewhere have documented how riparian forest buffers can help to restore the Bay. Their research also provides a broader understanding of the features that make a forest buffer most effective.

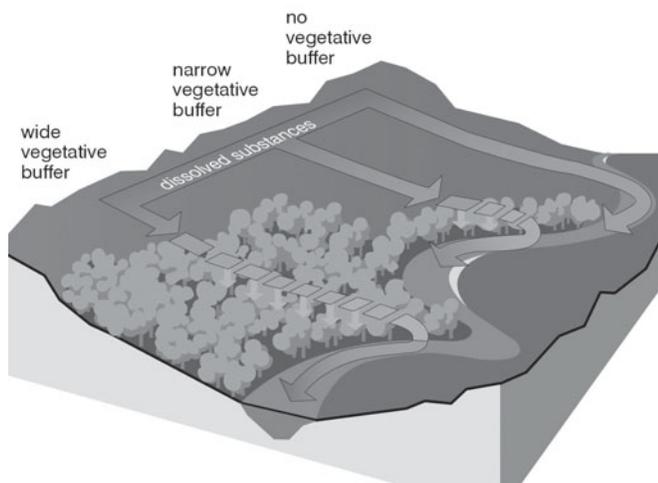
Riparian forest buffers offer enormous benefits to life on the land and in the water. These streamside systems:

- Filter pollution
- Sustain aquatic habitat
- Stabilize floodplains
- Transform and store nutrients
- Provide shade
- Provide wildlife habitat

There are few restoration initiatives that address both water quality and habitat needs so directly.

## Filter Pollution

Riparian forest buffers capture and filter rain water and sediment that wash off the land. The roughness of the vegetation and the forest floor slows runoff and allows it to infiltrate into the soil, filtering sediment from the water before it reaches local



Riparian forest buffers filter out pollutants before they reach the stream. The wider the buffer, the more effectively it reduces pollution.



Photo: Mike Land, National Park Service

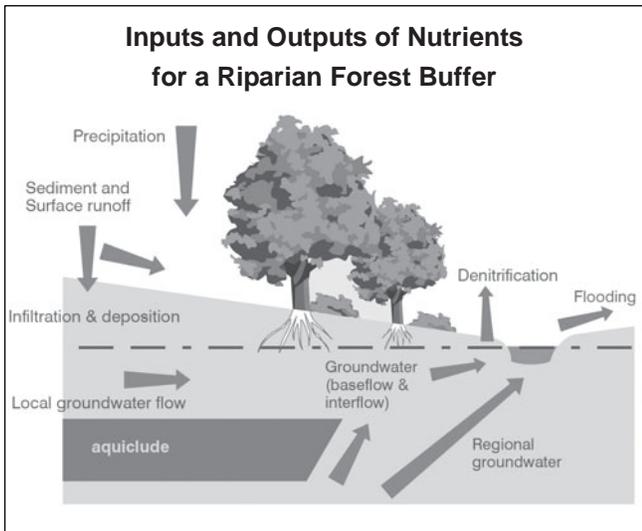
streams and rivers. Serving as a last “line of defense,” buffers remove pollutants such as nitrogen in the water and phosphorus bound to soil particles.

In fact, riparian forests can reduce nutrient and sediment inputs to a water body by 30 to 90 percent. The capacity of forests to absorb and store runoff can be 10 to 15 times higher than grass and four times higher than a plowed field. The wider the buffer, the more effectively it reduces pollution.

## Transform & Store Nutrients

Fertilizers and other pollutants travel to a stream through surface and ground water. Riparian forests act like pumps—taking up water and nutrients through their root system, storing them in the biomass of the tree, and releasing moisture into the air.

Streamside forests are also very effective in capturing and transforming nitrogen and other pollutants into less harmful forms, mostly due to the high level of chemical and biological activity in the wet, organic, carbon-rich soil. Through a process called “denitrification,” soil bacteria convert nitrate to a harmless nitrogen gas which is released into the atmosphere instead of polluting local streams.



