Maryland Stream ReLeaf Implementation Plan 2005-2010

October 2005

Maryland Stream ReLeaf

MARYLAND DEPARTMENT OF NATURAL RESOURCES

MARYLAND DNR FOREST SERVICE

MARYLAND

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2005-2010 Implementation Plan

Executive Summary 4/29/05

Riparian forest buffers (RFBs) are one of the cornerstones of restoration of the Chesapeake Bay watershed. The Chesapeake 2000 Agreement called for an expanded RFB goal, which was adopted in December 2003. This plan lays out strategy for Maryland to contribute to the RFB goals for the overall Chesapeake Bay watershed. The 2003 Riparian Forest Buffer Directive committed to (paraphrased):

1) Conserve and restore forests along at least 70% of streams and shorelines, with a near-term goal of 10,000 miles by 2010;
2) By 2010, work with 5 jurisdictions/state to assess and increase urban forest canopy, enhancing and extending buffer functions in a developed environment;
3) Encourage increased urban/suburban tree canopy by adopting tree canopy goals;
4) Maintain and monitor buffers to ensure a well-stocked stand of trees by 5 years;
5) Restore and conserve riparian forest buffers on public lands and in programs that protect private lands from development
6) Advance conservation of existing riparian forest;
7) Revise the states' Riparian Forest Buffer Implementation Plans.

This plan also identifies core functions and priorities for continued implementation of Stream ReLeaf in Maryland that would allow it to meet its commitments towards the Riparian Forest Buffer Initiative and the Chesapeake Bay Agreement.

Maryland restored 832 miles between 1996 and 2002, greatly exceeding the previous goal of 600 miles in the state. Of the 10,000 miles in the new RFB goal, Maryland expects to provide 2,032 miles, which is an additional 1,200 miles between 2003 and 2010. Maryland's Tributary Strategies to meet nutrient caps call for 20,168 acres of forest buffers from 2003 to 2010, which would be 1,664 miles of 100-foot buffers.

Priorities for implementation are:

1. *Tracking* progress in forest buffer restoration and conservation.
2. *Funding* restoration, maintenance, and long-term conservation.
3. *Training and education* on buffer establishment, maintenance, and management.

The tracking system for restoration will be improved, and a new tracking system for conservation, including an estimate of loss, will be created in coordination with existing GIS systems. Funding to carry out restoration and conservation will include working with key programs like the existing Conservation Reserve Enhancement Program and the new Conservation Security Program on agricultural lands, and coordinating with local government pollution reduction efforts on nonagricultural lands. Training will be offered on an annual basis to maintain and expand the number of individuals and agencies that can supply appropriate technical assistance for buffer establishment, maintenance, and management. The focus for training is a range of public and private natural resource professionals, local governments, and watershed organization staff.

Acknowledgments

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Introduction

Riparian forest buffers (RFBs) are one of the cornerstones of restoration of the Chesapeake Bay watersheds. Forests are the natural streamside vegetation in most areas of the watershed, and protecting the streamside area is critical to maintaining the basic environmental functions for water quality and habitat. Maryland's 38,870 miles of riparian area are estimated to be 65% forested, where once the majority had natural forest cover. The first Riparian Forest Buffer Initiative for the Chesapeake Bay Program was adopted in 1996, calling for 2010 miles of new RFBs by 2010. Maryland met its 600-mile commitment for that goal in 2001, and the Bay-wide goal was met in 2003, years ahead of the target date. Between 1996 and the end of 2004, Marylanders created 1,153 new miles of RFBs in the Chesapeake Bay watershed of Maryland.

The Chesapeake 2000 Agreement called for an expanded RFB goal, which was adopted in December 2003. This document lays out a strategy for Maryland to contribute to the RFB goals for the overall Chesapeake Bay watershed. The 2003 Riparian Forest Buffer Directive for the Chesapeake Bay committed to:

- Enhance and sustain the integrity of aquatic ecosystems over the long term through conservation and restoration of forests along at least 70% of all streams and shorelines in the watershed, which translates to about 26,000 miles of additional buffers in our jurisdictions, with the near term goal of achieving at least 10,000 miles by 2010.

- By 2010, work with at least 5 local jurisdictions and communities in each state to complete an assessment of urban forests, adopt a local goal to increase urban tree canopy cover, and encourage measures to attain the established goals in order to enhance and extend forest buffer functions.

- Encourage increases in the amount of tree canopy in all urban and suburban areas by promoting the adoption of tree canopy goals as a tool for communities in watershed planning.

- Ensure, through monitoring and maintenance, that newly established buffers have a well-stocked stand of trees after 5 years.

- Enhance and strengthen the restoration and conservation of riparian forest buffers, wherever possible, on public lands and in programs that protect private lands from development.

- Advance our efforts to conserve existing riparian forests along all streambanks and shorelines.

- Revise each Bay signatory's Riparian Buffer Implementation Plan to further capture program and policy opportunities for an enhanced buffer conservation and restoration program.

For the 10,000-mile goal listed above, Maryland is trying to provide 2032 new RFB miles in the Maryland Chesapeake Bay drainage. Marylanders created 1,153 miles between 1996 and 2004, and the state needs an additional 879 miles by 2010 to meet its commitment. Maryland's new Tributary Strategies call for 33,800 ac. of forest buffers to be created on urban (1,375 ac) and agricultural (32,506 ac) land between 1985 and 2010. As of the end of 2004, there were 22,698 acres of forest buffers tracked in the Stream ReLeaf database, leaving 11,102 acres to meet the Tributary Strategy target. This translates to 916 miles of 100-foot buffers, only slightly more than Maryland's contribution to the Bay-wide 10,000-mile goal.

Forest Buffer Benefits and Related Goals

Riparian forest buffers are being encouraged to meet a variety of goals, from basic water quality protection to wildlife habitat, streambank stability, aquatic habitat, water temperature moderation, recreation, biodiversity, and aesthetics. In the Chesapeake Bay region, the natural riparian vegetation in many areas is forest. Forest buffers not only attenuate pollution before it reaches streams, they support a diversity of habitat elements and food base that helps streams maximize capacity to capture nutrients even after they enter the water (Sweeney et al., 2004). Forest buffers take a few years to mature and reach full function, but can significantly reduce nutrients even after only 3-5 years and are a fundamental element to building and sustaining basic stream functions in our watersheds over the long term. Streams reflect characteristics of the entire watershed, but are most sensitive to conditions nearest the water. Forest buffers have been found to be closely linked to stream health as measured by an index of biotic integrity based on bottom-dwelling stream organisms, with good stream health only found where forest buffers exceeded 60% and impervious surfaces in the watershed were less than 10% (Goetz et al., 2003). Forests have high infiltration capacities to absorb runoff, low nutrient releases, and once established have a great ability to sustain themselves with few inputs.

The definition of riparian forest buffer used for the Maryland Stream ReLeaf Implementation Plan is based on the one adopted in 1996 by the Chesapeake Bay Executive Council. "Riparian areas are those lands adjacent to streams, rivers, and other bodies of water and serve as a transition between aquatic and upland environments. A forested riparian buffer helps to:

- Maintain integrity of stream channels and shorelines;
- Reduce the impact of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals;
- Supply food, cover, and thermal protection to fish and other wildlife."

Buffers counted towards the Chesapeake Bay goal are 35 feet or greater in width on average, contain more than one species of trees or shrubs, and emphasize native species. If the stream is buffered on both sides, the sum of the two widths should be 100 feet.

Establishing natural vegetation of lesser widths along waterways is recognized as very beneficial as well, but buffers less than 35 feet in width are less likely to be able to provide the extent and breadth of water quality and habitat functions being attributed to

forest buffer in Chesapeake Bay tracking. The benefits of narrower buffers can be tracked as streambank fencing or bank stabilization, other Best Management Practices that contribute to nutrient reduction goals for the Chesapeake Bay watershed.

This Implementation Plan is intended to coordinate with and support several policy goals.

Chesapeake Bay Tributary Strategies:

Tributary Strategies have been developed in Maryland to meet nutrient caps for nitrogen and phosphorus that achieve water quality goals in the Chesapeake Bay by 2010. The Tributary Strategy in Maryland calls for 33,800 ac. of forest buffers to be created from 1995 to 2010, with 11,102 acres remaining to meet that goal at the end of 2004. If buffers are established at an average of 100-ft widths, this translates to about 916 miles, fairly consistent with the target of 879 miles for Maryland's expected contribution to the RFB goal set for the Chesapeake Bay in December 2003. Current average RFB width exceeds 125 feet but is expected to decline with some funding program changes.

Other Related Chesapeake Bay Program goals:

Stream Corridor Goal-

By 2001, each jurisdiction will develop guidelines to ensure the aquatic health of stream corridors. Guidelines should consider optimal surface and groundwater flow.

By 2004, each jurisdiction, working with local governments, community groups, and watershed organizations, will develop stream corridor restoration goals based on local watershed management planning. In Maryland, it is estimated that 70 miles of stream will undergo stream restoration by 2010 with a long-term goal to maintain or improve the Combined Biotic Index (CBI) in nontidal watersheds.

Fish Passage Goal-

The new Bay-wide goal is 1000 miles and 100 projects by 2010 to restore passage for migratory fish of currently blocked river habitat.

Watershed Planning Goal-

The Chesapeake Bay Agreement commits to 2/3 of watersheds having watershed plans by 2010. The plans should "address protection, conservation, and restoration of stream corridors, riparian forest buffers, and wetlands for the purposes of improving habitat and water quality, with collateral benefits for optimizing stream flow and water supply." In Maryland, plans are being developed by local jurisdictions, supported in some cases by the Watershed Restoration Action Strategy Program. Riparian condition is included in the WRAS GIS characterization and field-based stream corridor assessment, identifying opportunity and need for forest buffer establishment. Supporting the use of riparian forest buffers in the WRAS plans is a simple way to coordinate related Bay commitments and increase effectiveness of each.