Riparian forest buffers filter, transform, and store nutrients, while stabilizing floodplains.

## Stabilize Floodplains

Healthy, wooded riparian vegetation helps stabilize streambanks and reduce erosion. The root system holds soil together, while both the stems and roots help protect banks by deflecting and reducing streamflow velocity during floods. Floodplain forests can lessen effects of flooding downstream.

## Provide Shade

Riparian forests benefit fish and other organisms by improving the quality of nearby waters through shading. In summer, the leaf canopy helps maintain cooler, more even temperatures, especially on small streams. Cooler water reduces stress on fish and other creatures and holds more oxygen, encouraging the

growth of diatoms, beneficial algae, and aquatic insects. A few degrees can have a major effect on water quality and the survival of aquatic organisms.

## Sustain Aquatic Habitat

Leaves fall into buffered streams and are trapped by woody debris and rocks. They provide food and habitat for insects, amphibians, crustaceans, and small fish which in turn form the food chain for fresh water streams.

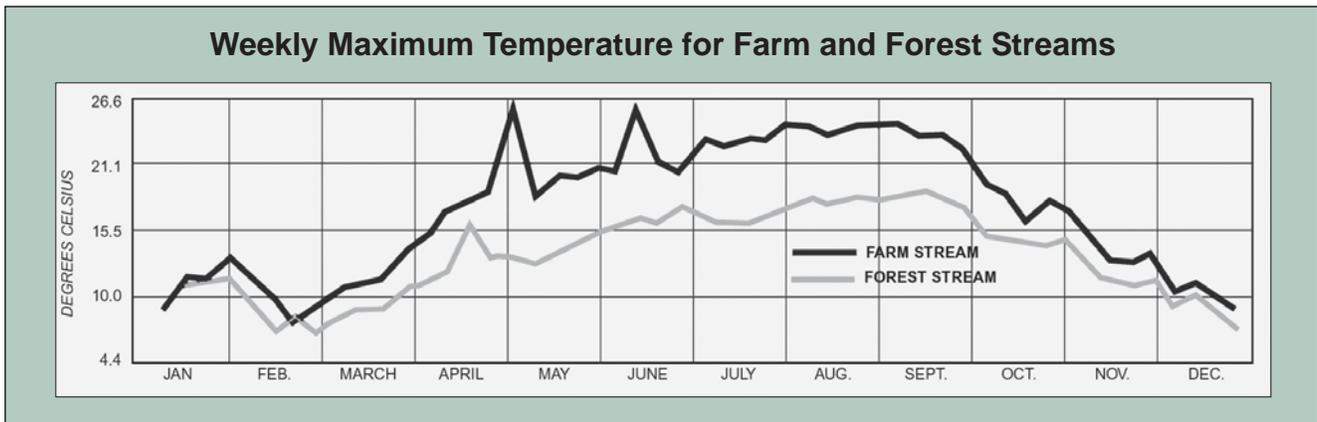


Photo: Chesapeake Bay Program

Leaf detritus supplies up to 75 percent of the organic food base in shaded streams. Woody debris also creates habitat structure and cover for fish and their food supply. When trees are removed from a stream, a wide range of species that depend on them are lost as well. Fish do “grow on trees.”

## Provide Wildlife Habitat

More than half of all species on earth rely on the interwoven layers of habitat provided in riparian areas and the availability of food, water, and diversity of shelter all within a small area. The zone of transition from streamside to upland is home to a multitude of important plant and animal species. In addition to permanent habitat, continuous stretches of riparian forest also serve as valuable corridors for migrating wildlife. These multiple benefits are especially enhanced when the forest is composed of native trees with a diversity of age and species.



Shade provided by riparian forest buffers reduces stream temperatures and enhances aquatic habitat.

# The Three-Zone Riparian Forest Buffer

The three-zone buffer system is a model riparian system designed to achieve better water quality and protect the stream, along with other landowner objectives. A three-zone riparian forest buffer may not be necessary or achievable in every setting, but it provides a useful way to understand the functions and management of a forest buffer system. Riparian buffers will vary in character, size, and effectiveness based on the environmental setting, management, and landowner objectives.



Cropland/ Pastureland/ Developed Areas	Zone 3 GRASS	Zone 2 MANAGED FOREST	Zone 1 UNDISTURBED FOREST	Streambottom/Channel
<ul style="list-style-type: none"> <li>For cropland: sediment, fertilizer, and pesticides are carefully managed.</li> <li>For pastures: fencing, crossings, designed watering facilities, and proper grazing are practiced.</li> <li>For developed areas: sediment control and stormwater management practices are used.</li> </ul>	<p><i>Supports Zones 1 &amp; 2</i></p> <p>Functions:</p> <ul style="list-style-type: none"> <li>Controls runoff</li> <li>Disperses flow</li> <li>Traps sediments</li> <li>Filters suspended solids</li> <li>Uses/transforms nutrient runoff</li> </ul> <p>Management:</p> <ul style="list-style-type: none"> <li>Periodic harvesting may be conducted to control vegetative regrowth and redistribution of sediment build-up</li> </ul>	<p><i>Critical to Nutrient Removal</i></p> <p>Functions:</p> <ul style="list-style-type: none"> <li>Removes sediment and nutrients from runoff and subsurface flows through a number of natural processes including filtration, deposition, plant uptake, and denitrification</li> </ul> <p>Management:</p> <ul style="list-style-type: none"> <li>Periodic harvesting is acceptable to remove nutrients sequestered in tree stems and branches and to maintain nutrient uptake through vigorous tree growth</li> </ul>	<p><i>Critical to Habitat</i></p> <p>Functions:</p> <ul style="list-style-type: none"> <li>Provides leaf and wood debris to the stream</li> <li>Helps maintain lower water temperature</li> <li>Stabilizes streambank</li> </ul> <p>Management:</p> <ul style="list-style-type: none"> <li>Tree removal generally permitted only for streambank stability</li> </ul>	<ul style="list-style-type: none"> <li>Woody debris provides fish habitat and channel structure.</li> <li>The biological community in healthy forested streams processes nutrients and other chemicals within the channel itself, reducing pollution from upstream.</li> <li>Forested streams are generally wider than meadow streams, providing more active surface area for aquatic life to flourish.</li> </ul>

# Maximizing the Benefits of a Forest Buffer

**L**INKING LAND AND WATER, riparian areas serve as a “circulatory system” for the Chesapeake Bay watershed. As the natural riparian vegetation in the Bay region, forests provide a number of benefits to streams in any location. The more forest cover that exists in a watershed, the more effective riparian forests can be. However, the magnitude of benefits delivered by a riparian forest buffer depends on site-specific factors. The location, width, and continuity of buffers set the overall context for effectiveness.