Wetland Restoration Goal-

By 2010, achieve a net resource gain by restoring 25,000 acres of tidal and non-tidal wetlands. Maryland's share of this goal is 15,000 acres. Some of the riparian buffer restoration projects also restore wetlands, and thus meet multiple commitments.

No net loss of Wetlands-

Achieve a no-net loss of existing wetlands acreage and function in the signatories' regulatory programs. There is potential for riparian buffer restoration to serve as wetland or waterway mitigation. Permittees requiring mitigation may find partners with landowners interested in doing riparian buffers.

Land Conservation Goal-

Strengthen programs for land acquisition and preservation within each state that are supported by funding and target the most valuable lands for protection. Permanently preserve from development 20% of the land area in the watershed by 2010. Maryland is looking for an additional 53,756 acres beyond what is currently under some form of protection from development. Some of this may be forest buffers.

Total Maximum Daily Load, modeling for Bay/Use Attainability Analysis-

TMDLs are intended to address point and nonpoint-source pollution in waterbodies that do not meet set water quality standards. The Chesapeake Bay mainstem currently does not meet water quality standards for nutrients, sediment, dissolved oxygen, and chlorophyll A, and the Chesapeake Bay Agreement and Tributary Strategies are intended to meet those standards as soon as possible. In 2010, areas of the Chesapeake Bay mainstem that still do not meet standards would have TMDLs developed. TMDL development begins with modeling, partitioning pollutant contributions by source in the watershed, an extensive interstate effort. TMDL regulations to limit contributions could then follow. The Use Attainability Analysis recently developed for the Chesapeake Bay allows economic feasibility to be factored into regulatory choices, but a regulatory approach may not optimize for feasibility and cost-effectiveness. Adopting riparian forest buffers prior to the 2010 deadline is a prudent effort, and allows time for the young forests to get established and increase in functions improving water quality.

Education-

Beginning with the class of 2005, provide a meaningful Bay or stream outdoor experience for every school student in the watershed before graduation from high school. Learning about and establishing forest buffers can be part of the outdoor experiences offered to students, such as through the Maryland TEAM Streams program. Schools have been a valuable volunteer base for tree plantings, particularly at annual Earth and Arbor Day events.

Other Strategies

Maryland Coastal Bays Comprehensive Conservation Management Plan

The Coastal Bays Comprehensive Management Plan was adopted in 1999. It includes recommended actions in four major areas: water quality, fish and wildlife,

recreation and navigation, and community and economic development. Buffers are related to goals for nutrient reduction from various land uses and to some habitat goals. Currently, TMDLs exist for 5 tributaries of the northern coastal bays, Newport & Sinepuxent Bays, and Big Mill Pond which empties into Chincoteague Bay. Riparian buffers will be an effective tool in reducing non-point source pollution to attain water quality standards and designated uses.

Restoration

The 2003 Riparian Forest Buffer Goal has two goals related to restoration. One is a short-term goal to create 10,000 miles of RFBs in the Chesapeake Bay watershed by 2010. Another is to expand RFBs to 70% of the stream and shoreline miles in the Bay watershed as the long-term goal needed to support robust stream system function and resiliency. Tributary Strategies also set out targets for RFB restoration as one of the suite of Best Management Practices expected to be used to meet Maryland's nutrient cap for the Chesapeake Bay. The extents of the goals are compared below (Figure 1), followed by brief descriptions.

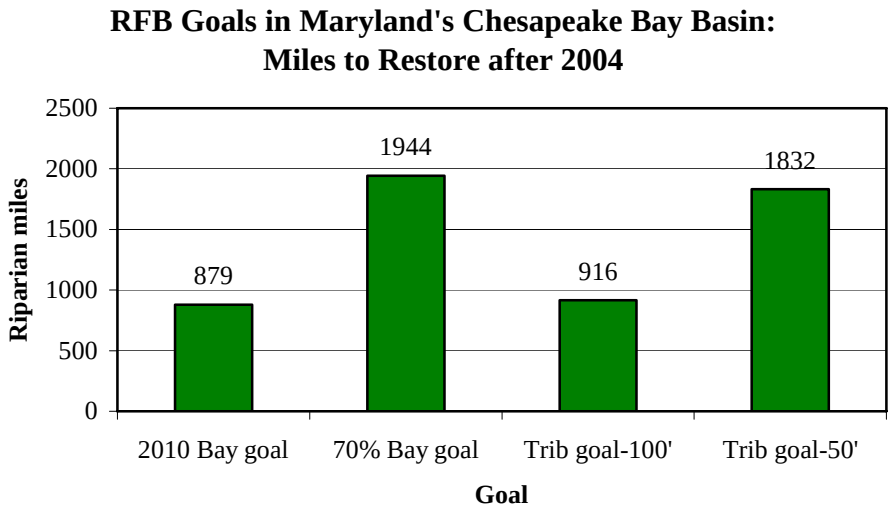

Figure 1: Riparian Forest Buffer Restoration Goals from the Chesapeake Bay Riparian Forest Buffer Initiative and Maryland Tributary Strategies.

For the 10,000-mile Chesapeake Bay RFB goal, Maryland's expected contribution is 2032 miles between 1996 and 2010. By the end of 2004, Marylanders have already established 1153 miles, and have 879 miles remaining to be created by 2010. The goal requires a minimum 35-foot width, or for streams buffered on both sides, a total of 100 feet combining both sides of the buffer. Widths on already restored buffers have averaged over 100 feet on one side.

For the long-term goal of 70% forest buffers, approximately 65% of the 38,870 riparian miles (two sides of the stream) in the Chesapeake Basin in the state are estimated to have riparian forest buffers. To meet the long-term goal, at least 1,944 miles will need to be restored in the future. Recent Penn State data estimate that 49% of Maryland streams already have forest buffers on two sides.

The Maryland Tributary Strategy sets a goal of 33,800 ac. of forest buffers to be created from 1995 to 2010. Through 2004, 22,698 acres had been established and recorded in the Stream ReLeaf database, leaving 11,102 acres still remaining. If buffers are established at 100-foot widths, this would cover about 916 riparian miles. If buffers are 50 feet wide, riparian mileage covered doubles. An estimated 13,605 miles of streams and shorelines

currently lack RFBs. Some of these miles may have other best management practices such as grass buffers or be developed to the extent that new RFBs are infeasible.

Over 90% of the buffers created in Maryland have been through the Conservation Reserve Enhancement Program (CREP), first established at the end of 1997. The CREP program reached its 5-year time limit, and a new state contract has been developed to support a CREP program through 2007, although sign-up is not expected to be open until 2005.

The Maryland CREP program has 28,791.5 acres remaining in its 100,000-acre allotment for practices ranging from forest buffers to grass buffers, wetlands, and erodible soils. Since 1998, riparian forest buffers have averaged about 25% of CREP sign-ups. The new CREP program continues to offer slightly higher payments for trees than grass, but has restricted eligibility of tree practices on the Eastern Shore (no trees on ditches) and widened eligibility of grass practices on pastureland. These changes suggest that a more modest percentage of CREP acres are likely to be RFBs. If 20% of the remaining acreage is enrolled in CP-22, the riparian forest buffer practice, then CREP would be likely to support between 475 and 950 miles (100-ft and 50-ft buffers, respectively) (Figure 2). If dramatically fewer signups are in the forest buffer practice, the contribution of CREP would be even less, far short of previous contributions and likely short of goals desired for nutrient reduction in the Chesapeake Bay.

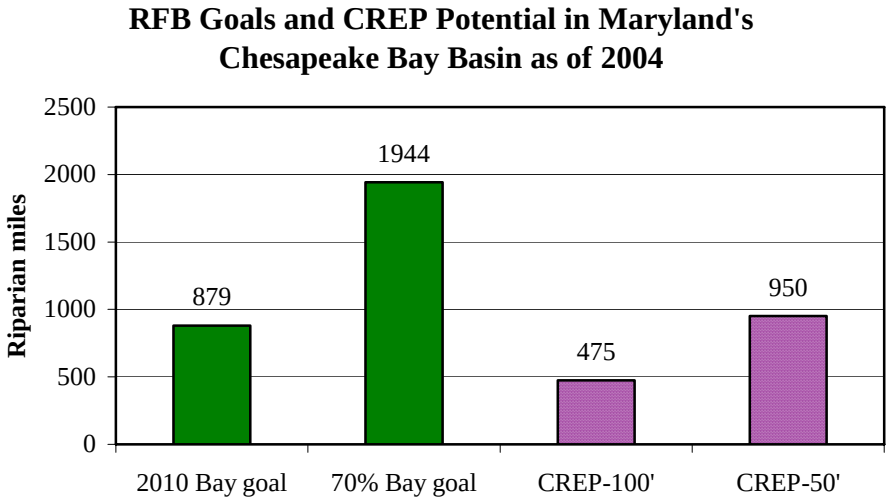

Figure 2: Comparison of Riparian Forest Buffer goals and Potential for CREP Incentive Program to establish forest buffers at two average widths

To reach the scale of participation anticipated by these goals, further incentives for private landowners will be needed. Maryland's Tributary Strategies envision most of the RFB establishment on agricultural land, but 1375 acres in developed areas also are sought. Additional incentives or programs should include non-agricultural land.

Costs

Riparian forest buffers are one of the least expensive Best Management Practices (BMPs), especially compared to structural BMPs. Cost estimates have been developed at the state and regional levels, and are in documents such as the UAA, Cost estimates for C2K, Technical Support Document for the 2003 Riparian Forest Buffer Goal, and RFB Attainment Strategy. Costs fall into four major categories:

- *Incentives for land conversion*- payments to offset loss of income when converted to conservation purposes;
- *Establishment costs*- landowner expenses for establishing the RFB (seedlings, labor, tree protection devices and treatments), often partially reimbursed through cost-share payments;
- *Maintenance costs*- landowner expenses for maintaining RFBs, generally concentrated in the first 3 to 5 years; and
- *Technical/Administrative Assistance costs*- agency costs for assisting landowners with designing and installing practices and administering sign-ups and payments.

CREP has been the most popular program for planting forest buffers because of the generous incentive payments and substantial cost-share for establishment costs (50% federal cost-share, plus 37.5% state cost-share for a total 87.5%). CREP also has $7/acre/year maintenance payments, an amount that does not cover normal maintenance costs for the first 3-5 years, but continues for each year of the 10-15-year contract. The Maryland CREP Program has been renewed through 2007 with new eligibility and rules; signups are expected to begin in March 2005. Average program payments are summarized below (Table 1)

Table 1. Maryland Conservation Reserve Enhancement Program payments, 2004

Payment type	***Cost to landowner***	***CREP Payment***	***Payments/acre, 15 years***
Land rent (rental rate plus bonus)	$75 average foregone annual income $1125 over 15 yrs	Soil rental rate (range $40-102/ac.), $200/ac for 1st 50 ft, $50/ac for 50-100 ft.	$175/yr for 15 yrs $2625 paid to landowner
Signup Incentive Payment		$10/ac/year of contract	$150 paid to landowner
Practice Incentive Payment		40% of eligible installation costs	$400 paid to landowner after establishment
Establishment cost	$1,000/acre cost $125/acre not reimbursed	50% federal cost-share 37.5% state cost-share	$875 reimbursed to landowner after establishment
Maintenance cost	$130/ac first 2 yrs +$60/acre years 3 to 5 = $440	$7/acre/year If fenced, $10/ac/yr	$105 paid to landowner
Total	$1690		$4155

Assumptions: 15-year contract, $75/ac average soil rental rate, 100-ft wide buffers, $1,000/acre establishment cost for hardwood buffer

Costs of technical and administrative assistance are estimated at $800-1200/acre, counting the federal, state, and local agencies involved in various steps of administering the program. These costs are built into existing agency budgets, as few of the agencies involved have received any additional staff to support the major increase in buffer planting. State agencies expect to continue to have limited ability to hire new personnel, so future costs may need to include payments to private technical service providers since rates needed to meet the buffer goals exceed the current rate of implementation.

Total costs to meet the Maryland Tributary Strategies goal have been estimated based on CREP costs at $45.7 million ($4,115/acre for 11,102 acres). For the estimated 10,654 acres remaining for Maryland's portion of the 10,000-mile goal, costs at these rates would reach almost $44 million. The on-the-ground restoration costs are less than a quarter of the costs, with the bulk of the expense being landowner incentives. Although costs could be lower if incentives are lower, recent experience with lower rates has found the progress to be lowered even more than the costs.

Technical assistance

Technical assistance is critical for effectively establishing plantings that will mature into fully functional RFBs. Assistance ranges from planting design, matching landowner goals and planting specifications to site conditions, to planting coordination, assisting with seedling ordering and planting, to maintenance recommendations based on likely problems on the site.

In Maryland, the DNR Forest Service foresters typically have provided the technical assistance, a role that is expected to continue within the constraints of staffing. Several years of a state hiring freeze, retirements, vacancies, and layoffs have reduced staff about 30%. RFBs remain a priority for state staff, but opportunities for staff expansion are expected to be limited in the near future. Expansion could occur through programs like the Technical Service Providers used for NRCS programs or licensed professionals for the Forest Conservation Act. A well-developed and consistently offered training program is needed to maintain a technical assistance base of this nature.

Many people are now involved in reforesting buffers; some are foresters with experience in planting buffers but many others need assistance to plan a successful and effective planting. Technical assistance has been offered one-on-one to individual landowners and volunteer groups, and as specific technical training workshops, field tours, and written materials. However, many other partners still need more assistance in learning techniques for restoring forests and buffers, and the need currently exceeds availability. Training should be provided to expand technical knowledge to several categories of active partners (train the trainer).

- Watershed groups: training on easements, tree planting, education/outreach to reach early adopters
- Local jurisdictions: regional training on tree planting and maintenance/ FCA standards for planners, inspectors
- SHA staff
- Fisheries staff

- Land Trusts
- Technical Service Providers for CRP/CREP

Coordination with related efforts should occur, such as the USDA Interagency Training Committee at MDE. The possibility of combined training will be discussed during winter 2005.

Training materials should be developed in modules that can be tailored to fit needs of different groups. Some suggested categories are:

- Why: stream ecology, trees preventing erosion, combining with Warm Season Grasses for habitat
- Where: watershed planning, protection mechanisms for ag and urban/suburban
- How: design and maintenance of buffers in different land uses, template for local guidelines or rules for establishing and conserving forest buffers, information/technical specifications on including buffers and retained forest in stormwater requirements and/or Low Impact Development

Templates that identify policy changes to increase use of RFBs is of particular interest in WRAS watersheds, where jurisdictions are looking for policy changes as part of the development of their watershed plans. Where TMDL plans have been or will be developed, forest buffers and forest conservation should be considered as tools in responses to meet plan requirements.

Targeting locations for effectiveness

A targeting scenario for RFB restoration developed for this plan uses a combination of 1) site-specific criteria like proximity to water and steep slopes with 2) watershed- or landscape-scale criteria like the SPARROW model nutrient loadings predicted by watershed and 3) programmatic criteria like protecting drinking water intakes and minimizing impact on prime agricultural soils. It emphasizes buffer restoration in watersheds with high nutrient loading, erodible soils, and land cover suitable for establishing buffers.

The model criteria are listed in the Appendix. The results, averaged by watershed, are illustrated in the figure below. The methodology emphasizes watersheds with low forest cover and low percent streams buffered and high non-point source nutrient loadings. Some habitat information like naturally reproducing trout streams could be added, but they are limited in distribution statewide, and would likely occur in the same watersheds listed as high priority in the Frederick/Carroll/Allegany county area. The Nature Conservancy has identified streams that are significant for identified habitat matrix areas, but only for the Coastal Plain Province. These could be used to place additional prioritization on the Eastern Shore as an overlay.

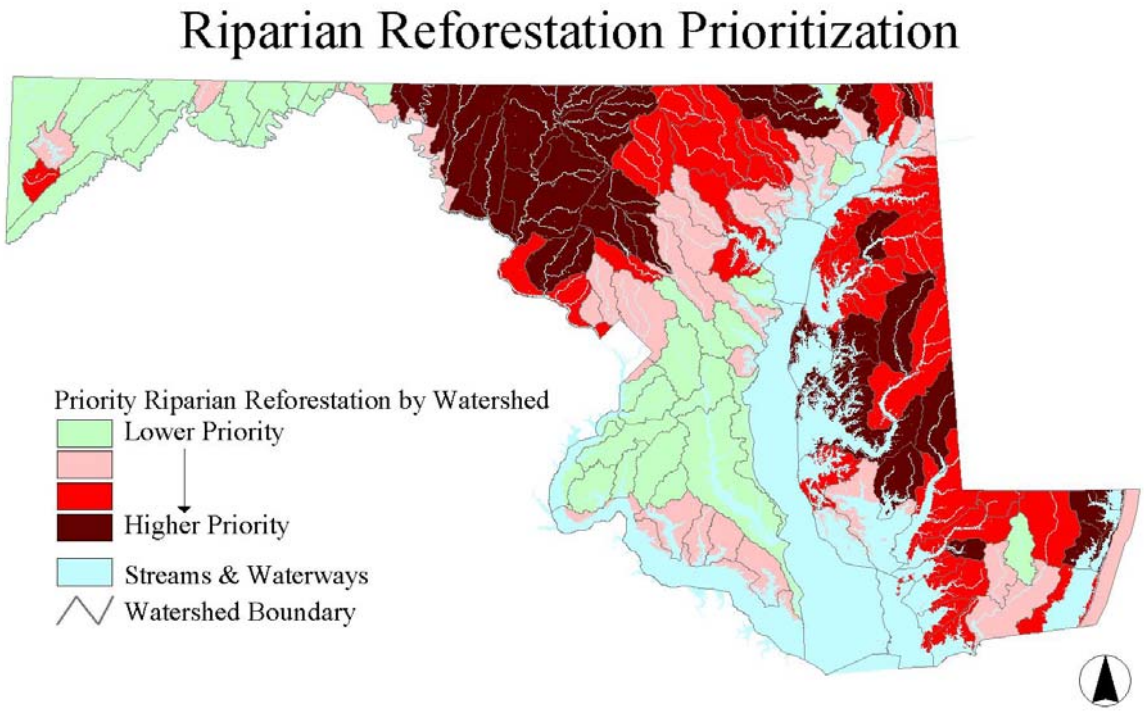

Figure 3: Maryland watersheds targeted for riparian reforestation potential

Nutrient reduction

Additional local targeting for buffers should be coordinated with targeting for other related efforts for nutrient reduction:

- WRAS plans and other watershed plans- with counties, watershed groups, or municipal governments: develop guide to local projects or rules to enhance RFB creation and conservation, identify contributions to municipal stormwater management MS4 permits, prioritize stream restoration
- Priority wetlands targeting plan- with MD Department of Environment for identifying opportunities and focusing wetland restoration statewide (methodology documented in Coastal Bays wetland targeting).
- Governors Land Conservation Plan- Use targeting map for ecological improvement through land conservation in areas such as gaps in the Green Infrastructure.
- Headwaters areas- Small streams are greatly influenced by adjacent vegetation, and protecting headwaters/small streams with forest cover maximizes contribution of trees.
- TMDLs for nonpoint source nutrient issues- Many of Maryland streams are listed on the 303d list for not meeting some type of water quality criteria. RFBs are typically one of the best practices suited to control biological impairment, nutrient, or sediment issues from nonpoint source pollution.