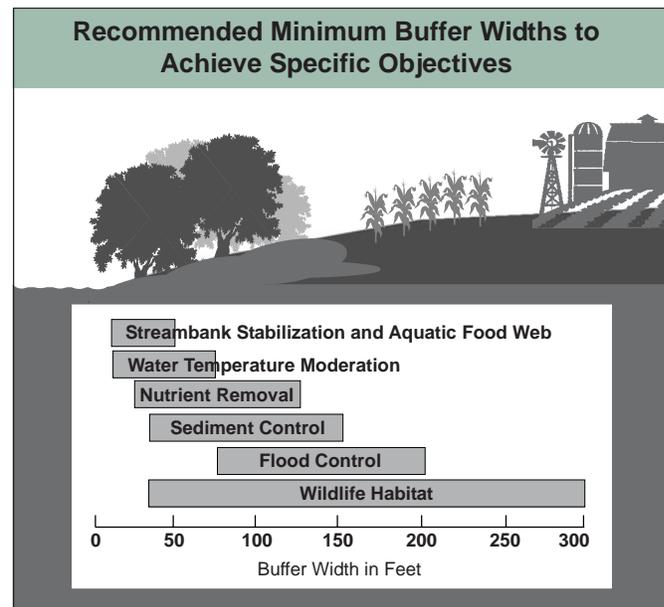
## Location of the Buffer

Riparian forest buffers that are planted with clear outcomes in mind are often the most effective because the buffer width and planting plan can be designed in ways that best achieve those objectives. The following benefits are usually considered in the process of selecting a targeted buffer location:

- **Reducing nitrogen.** Nitrogen is one of the most damaging pollutants in the Bay. Restoring riparian forest buffers in areas of high nitrogen runoff can greatly reduce the quantity of nitrogen that travels through the buffer and enters streams and tidal waters.
- **Protecting headwater streams.** Headwater streams are the smaller waterways that feed other streams and rivers. Restoring forest buffers to the headwaters will send cleaner, cooler water downstream.
- **Improving aquatic habitat.** Restoring riparian forest buffers can launch or complement existing efforts involving fish passage, stream health, and other living resource objectives.
- **Creating forest corridors.** Larger, continuous forest buffers provide connected habitat for terrestrial and aquatic wildlife. They also enhance the ability of species to migrate and to sustain their overall population. Sometimes restoring continuity may be as important as expanding width.

## Width of the Buffer

The ideal width for a riparian forest, and the factors that bring it to full maturity, vary. In general, wider buffers bring a greater variety of benefits and



are more likely to sustain those benefits over time. The Chesapeake Bay Program recommends minimum widths of 75 to 150 feet wherever possible, in order to achieve the widest range of water quality and habitat objectives. Some site-specific factors that influence ideal buffer width include:

- **Physical characteristics of the site.** These could include soil, slope, stream order, or stream stability. For example, a wider buffer might be needed to offset faster runoff from a steep slope.
- **The value of the stream being protected.** For example, does the stream provide drinking water or a high-quality trout fishery?
- **Intensity of the neighboring land use.** Agricultural land that requires a high level of fertilizer or pesticides may need a wider buffer than land with less polluted runoff, such as a pasture or low-density residential area.
- **Landowners' objectives.** Establishing a suitable buffer width must balance restoration objectives with the needs and interests of the landowner.
- **Limitations of an urban site.** Existing development often limits the width of riparian areas available for restoration in urban areas. In addition, stormwater practices may cause runoff to bypass the buffer. Buffer design should be integrated with stormwater management practices to optimize benefits.

# The Chesapeake Bay Riparian Forest Initiative

**T**HROUGHOUT THE CHESAPEAKE BAY watershed, work has been underway to protect and restore riparian forest buffers. The Chesapeake Bay Program launched this initiative in 1994 and celebrated its success in 2003 by advancing a new, expanded set of goals for riparian forest buffers.

When the initiative began in 1996, the Chesapeake Bay Program set out to restore 2,010 miles of forest buffers in the Bay watershed by the year 2010. Facing a formidable challenge at the time, partners in the program responded with vigor. Maryland, Pennsylvania, Virginia, the District of Columbia, and the federal government each pursued this goal by forming partnerships with landowners, local governments, and community organizations, and by building new programs to address the need. Their combined efforts led to resounding success—the goal for 2,010 miles of forest buffers was met and exceeded eight years ahead of schedule, spurred by new incentives for landowners to plant forest buffers.



Photo: Al Todd, US Forest Service

The Chesapeake Bay Program is working to restore 10,000 miles of riparian forest buffers by 2010.