Data on areas with greatest opportunity for nutrient reduction through riparian forest buffers should be presented to key stakeholders such as Soil Conservation Districts.

Presentation at the summer or winter meeting of the Maryland Association of Soil Conservation Districts is recommended.

Aquatic habitat

Potential local targeting of RFBs for aquatic habitat includes fish passage projects, cold-water reproductive trout habitat, shoreline stabilization and living shoreline projects.

The Chesapeake Bay Fish Passage goal aims to increase accessible stream miles by 1000 miles through 100 projects by 2010. Riparian forest buffers could be targeted to appropriate locations in these miles newly accessible to anadromous fish. Fish passage projects anticipated in the next few years are located in:

- Octararo watershed (Cecil Co.)
- Raven Rock (near Hagerstown, Washington Co.)
- PPG Dam on North Branch of the Potomac (near Cumberland, Allegany Co.)
- Scotchman's Creek in the Bohemia watershed (Kent Co.)
- Chester River (Queen Anne's/Kent Co.)

Areas where streams with acid mine drainage have been remediated could also be targeted to support long-term fish habitat, if they lack forest buffers.

Shoreline stabilization projects are undertaken in areas with erosion, and RFBs can reinforce improvements with long-term stability. Living shoreline projects, which emphasize vegetative solutions to erosion control, may be particularly appropriate. RFB design should assure that grasses and SAV used for shoreline stabilization have adequate exposure to sunlight.

The Nature Conservancy has identified selected streams that affect habitat in high priority conservation areas in the Chesapeake Lowlands ecoregion, covering the Eastern Shore and Southern Maryland. These stream systems would be important to restore buffers of natural vegetation where lacking, in order to minimize effects of upstream disturbances on key habitat areas.

Planting stock

Availability- Maintaining consistent demand for seedlings is important to maintain availability of the diversity of riparian species desired. Nurseries, both public and private, generally can and do respond within 1-2 years (depending on how long species take to propagate) to increased demand. The Ayton State Nursery currently offers 45 species of primarily native tree and shrub seedlings (11 conifers, 34 hardwood). Numerous local sources of containerized stock are also available. Local availability of riparian species increased in response to the 10-fold increase in planting for RFBs between 1996 and 2000, but species selection often was limited. Current projections of the pace of RFBs do not call for such a rapid increase in rate, but since all nurseries (including the state) need to support operations with sales, great variations from year to year in demand are more likely to result in fluctuations in plant availability. Program design for incentives or cost-share for RFBs should encourage consistent demand.

Distribution- Proper transport and storage of planting stock during the relatively short window of the preferred planting season remains an issue. Seedling cooler storage has been expanded, but is still limited in some regions of the state. Keeping planting stock, particularly seedlings, cool and moist during storage and transport directly affects survival after planting. Investment in appropriate storage facilities throughout the regions should be made where insufficient.

Utilization of nursery overstock- Overstock of unsold nursery plants may be a means to allow projects that otherwise would not proceed, particularly volunteer projects without funding, where the time frame for implementation can wait for a year when overstock is available. Generally, it is not a reliable source of seedling availability or species choices, and should not be used if funding is available to purchase plants. Procedures can be set up to avoid waste of unsold seedlings, but should not jeopardize nursery profitability and ability to stay in business, which would be a long-term detriment to native seedling supply. If donations are made to a nonprofit, tax benefits may ease financial strain of unsold stock.

Survival and Maintenance

Augment assistance and funding for maintenance: Maintenance continues to be the largest factor affecting RFB planting success. Weed control in the first three years, as well as use of seedling protection like tree shelters significantly increases survival of planted seedlings. Maintenance issues should be included in the training materials mentioned above, with particular reference to noxious and invasive species. CREP currently limits cost-shared herbicide treatments to 2 occurrences, which may not be sufficient to control a particularly problematic weed like Canada thistle, or weeds that emerge as a result of thistle control. Expanding, even slightly, the herbicide treatments available for cost-share is likely to increase weed control during the critical first 3 years of a RFB planting, resulting in more successful and rapid forest stand establishment and earlier crown closure.

Materials for training and ongoing reference for RFB maintenance are needed. There are volumes of information on particular invasive species or tree protection products available, but a summary of findings and sources would be useful. A guide to design and maintenance has been developed by MD DNR Forest Service, and is available on-line. http://www.dnr.state.md.us/forests/download/rfb_design&maintenance.pdf Additional fact sheets to serve as reminders of typical maintenance needs and schedules could also be useful.

Limit use and occurrence of nonnative species: The RFB Initiative calls for a minimum of two species in RFBs, with an emphasis on native species. While most plantings have consisted of only native species, some plantings have included nonnative species valued for their ability to provide wildlife food prolifically, such as bicolor lespedeza and sawtooth oak. These species are on some but not all invasive species lists, and are recommended for use only in moderation. In years like 2004 where the native oak acorn crop has been very low for almost every species, wildlife may benefit from the prolific seed crop of the sawtooth, which bears acorns at less than half the age of native oaks. However, problems with potentially invasive species are seldom easy to control by the

time their impact on native plant and animal communities is fully realized, and the use of species native to the region is encouraged. For example, Callery pear, particularly the Bradford pear cultivar, has been extensively used in landscape plantings, including buffers in developed areas, and also has invasive characteristics, without the wildlife benefits of some of the other nonnative species used.

Of even greater concern is the need to limit noxious and invasive species in new buffers. Maintenance is critical for keeping spread of invasive weeds in check as well as allowing rapid development of forest cover. Control of noxious weeds is required by state law. Canada, bull, and plumeless thistles and Johnsongrass are the most commonly encountered noxious weeds on buffer plantings. Maryland Invasive Species Council is a point of coordination on invasive species. The MD Department of Agriculture Weed Control specialists also are valuable sources of technical assistance for weed control in new plantations. The Chesapeake Bay Program is developing management plans for two particularly problematic invasive plants, phragmites (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*).

Develop maintenance teams: Maintaining hardwood plantings for several years after establishment is challenging to keep up with, whether it is a private landowner, public agency, or volunteer group on public or community property. Knowledge of when to act, what becomes problematic over time, and how to control major problems is not universal. The development of teams who could assist with or carry out maintenance in the critical first years would be useful for many projects. A training program and coordination of need for services with availability of teams would be needed. Services can already be contracted, but smaller plantings may be less attractive to traditional service providers. Examples of volunteer assistance with maintenance or restoration are the Weed Warriors with MD National Capital Park and Planning and Restore Corps with the Alliance for the Chesapeake Bay. Other organizations that could develop such a resource include watershed organizations, homeowners associations, scouts, school environmental clubs, or River Keeper networks.

Use protection mechanisms effectively: Many areas of Maryland have fairly high deer populations and numerous invasive weed seed sources. Tree protection mechanisms to help seedlings survive under these conditions include translucent tree shelters, mesh tree shelters, weed mats, tree collars, repellents for deer or voles/mice. Generally, costs for protection exceed cost of the trees, but often are a good investment alternative to repeated planting failures. Translucent tubes are the most widely used; they limit deer browse, and also allow directed spray if herbicide control of noxious or invasive species is needed. Training materials should include information on effective use of the various tree protection options.

Urban canopy

In urban areas, stream hydrology is extensively modified by impervious surfaces and stormwater drainage systems. While RFBs are still important in urban stream corridors, expansion of urban canopy to mitigate stormwater runoff is needed to augment buffer function beyond the riparian corridor. The Tributary Strategy goal calls for 1,375 acres of

urban forest buffers, as well as 10,390 acres of tree planting in the "urban pervious" category.

In 2004, the Chesapeake Bay Program Scientific and Technical Advisory Committee held a regional workshop on urban forest canopy to share information and develop consensus of the tree canopy assessment and increase called for in the 2003 RFB goal for the Chesapeake Bay. Advances in remote sensing technology and ongoing research on air and water quality benefits of tree canopy in urban areas are building impetus and ability to track and expand the use of urban trees. Guidelines have been developed regionally for meeting the urban tree canopy goals of assessing and adopting and tree canopy targets in at least five jurisdictions or communities in each state.

Urban tree canopy definition: trees growing individually, in small groups, or under forest conditions on public and private lands in our cities, towns, and their suburbs. Tree canopy is the layer of tree leaves, branches, and stems that cover the ground when viewed from above.

Community definition: Cities, counties, towns, or boroughs that are incorporated and thus support an elected governing body; entities that do not meet the above definition but maintain a recognized board or leadership (elected or designated) and have direct responsibility of influence associated with a clearly defined geographic area (e.g., unincorporated towns, school districts, military facilities, homeowners associations, conservation groups, land trusts).

Canopy analysis and goal setting in local jurisdictions

Responsibility for selecting communities resides with the state forestry agency, in Maryland's case, DNR Forest Service, and may occur in consultation with the urban and community forestry council, a subcommittee of the District Forestry Board Association. Communities can volunteer to be selected for assistance with canopy assessment and goal setting. Technical assistance will be provided by the Maryland DNR urban forestry program, which has led the development of tree canopy assessment technology using 1 m resolution remote sensing imagery. One of the more difficult steps is differentiating between grass and trees. Minimum standards for tree canopy assessment are:

- Use existing national imagery sources for acquiring percent canopy cover data (e.g., IKONOS) that has been completed within three years of goal setting;
- Assess imagery at 1-meter resolution;
- Clearly define geographic boundaries for the assessment;
- Over the specified geographic area, included in the assessment:
    - Percent land cover types
    - Percent of land with tree canopy
    - Opportunities/priorities for canopy enhancement
    - Percent imperviousness
- State Forestry agency leads assessment development and works in cooperation with the community;
- Assessment is repeated at 5 to 10-year interval.

The standards for communities setting an urban tree canopy goal are to:

- Adopt a local goal to increase urban tree canopy;
- Outline a 10-year timeframe for attainment of the goal;
- Goal-setting and endorsement of implementation must be done by locally elected officials, local governing body for unincorporated jurisdictions, non-profit organizations, or other entitites.

The strategy can include sub-goals for specific areas like public streets, public lands, institutional/commercial/industrial areas, parking lots, or buffers.

Annual reporting to the Chesapeake Bay Program Executive Council will include:

- Participating communities that have approved willingness to assess and set canopy increase goals through their elected officials or governing body;
- Completed assessments and findings;
- Percent canopy goals established and approved; and
- Evaluation of each community's progress towards completion of an assessment, goal setting, plan development, and implementation.

The actual capacity of urban tree canopy to provide air and water quality benefits depends on more than just area covered. Species, height, canopy size, crown structure, soil, and plant understory all affect ability to function. Additional models that can help inform function and extent will be used as available to aid local decision-makers. Models include a Leafout Analysis for looking at likely tree canopy remaining after development allowed by zoning, or UFORE (Urban Forest Effects) for assessing air and water quantity/quality functions. GPS-linked videography may be an additional technology useful for capturing the structure and size of urban forests that affect function, particularly as it relates to UFORE model inputs.

A mix of planting stock is envisioned, from large ball-and-burlap trees, containerized saplings, and seedlings where appropriate. Local plans and requirements will affect planting stock types needed. Generally, commercial nurseries can provide a wide range of large trees, although some native species are not as widely available. Maintenance is an important issue in urban environments, including protecting trees from overzealous application of weedeaters and lawnmowers.

Maryland has already done several assessments, and is working with several jurisdictions on urban tree canopy assessment and goal-setting. Locations where assessments are completed are Baltimore City, Frederick, and Hagerstown. Annapolis and LaPlata are underway, and Salisbury is in the initial stages.

Restoration Actions identified:

- Share targeting strategy with Maryland Association of Soil Conservation Districts and the Chesapeake Bay Program Fish Passage Working Group, Nontidal Habitat Work Group, and Watershed Assistance Work Group, possibly targeting at a more local scale and with habitat overlays.

- Expand availability of expertise in establishing and maintaining forest buffers by offering regular training on buffer function, establishment, and maintenance, including invasive species, for professionals and volunteer organizations, establishing self-training materials and regular workshops. This would include supporting training for third-party technical assistance providers for Farm Bill programs and developing partnerships to support technical assistance services.

- For planting stock, identify appropriate mechanisms and circumstances (tax benefits for donation to non-profit, etc.) for use of nursery overstock, continue volunteer seed collection through Growing Native.

- Support urban tree canopy goal-setting and increases.

- Create templates for effective buffer conservation/restoration (could be used to support program changes in WRAS watersheds or other watershed-based management plans- look at Tacoma Park, Rockville ordinances).

- Pursue carbon sequestration projects that include riparian forest buffers as a long-term forest use.

- Implement forest buffer on one side of ditches to maximize ecological function while allowing continued ditch maintenance and drainage function.

- For Rural Legacy agreements, add establishment and management of forest buffers where not already present.

Conservation

Maryland has an array of conservation programs, regulatory and voluntary, that provide a substantial basis for conservation of the buffer areas within the state. Protected lands of various types are mapped, and updated and improved periodically (Figure 4).

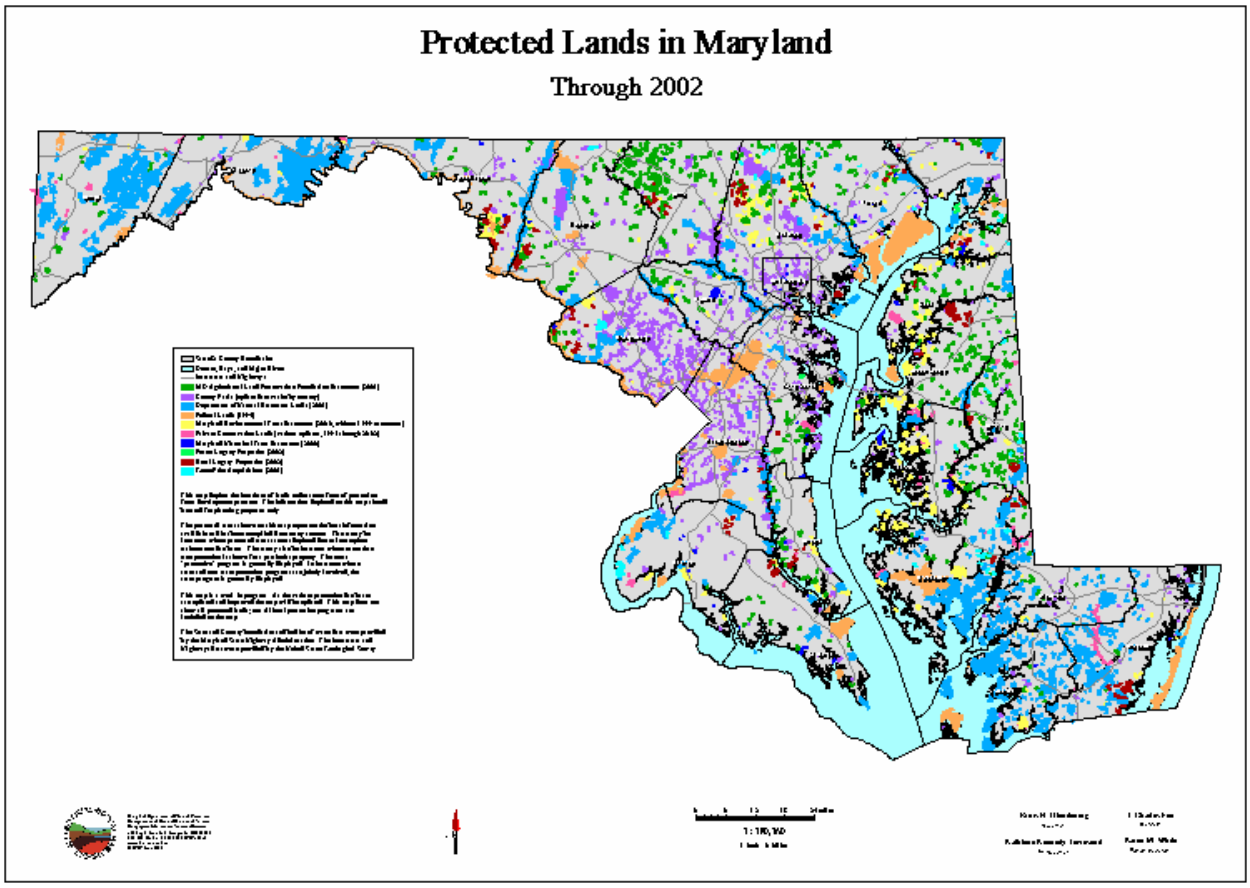

Figure 4: Protected Lands in Maryland, where development is not likely to occur

Retaining Forest Cover

Conserved riparian forest buffers are those that offer long-term protection (minimum of 10 years) of the forest land cover through a legally traceable instrument. Buffer functions cannot be permanently impaired (e.g., under impervious surface) and should be able to be maintained (e.g., removal of invasive species that could interfere with water quality or habitat functions, management to minimize spread of damaging pests or diseases, careful harvesting to maintain active nutrient uptake while protecting bank stability and aquatic habitat inputs). Consistent with restoration tracking, minimum forest cover width for tracking buffer conservation is 35 feet and maximum 300 feet. Forest cover can use the Forest Conservation Act definition of a biological community dominated by trees and shrubs with a minimum of 100 trees/acre, with 50% being 2 inches or greater in diameter.

Long-term protection for riparian forest conservation will be tracked in three categories:

Easements- perpetual or term easements (long-term agreements for a fixed time)/ deed restrictions that would retain existing forest buffers (distinguishing between term and perpetual easements)

Management agreements- public or private lands with plans or written/clear ownership goals or policies that can show retention of forest cover by streams, programs that require commitment to maintaining forest cover (can include FCMAs, CREP, CRP, WRP etc., at least for length of contract).

Regulatory- forest cover for a minimum of 35 feet required by law or regulation (includes local zoning, subdivision, or grading ordinances that implement Forest Conservation Act, Chesapeake Bay Critical Area law requirements). Local plans that advise land use patterns but could not be used to enforce retention of forest cover would not be considered conservation through regulatory mechanisms.

Programs that could affect RFB conservation include Forest Conservation Act, Chesapeake Bay Critical Area Law, Nontidal Wetlands Law, Maryland Environmental Trust easements, Forest Conservation and Management Agreements, agricultural preservation, reservoir management plans, and local zoning. Tracking would need to coordinate gains from all these programs. The data and formats available and the responsible agencies and contacts should be cataloged to coordinate tracking.