*The Chesapeake Bay Program is widely recognized as a national leader in restoring and protecting riparian forest buffers.*



In December 2003, the Chesapeake Executive Council built on this success by issuing a directive for *Expanded Riparian Forest Buffer Goals* (Directive No. 03-01). This new directive defines a long-term vision for forest buffers in the Bay watershed, while also setting several short-term goals and recommending policy changes. The new goals include the following:

- Restore at least 10,000 miles of riparian forest buffers by 2010.
- Ensure that at least 70 percent of streambanks and shorelines are buffered in the long term.
- Advance efforts to conserve existing forest buffers.
- Work with at least five jurisdictions per state to promote urban forests and increase tree canopy.

## Raising the Bar

**T**HE 2003 DIRECTIVE RAISES the riparian forest restoration goal from 2,010 to 10,000 miles by 2010. This five-fold increase represents a commitment to plant nearly 900 miles of streambanks and shorelines in each of the next seven years.

At present, approximately 60 percent of the Bay's riparian areas are forested. To reach a long-term goal of 70-percent coverage in the entire watershed, the Chesapeake Bay Program and its partners will need to restore at least 30,000 miles of riparian buffers and conserve all riparian areas that are currently forested.

**1994**

Chesapeake Executive Council calls for the first riparian forest buffer policy for the Bay watershed.

**1996**

First goal set: 2,010 miles of forest buffers to be restored by 2010.

**2002**

2010 goal met eight years early.

**2003**

Chesapeake Executive Council sets new goal: 10,000 miles to be restored by 2010.

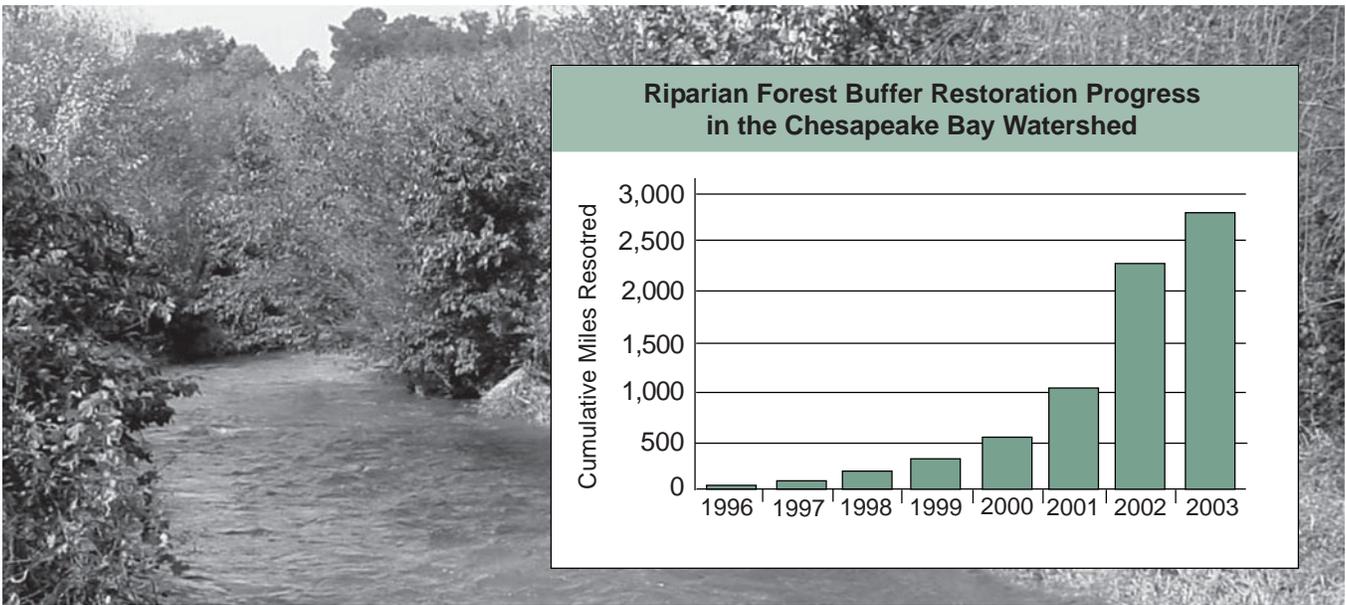


Photo: LandStudies, Inc.