Identify loss

Forest buffer loss has been challenging to capture in detail. Overall conservation requires information on loss as well as establishment, so better data on RFBs lost will be pursued. Large-scale estimates are being developed periodically, but suffer from difficulties in changes in data sets and land cover analysis procedures. Consequently, greater effort needs to be placed on developing more site-specific methods of quantifying loss of RFBs. Information sources for fine-scale loss, similar to restoration tracking, include:

- Variances granted by local governments (combination of paper and digital)
- Waterway permits for authorized stream impacts (MDE database) This will not identify the extent of forest cleared. We would have information on alterations to the channel and coarse information on alterations to the floodplain.
- Forest Conservation Act reporting (DNR database)
- WRAS Stream Corridor Assessment info on 500 miles/year
- Clearing for stormwater facilities

Recent research on forest buffer conservation was conducted at George Mason University, looking at five subwatersheds of Frederick County, MD. Average buffer loss was 0.3 % between 1994 and 2004. The location in Pennsylvania saw increases in forest buffers due to aggressive restoration in the areas sampled, and the location in Virginia saw a 3% decrease in forest buffer area. Neither Virginia nor Pennsylvania have ordinances like the Forest Conservation Act to limit buffer clearing during development.

Increasing extent of conserved forest

Maryland has several programs that require retention of forest cover near streams, particularly the Critical Area Law (has 100-ft buffers for waters within 1000 ft of tidal waters, generally) and the Forest Conservation Act (streams are priority retention and planting areas, 50-ft minimum buffer, generally). Some changes to programs could strengthen buffer conservation even more. For example, sites with less than 15% forest cover must afforest to this minimum; requirements could include that the afforestation be along buffers if present. Currently, Rural Legacy easements require a vegetated buffer that is forest or will become forest through succession. Other MD Environmental Trust easements require natural vegetated buffers.

Tax incentives could also be used to greater effect to promote buffer conservation. Forest buffers under easement could be used to qualify landowners for low or no assessment on property taxes. Contracts similar to Forest Conservation Management Agreements could be designed to offer tax benefits to participating landowners with a conserved forest buffer on smaller acreages than allowed by FCMA rules. Conservation tax districts could be set up, similar to those proposed in the Monocacy Watershed Restoration Action Strategy.

The Conservation Security Program has begun in Maryland, with program availability rotating by federal watershed, anticipated on an 8-year cycle. The state's first watersheds that will be eligible for CSP are the Monocacy and the Chester/Sassafras. The program will offer payments in proportion to the extent of conservation practices on the farm. Level I payments are based on a field-by-field basis. The higher Level II or Level III payments are based on farm-wide practices and are the levels likely to require buffers on waterways wherever they occur on the farm. Details on practices and payments are still being developed, but could offer incentive for conserving and establishing stream buffers. Buffer establishment would be supported by cost-share programs such as EQIP or CREP, but the CSP may increase the incentive to participate. The 2007 Farm Bill may reauthorize or expand this program, so attention should be paid to assuring the basic conservation needs such as forest buffers are given appropriate incentives.

Increasing effectiveness of conserved forest

Encourage the use of community open space for meeting FCA requirements, since that creates forest areas more viable for ecological functions and is more amenable to forest management to maintain desired forest conditions and functions than areas on many separate private lots. Management plans should emphasize the need to manage to achieve desired objectives. To maintain functions even as basic as water quality protection and wildlife habitat, active management is usually needed in today's context of fragmented forests, invasive weeds, and growing deer populations. Mechanisms to support forest conservation and effective management include the Maryland Sustainable Forestry Executive Order and a new regional program being developed in conjunction with the Chesapeake Bay Program, Forestry for the Bay. Forestry for the Bay is expected to focus on landowners with small acreages, lands that may be vulnerable to further forest loss through development.

Targeting priority areas

Targeting conserved forest buffers can use many of the same rationales and sources as restored forest buffers. Targeting should identify areas where multiple ecological benefits will be supported. For conservation, suggestions include:

- Governor's Land Conservation Plan (www.dnr.state.md.us/download/mdlandconprog), identifies goal of 7680 acres/year to reach 53,756 acres by 2010 to meet the C2K goal for land conservation, and the Strategic Forest Land Assessment of Forest Lands Ecological Importance ranking included in the plan could be used to identify appropriate areas to target;
- Maryland's Coastal and Estuarine Land Conservation Plan (in progress and being prepared by MD DNR). Assessment framework provides a robust approach to prioritizing lands, particularly for habitat functions. Combines Green Infrastructure status with rare species habitat areas. Could be used to target areas were wider buffers would be particularly beneficial. NOAA approval anticipated by 6/30/2005.
- The Nature Conservancy's Ecoregional Plan priority areas with significant streams identified for the Chesapeake Bay Lowlands (Southern Maryland and Eastern Shore);
- Priority Areas for Wetland Restoration and Preservation (in progress and being prepared by MDE). Completion date is 6/30/2005.
- Reproducing trout streams- high quality watersheds, not regulatory information.

Conservation Actions identified

- Develop tracking system from array of programs that offer some level of forest buffer conservation and some mechanism to identify rate of loss;

- Develop targeting system to identify areas with greatest priority for easements, coordinating with related prioritizations for resource protection;

- Coordinate buffer conservation with sustainable forestry initiatives to maintain forest condition and extent in the watersheds;

- Work with emerging conservation programs like Conservation Security Program for agricultural land to incorporate effective incentives for retaining and restoring forest buffers;

- Continue to work with Program Open Space programs, when funding is restored, to assure conservation and restoration of forest buffers and appropriate management;

- Develop proposal for easement acquisition in area with high buffer conservation priority and overlap with other resource protection priorities;

- Consider special tax districts for conservation areas like forest buffers.

Incentives

The Restoration section pointed out the need to expand beyond existing incentive programs at the current level of funding. The great majority of land in the state is privately owned, and the anticipated rates of RFB restoration must include significant portions of private land. Below are incentive programs or ideas that are expected to contribute to buffer restoration over the next five years.

Restoration Incentives

Agricultural Land incentives: The most commonly used incentives for buffer restoration are available only on agricultural land. These programs are anticipated to be critical for meeting the goals within the timeframe for voluntary Chesapeake Bay restoration.

Conservation Reserve Enhancement Program (CREP)

- Offers the greatest range of benefits, including soil rent, bonuses, and cost-share
- Greatest benefits are in first 50 feet from stream;
- Likely to supply at least 400 miles towards goal with 28,791.5 ac. remaining in the program;
- USDA program authorized through 2007;
- Can be used with Conservation Reserve Program (no bonuses) to expand buffers beyond 100-150 feet in some areas.

Environmental Quality Incentive Program (EQIP)

- Recent expansion by the USDA, eligibility now includes forest practices;
- Offers cost-share payments of 50% towards forest buffer creation, no land rent or bonus;
- Likely to be used only where CREP not applicable, supplying a low number of miles towards the goal.

Conservation Security Program (CSP)

- New USDA program that pays farmers based on level of farm conservation practices in place;
- Available only in selected watersheds that change each year (possible 8-year cycle among watersheds);
- Provides incentive for farmers to adopt or retain buffers to get to Tier 2 or 3 (higher payments);
- Unclear whether forest buffers will trigger any greater incentive payment than grass buffers.

Mixed land use incentives: Several programs are available that are not limited to agricultural land uses, but have their own requirements and eligibility. Most offer partial cost-share but no incentives beyond that. Some of these are good matches for landowner goals and site characteristics, but typically have involved less than 10 miles of buffers per year. The widespread application of buffer restoration called for in the RFB goal would need some greater level of incentive and outreach for non-agricultural lands than

currently exist. Maryland DNR has authority to provide assistance for forest buffers under the Green Shores legislation from 1986. However, budget cuts over the last few years have resulted in loss of funding for the state Buffer Incentive Program previously offered, as well as layoffs and hiring freezes for staff involved in technical assistance.

Forest Land Enhancement Program (FLEP)

- USDA program for forest land assistance, replacing Stewardship and Forest Incentive Programs;
- Funding cut due to wildfire control costs borne by the USDA Forest Service, partially restored and likely to be modest in the future;
- Offers 50% cost-share for forest buffer establishment and invasive species control.

Woodland Incentive Program (WIP)

- State program that offers 50% cost-share for forestry practices, including tree planting;
- Landowners with 10-500 acres of woodlands are eligible;
- Funding does not usually exceed $100,000 per year for the state and all covered practices.

Forest Conservation (FCA) fee-in-lieu/mitigation banks

- When developments can't meet replanting requirements on site, some jurisdictions offer fee-in-lieu fees that are used to replant off-site and mitigation banks that offer already planted areas for purchase;
- Areas have to meet long-term protection requirements and local FCA planting guidelines;
- First priority is to meet planting requirements on site, and not every jurisdictions has authorized fee-in-lieu or mitigation banking, so acreage has been limited so far but could increase in the future.

Chesapeake Bay Trust grants

- Grants for Chesapeake Bay restoration projects can include RFBs (trees, tools);
- Preference given to projects that involve education and volunteers as well as restoration;
- Small grants offered year-round, larger grants on a competitive annual cycle.

Partners for Wildlife

- US Fish and Wildlife Service program provides cost-share and technical assistance for wildlife habitat;
- Eligibility for private land, native species only;
- Funding is generally available at modest levels.

Wetlands/waterway mitigation funds

- Unavoidable disturbances to wetlands or waterways require mitigation, and buffers and stream restoration may be used to mitigate out-of-kind;
- Could fund buffer establishment as part of stream restoration project or buffers alone.

- Private landowners may receive payments beyond what is offered for construction cost share by allowing mitigation on their property.

Carbon sequestration

- Tree planting used to offset increases in carbon dioxide concentrations;
- Market in US only preliminary, not expected to be regulatory or widespread within timeframe of this plan, but future potential acreage could be large;
- Pilot projects being undertaken by energy companies (e.g., Constellation in Baltimore County, establishing buffers on a Rural Legacy property) and credited in a national database;
- Requires periodic measurements to estimate eligible carbon credits.