In addition to these goals, the Directive adopts the following policy recommendations:

- Ensure that adequate technical assistance is available to landowners and communities.
- Continue the Conservation Reserve Enhancement Program (CREP), a federal-state partnership that provides financial incentives for restoring forest buffers on agricultural land.
- Promote innovative restoration techniques, wider buffers, maintenance of planted buffers, and buffer restoration on a range of land uses.
- Strategically target high priority areas for buffer restoration.
- Expand scientific knowledge on the benefits of urban tree canopy.

### Counting the Miles

Every buffer planting—large or small—will help to restore 10,000 buffer miles in the Chesapeake watershed by 2010. Any group, organization, or local government that conducts a buffer planting should report their work towards this collective goal by using a simple, on-line form to describe the location of the buffer, size of the planting, and contact information.

[www.chesapeakebay.net/riparian.htm](http://www.chesapeakebay.net/riparian.htm)

## Increased Conservation & Maintenance

**T**O PROMOTE THE MATURITY and quality of forest buffers, the 2003 Directive brings new emphasis to conservation and long-term maintenance.

The rate of loss of riparian forests is currently unknown. However, the long-term vision of buffering 70 percent of all streams and shorelines with forests represents a commitment to a net gain and points to a need for stronger protection. Conserving existing mature buffers is one sensible strategy towards achieving this goal.

Maintenance of restored buffers is also critical, especially for those that are newly planted. Newly

planted buffers require at least seven years before they begin to provide the same level of benefits expected from a naturally existing forest. In order to grow and thrive, trees must survive threats from drought, deer, voles, beavers, insect pests, invasive plants, lawn mowers, and people.

Maintenance needs are site specific and may include thinning, mowing, and weeding. Maintenance also requires efforts to prevent surface runoff from forming channels in the buffer area. This ensures that water remains diffused across the buffer, so that the forest can absorb and filter it effectively.

# Accelerating Progress

THE SUITE OF GOALS outlined in the 2003 Directive presents exceptional challenges to states, federal agencies, and partners of all kinds.