Ozone mitigation

- Urban areas in MD don't meet air quality standards for ozone, and State Implementation Plans (SIP) are used to find ways to reduce ozone in noncompliance areas, mostly through source reduction;
- Studies have shown utility of trees in reducing ozone, particularly through cooling the heat island effect in cities, one of the few ways to reduce ozone post-production;
- If afforestation is added to the MD SIP, mitigation funds could support substantial tree-planting, most in urban areas and surrounding counties, some of which could be in buffers.

Local jurisdiction requirements

- Local ordinances can require more stringent mitigation requirements, additional buffer protection, urban forest standards that would support forest and buffer cover in watersheds;
- Comprehensive Plans can identify watershed receiving areas or greenbelts around towns;
- Mitigation standards vary regarding planting stock size, spacing, and composition, and in some cases could be more cost-effective or effective if adjusted.

Chesapeake Bay Restoration Funds

- New financing like the Maryland Chesapeake Bay Watershed Restoration fund or a regional program promoted by the Chesapeake Bay Program Blue Ribbon Financing Panel could fund RFBs as one element in Bay restoration;
- The Maryland fund is currently dedicated to sewer treatment plant upgrades, another important restoration activity, but expanded practices for even a small percentage of the fund would allow some nonstructural solutions like RFBs to be pursued;
- Regional financing, if authorized and appropriated, could be used to provide incentives for RFBs outside of agricultural lands targeted to areas of greatest need.

National Fish and Wildlife Foundation

- Grant programs offer restoration funds from a variety of funding sources;

- Eligibility varies by type of grant but some include forestry projects and buffers in particular as priority items to fund.

Watershed Forestry Assistance Program

- USDA Forest Service program being developed as part of the Healthy Forest Restoration Act;
- States set focus watershed and watershed restoration targets;
- Can provide cost-share for restoration activities;
- Currently not funded, may be within timeframe of this plan.

Conservation Programs/Incentives

To keep the long-term resiliency envisioned by the riparian forest buffer initiative, the existing buffers must be kept on the landscape. Maryland has several programs that limit forest clearing in buffer areas, target buffers for reforestation, and preclude future development and land use conversion.

Program	**Type and Jurisdiction**	**Role**
Forest Conservation Act	Regulatory, Statewide outside Critical Area, through local regs for properties being developed	Limits forest clearing during development, 50-ft or greater forest buffer, targets afforestation to buffer/wetland areas
Chesapeake Bay Critical Area Law	Regulatory, area 1000' from tidal waters, through local regs.	Requires 100-ft buffer on most lands, 50-100+ ft harvest buffer, and 25-ft ag buffer
Nontidal Wetlands Law	Regulatory, protects nontidal wetlands	Requires avoidance, minimizing or mitigating stream crossings, 25' wetlands buffer
Forest Conservation Management Agreement	Voluntary, Statewide	Precludes development for term of 15-year contract, offers lower property taxes
MD Agricultural Land Preservation Foundation	Voluntary, 25-year easements	Precludes development while under easement, does not restrict forest clearing
Rural Legacy	Voluntary, state easement purchase program in selected areas nominated by counties	Precludes development and encourages reforestation of buffers
Forest Legacy	Voluntary, federal/state easement purchase program in selected areas nominated by state	Precludes development on forested parcels
Conservation Reserve	Voluntary, easements on	Precludes development or

Enhancement Program	land under CREP contract and some adjacent acreage	forest clearing/ change of land use, allows forest management
Conservation Security Program	Voluntary, federal incentive program for agricultural lands	Provide payments over 8 years for landowners who meet conservation standards
Maryland Environmental Trust	Voluntary, state easement donation program, often in concert with local land trust	Precludes development, requires 50-ft naturally vegetated buffer
Landowner Incentive Program	Voluntary, federally funded state program to enhance, protect, or restore wildlife habitat for species at risk	Includes easements, management plans, restoration, invasive species control
Wetland Reserve Program	Voluntary, USDA easement program	Easements for wetland protection, term or perpetual
Regional and local land trusts	Voluntary, private/non-profit easement program, usually as donation, priorities set by land trust	Precludes development, may or may not accommodate forest management
Wetland/waterway requirements or mitigation	Regulatory, requirements to avoid/minimize/mitigate disturbance to wetlands and waterways	Permanent protection in mitigation areas, preclude building in floodplains, clearing by wetland/streams

Incentive Actions identified

- Assess annual progress in CREP sign-ups for riparian forest buffers, and evaluate potential changes needed prior to reauthorization of the Farm Bill in 1997 (e.g., increases in acreage cap, higher incentives for forest practices, modification of pastureland ruling for Eastern states);
- Restore funding to Program Open Space to allow Rural Legacy and CREP easements to continue;
- Include watershed organizations as easement holders for land trusts, can assist in monitoring over time;
- Assure that the Conservation Security Program rewards retention and establishment of forest buffers as conservation practices
- Restoration on large lots/small farms- focus on education (environmental function, privacy, increase in lot value) and availability of suitable trees (free seedlings, coupons for containerized with participating nurseries?);
- Greenbelts around towns/ targeted downzoning in buffers;
- Develop NAWCA (North American Wetlands Conservation Act) grant proposal to target easements that protect wetlands and waterfowl habitat (more likely in S MD or E Shore);

- Work with the Coastal and Estuarine Land Conservation Plan (CELC), designed to protect coastal and estuarine areas with significant conservation, recreation, ecological, historical or aesthetic values or those that are threatened by conversion from their natural state to other uses. Administered by NOAA, eligible in coastal zone counties;
- Develop conservation tax credits/incentives for smaller non-agricultural land, such as:
    - Streamline easement process and identify costs/benefits,
    - Identify protection zones where benefits worth public investment,
    - Riparian tax credit zones,
    - Tax credits donated to nonprofits (VA program),
    - Frozen tax assessment for sensitive lands and lands used as receiving areas for protection or restoration, and
    - Comprehensive Plans identifying receiving areas/effective mitigation incentives;
- Encourage donations- capitalize on tax benefits (federal, state)-Use MET tax credit for donated lands, $5,000/year for 5 years ($70,000 max);
- Develop a model conservation easement that integrates forest, agricultural, and wetland conservation and evaluation framework with criteria for prioritizing acquisition of easements; and
- Engage developers/engineers with training in reduction of stormwater requirements with appropriately placed/conserved forest
- Develop a Trees-for-Fish program targeting trout streams, with incentives of a Fisherman's Gold Card (free fishing license if an RFB is put under long-term protection-could be mature or newly restored) and coordinated with organizations like Trout Unlimited, Coastal Conservation Alliance, or Federation of Fly Fisherman and funding options like waterway mitigation projects.

Education and Outreach

Educational materials should be available for different types of audiences/partners, with modules and targeting unique to each. Emphasis for outreach efforts will be on partners creating or conserving forest buffers, although more general materials for interested individuals will be available as well. The parties implementing the forest buffers have more specific needs that should be met by Stream ReLeaf efforts, such as expanding technical assistance and training sessions open to a variety of agencies. Media contacts are anticipated to involve specific planting events or conservation announcements, not general program awareness. Templates can be used for providing a story on an event to local papers for their use, often the most effective means of getting the message out.

Outreach on Goal Awareness and Buffer Function

Primary audiences for goal awareness and buffer function are the general public and landowners. Most of the funding used to create buffers is public, so materials to share the program existence and significance are important for developing awareness and support among voters and legislators. Information is provided via the internet, but printed materials are important in other venues like state and local fairs. Identified print information needs are listed below.

- Landowners- explain assistance available, expectations for planting needs and maintenance requirements (fact sheet or brochure)
- General public- explain public benefits of RFBs for Maryland and contacts for more information and reporting (brochure or doorhanger)

Supporting publications on buffer functions and the regional initiative are available from the Chesapeake Bay Program, specifically a recent booklet entitled "Linking Land and Water", as well as reprints of the summary of buffer science produced prior to the 1996 goal, "Water Quality Function of Riparian Forest Buffer Systems in the Chesapeake Bay Watershed". These publications provide more detailed information than a brochure could, and are good follow-up references to a general Maryland Stream ReLeaf brochure.

The Conservation Reserve Enhancement Program also has outreach products and actions that convey the availability of incentives and cost-share for riparian forest buffers, among other practices. Products include a brochure with general information, a fact sheet with more detail on practices and incentive rates. Actions include including incentive information in Farm Service Agency newsletters and in county Soil Conservation District offices. Other cost-share programs such as Environmental Quality Incentive Program continue to be advertised as well, and include forest buffers among eligible practices. All of these program outreach activities convey the desirability and benefits of buffers, with a focus on farm landowners and operators.

Stream ReLeaf Media Outreach

Well-placed media releases can be an effective and cost-efficient way to get messages out to the general public and potential volunteers. Generally, these are envisioned in concert with a planting event. The MD DNR Media Office will develop a template for media releases and can assist with media contacts if desired. With the template, general information on Stream ReLeaf will be pre-written, so the major task will be to plug in the specifics of an event, i.e. time, place, people involved, etc. There are three (3) types of press materials that the DNR media office uses: press releases, media advisories and calendar/event listings.

A press release **informs** the media of something you are doing or have done, such as a planting or a conservation announcement. These should be sent out on the day you have something to announce. Old news is just that, old.

A media advisory **invites the media** to an event you are having such as a planting. Be sure to give them a few days to get it on their calendar. Reporters plan their schedules a

few days in advance. And know that if you have breaking news, it could detour reporters away from your event.

A calendar/event **invites the public** to an event you are having. The listing is sent to calendar editors at media outlets in the region where the event will happen so that the public. Provide a contact number for the public to call if they would like more information. The MD DNR web page has a calendar area, and events can be posted there.