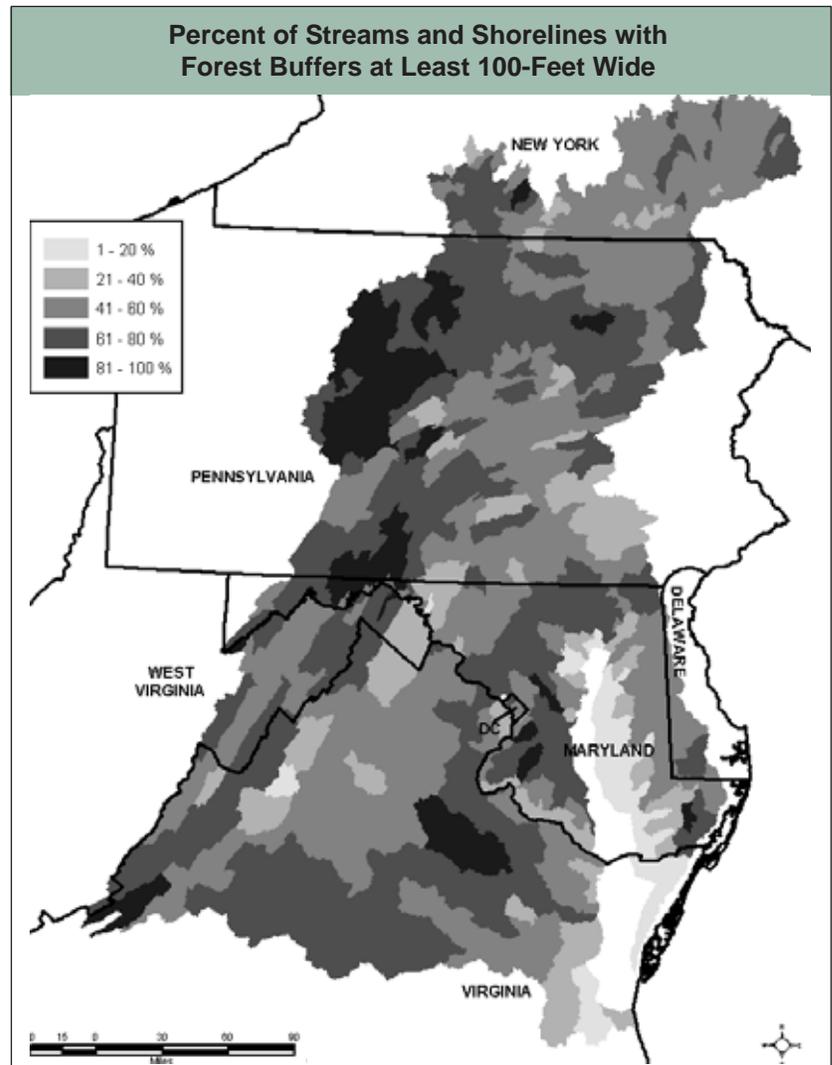
One of the foremost challenges is to sustain the aggressive rate of recent tree plantings. Financial incentives through the Conservation Reserve Enhancement Program (CREP) have been an effective means for driving buffer restoration to date. However, with an estimated \$87 to \$100 million spent through CREP since 1996, increasing the rate of riparian forest buffer restoration will require strong fiscal commitments by state and federal leaders.

The new emphasis on conserving existing forest buffers poses challenges that will require multiple solutions. Many initiatives are already underway, including conservation easements, purchase of development rights, and watershed land use planning. Losses to development, however, continue to subtract from overall progress. Commitments from local governments will be essential in addressing this situation because local ordinances are often the deciding factor in protecting riparian forests during development or requiring mitigation for their removal.

Other actions that will support the advancement of these goals include the following:

- **Helping landowners and communities.** The greatest barrier to voluntary restoration of riparian forest buffers on private lands is the ability to provide effective outreach and technical guidance to farmers and local groups willing to plant and maintain riparian forests. This service is most often provided by state and federal agencies. Having an adequate number of field foresters and biologists available for assisting landowners in buffer restoration is crucial.

- **Optimizing and targeting financial incentive programs.** A wide variety of incentive programs are available, but many of these do not always effectively



The map above shows the percentage of streambanks and shorelines that have riparian forest buffers with a width of 100 feet or more. Much work remains to buffer 70-percent of all riparian areas in the entire Bay watershed.

target riparian forest buffers. While programs that serve agricultural landowners must continue and increase, other new and existing programs must be tailored to areas such as urban/suburban and shoreline settings. Voluntary programs should be designed to favor effective practices like forest buffers and directed to landscapes where they will be most effective.

- **Reducing the cost of plantings.** The cost to ensure the survival of planted forests on agricultural and urban sites can be high. Costs could be reduced, and survival increased, by identifying techniques that support and enhance natural forest regeneration. Additional field studies are needed to experiment with a variety of planting and maintenance strategies.

# A New Focus on Trees in Urban Areas

**M**ORE THAN 100 ACRES OF FOREST are lost each day to urban development, further compromising streams and watersheds under stress. Studies show that a number of cities have lost more than 15 to 30 percent of their urban forest canopy in the last twenty years alone—increasing stormwater treatment costs and ozone pollution, and diminishing the beauty and livability of our cities. The 2003 Directive ensures that trees in urban areas will receive unprecedented attention from Chesapeake Bay Program partners.

In urban settings, riparian forest buffers are often removed or constricted by development, and riparian functions are compromised by stormwater runoff. Even when buffers are established, the intensity and diversion of stormwater runoff make it much harder to achieve the levels of benefits possible in more rural areas.

Nevertheless, trees remain vital to urban ecology. In urban and suburban areas, ample urban forests can improve a stream's water quality and condition while reinforcing buffer functions. Urban trees help reduce stormwater runoff and encourage infiltration—intercepting falling rain, absorbing and storing water, reducing runoff, protecting soil from erosion, filtering pollutants, and improving air quality. In addition, urban forests help make population centers more desirable, supporting smart growth objectives.



Photo: Edward Gilman, University of Florida

Trees in urban areas, such as these in Pennsylvania, beautify a community and provide environmental benefits.

## Promoting Tree Canopy

“Tree canopy” is the area that, when viewed from above, is occupied by the leaves and branches of trees. Tree canopy serves as an indicator of the health and extent of an urban forest and the benefits it provides.

The Chesapeake Bay Program has committed to increasing the amount of tree canopy in urban and suburban areas by working with at least five local communities in each state to set and achieve tree canopy goals for their areas. This new partnership with communities will:

- Assess tree canopy
- Adopt local goals for tree canopy
- Take steps to increase tree canopy coverage



Photo: Roderick Salguero, US Forest Service

### Urban Forests...

- ✓ Protect water quality
- ✓ Reduce air temperature
- ✓ Improve air quality
- ✓ Provide wildlife habitat
- ✓ Reduce noise pollution
- ✓ Beautify the landscape
- ✓ Offer a connection with natural resources

# Looking Forward

**T**HE CHESAPEAKE BAY PROGRAM has mobilized around the riparian forest buffer restoration effort with extraordinary success. The progress to date is heartening, but many challenges remain. Participants in the Chesapeake Bay Program are committed to using their achievements, partnerships, and evolving knowledge as a foundation for continued success. The 2003 *Expanded Riparian Forest Buffer Goals* (Directive No. 03-01) sets forth a number of aggressive goals and policy recommendations. Riparian forests are also featured prominently in the Tributary Strategies outlined for many of the region's rivers. In fact, the Tributary Strategies indicate that still greater restoration efforts may be needed to avoid federal regulatory actions to protect water quality. Together, these documents reinforce the critical role of the riparian forest buffer initiative and call for the continuation and advancement of this important regional effort.

The partnerships that will achieve these goals are many. Along with the leadership of Maryland, Pennsylvania, Virginia, the District of Columbia, and federal agencies, continued contributions from citizens and nonprofit organizations are critical. Many groups—such as schools, environmental organizations, sports fishing organizations, outdoor education centers, civic groups, and others—will help to achieve the expanded goal of 10,000 buffer miles by 2010.

New and broader partnerships will also play an important role, especially those between public and private organizations. In addition, policy changes must



Photo: Heather Richards, Potomac Conservancy

be explored to further protect and restore the region's riparian forests.

Of course, as efforts are directed at creating new riparian forests, the challenge of conserving and maintaining existing ones remains critical as well. Only the combined efforts of both conservation and restoration will achieve the long-term goal of buffering 70 percent of all streams and shorelines within the entire Bay watershed.

Each step towards this goal—whether large or small, or the product of public or private efforts—represents progress. In combination, these efforts will bring the multiple benefits of riparian forests to bear on countless streams, rivers, and ultimately, the Chesapeake Bay.





**For additional information,  
please contact:**

The Chesapeake Bay Program  
410 Severn Avenue, Suite 109  
Annapolis, Maryland 21403

(410) 267-5700  
1-800-YOUR-BAY

[www.chesapeakebay.net](http://www.chesapeakebay.net)



## **Chesapeake Bay Program**

[www.chesapeakebay.net](http://www.chesapeakebay.net)

410 Severn Avenue, Suite 109  
Annapolis, Maryland 21403

(410) 267-5700

1-800-YOUR-BAY