If you are holding a volunteer planting as part of the Stream ReLeaf program, there are two major ways to utilize the media:

1. To solicit volunteers to help with the planting. Every newspaper has a community news section that includes space for a "Call for Volunteers." Check with your local paper as to what their deadline is for inclusion in this section of the paper and allow enough time for volunteers to see and respond to the article in the paper, generally, 3 to 4 weeks ahead.
2. To promote the planting as a great community event and garner coverage in the newspaper or on radio/television. You can either invite the media to come to your event and take photographs and write a story, or you can distribute a press release and photos after the planting is over to let the media know it took place. If you have local dignitaries invited to your event, such as a mayor or delegate, be sure to include that information in any press materials, they make a nice photo opportunity.

Expanding training/reporting of buffer creation and conservation

One of the major needs identified during development of the Implementation Plan was continued training on riparian forest buffers for an expanded range of people involved in afforestation. Training programs were developed and held by Maryland Cooperative Extension Service in several locations following adoption of the initial RFB goal in 1996, supported by the US Forest Service. Due to changes in personnel and loss of positions, the training has not continued, although several good resources are available, including

- RFB Video on buffer function and design;
- Chesapeake Bay Riparian Handbook (print or CD copies and at www.chesapeakebay.net);
- RFB Fact Sheets (set of 9 at www.naturalresources.umd.edu);
- Web site (www.riparianbuffers.umd.edu)

An additional resource is the RFB Design and Maintenance Manual under development and expected by June 2005.

Training should be renewed and offered to the range of partners now involved in forest buffer restoration. A list of audiences and topics is listed below.

- Local government (counties and municipalities, including those who have developed or are developing WRAS plans, and Soil Conservation Districts)- mitigation banks, including design and implementation, and planting inspection requirements;

- Nonprofit and community organizations- planting and maintenance techniques;
- Watershed organizations and Forestry Boards- outreach strategies, volunteer coordination, holding and monitoring easements, planting and maintenance techniques;
- Land trusts- outreach strategies, holding and monitoring easements/bundled riparian easements, need and assistance programs for RFB establishment on conserved lands.

Separate outreach efforts are needed for other audiences, particularly students and educators. MD DNR has had the TEAM program for stream assessment, monitoring, and restoration. The restoration component is a good complement for Stream ReLeaf, particularly if sites suitable for school involvement can be identified. Planting and maintaining RFBs also are a suitable component for the Student Service Learning (SSL) program or the Green School Program. Closer coordination with the MD State Dept. of Education and local schools is needed to make tree planting a more commonly used option for SSL or Green Schools.

The Stream ReLeaf Recognition Program was developed in 1998 to reward exemplary buffer restoration efforts in five categories:

- Landowner;
- Local government;
- Education;
- Community organization; and
- Business.

Stream ReLeaf awards will continue to be offered to recognize outstanding projects, expand awareness of good projects and benefits of buffers, and provide incentive for others to participate. Awards are selected by the Stream ReLeaf Coordinating Committee and given out at the annual Tributary Team meeting.

Education and Outreach actions identified

- Print new Stream ReLeaf brochure

- Develop template for media releases for Stream ReLeaf events

- Update and expand teaching materials for forest buffer functions and establishment for at least middle and high school, incorporating current curricula requirements; present at Maryland Association for Environmental and Outdoor Education (MAEOE) annual conference.

- Continue Stream ReLeaf awards, especially if volunteers can be found to help solicit nominations and publicize awards.

- Train natural resource professionals with programs offered annually and self-study resources online.

- Develop and convey information on need for buffer conservation; make available costs of not protecting buffers as part of outreach to local governments, based on existing Baltimore County data on costs and tools for water quality protection (drinking water).

Coordination

The Stream ReLeaf Coordinating Committee is the central point of organization and information exchanged for Stream ReLeaf. Membership is available to interested stakeholders. The Committee should coordinate data collection statewide and review progress annually. Support staff should be provided by MD DNR Forest Service to assist with tracking and report preparation.

Tracking database improvement

A reliable reporting mechanism is a fundamental need for implementing goal-oriented initiatives like Stream ReLeaf. MD DNR foresters have been the major avenue for reporting using standardized state reporting forms, although several counties and some nonprofit organizations also have contributed.

The Stream ReLeaf database is currently maintained by the Stream ReLeaf Coordinator, housed in the MD DNR Forest Service. The database is in Access format and can be displayed geographically by location and planting year through GIS programs like ArcView. The tracking should be coordinated with related efforts including:

Forest Conservation Act afforestation in buffer areas
Wetlands tracking
WRAS implementation
Stream Restoration projects
Nonprofit organizations' buffer plantings.

A new web-based reporting system has been developed by the Chesapeake Bay Program. It is available at www.chesapeakebay.net/RFB. After refinements to the interface and the process for states to review submissions for completeness and lack of duplication are in place, the availability of this reporting mechanisms should be shared widely.

Annual progress report

A short annual progress report should be used to present summaries of restoration and conservation. Summaries should include state, regional, watershed and county information for the year and cumulative totals since 1996. Progress towards the RFB goal for 2010 and the Tributary Strategies goal should be clearly presented. Coordination with related Chesapeake Bay goals should be included as applicable. The progress report can be included on the DNR web site that currently provides state mileage only. Data should be made more available to local jurisdictions, watershed, and community organizations.

Riparian buffer mileage is reported to the Chesapeake Bay Program twice a year, and included in annual state reporting of Best Management Practices credited for nutrient reduction in the Chesapeake Bay Program model.

Coordination Actions identified

- Work with state agencies and local governments to coordinate with TMDL modeling/permitting and NPDES permitting, including MS4 permits/reporting (Municipal separate storm sewer system, currently required in cities over 100,000) to use RFBs wherever appropriate and increase accounting of all RFB establishment.

- Develop outreach mailing list for distribution of Stream ReLeaf Plan and information updates and listserv for facilitating exchange of information on buffer issues and progress.

- Short annual report on progress and issues

- Expand information resource list/links on the University of Maryland web site

- Encourage RFB establishment on available public land to lead by example

- Coordinate future study on the need for expanded or adjusted buffer conservation regulations.

Implementation Priorities and Schedule

Priorities

Priorities for riparian forest buffers from 2005-2010 were identified as:

- Tracking, needed to document progress towards restoration and conservation goals;
- Funding, needed to achieve restoration and conservation; and
- Training and education, needed to support sufficient technical assistance and informed landowners.

For *tracking*, the restoration database will be expanded and a conservation database will be developed. Suggested features include

- Internet-based option for reporting (will incorporate system already developed by Chesapeake Bay Program);
- Access to summary reports;
- Mechanism for tracking buffer loss for conservation;
- Compatibility with GIS.

Targeting is suggested to direct efforts to geographic areas with greatest needs and opportunities for restoration and conservation of forest buffers.

For *funding*, several major options were identified for restoration and conservation:

- Continuing Conservation Reserve Enhancement Program, including natural regeneration options;
- Assuring incentives for RFBs in the new Conservation Security Program;
- Including RFBs as an option for Chesapeake Bay restoration funding and pollution mitigation funds (from ozone to carbon to wetlands/waterways);
- Coordinating with locally implemented pollution reduction efforts to include RFBs as a means of preventing degradation (conservation) or improving water quality (restoration)- includes TMDL models/permits, municipal stormwater (CSO or MS4 permits), stormwater utilities if enacted, and watershed plans (WRAS or others);
- Developing a proposal to protect a priority area for buffer conservation through existing federal conservation initiatives (e.g., Coastal and Estuarine Land Conservation or North American Wetlands Conservation Act);

For *training and education*, the need for regularly offered technical workshops and information was emphasized. The Committee also recognized the importance of continuing education efforts for basic program awareness with the public generally and landowners specifically, and for incorporating buffers into school curricula. Suggested actions are:

- Establishing regular RFB Establishment and Maintenance Training in the state and region so buffer restoration expertise remains available even if state staff remains low or declines;
- Expanding existing educational resources (video, handbooks, internet resources) by adding an on-line buffer design and species selection tool and other resources for on-demand learning;
- Updating Stream ReLeaf outreach materials, emphasizing a general brochure and articles for local papers relating to restoration activities;
- Building on existing education tools for RFBs to update relevance to existing curricula and requirements, student service learning opportunities, and meaningful Bay or stream outdoor experiences.

Implementation Schedule for priorities

Priority Action	***Approach***	***Time Frame***	***Lead and Participants***
Tracking and Targeting			
Tracking Restoration	Refine existing tracking database, incorporating internet-based tracking	2005-2010, semiannual updates	MD DNR Forest Service
Tracking Conservation	Develop forest buffer conservation tracking system, coordinated with Maryland Protected Lands GIS layer	Produced by Dec. 2005, updated annually	MD DNR, Forest Service and GIS units
Targeting Conservation	Establish Stream ReLeaf subcommittee to modify CELC targeting approach for forest buffer conservation	Feb 2005-April 2005	Stream ReLeaf subcommittee (Horan, Herrmann, Clearwater, Schnabel, Horsey, Lynch, Baxter or rep.)
Coordinate Targeting	Meet with partner groups to coordinate more local targeting for restoration and conservation	2005-2006	Stream ReLeaf subcommittee and MD DNR staff
Funding			
Restoration Funding	• Continue support for forest buffers in CREP, with annual evaluation of need for policy changes; • Work with local and state government to consider RFBs as part of pollutant controls in TMDL, MS4 permits, pollution mitigation funding, or stormwater utilities • Support urban forestry canopy assessment and increase	• 2005-2007, with possible extension • 2006-2010 • One urban canopy assessmt/ yr, min	NRCS, FSA, MD DNR MD DNR, MDE MD DNR Forest Service, Urban Forestry Program in cooperation with local governments (Annapolis, LaPlata, 3 others).
Conservation Funding	• Coordinate closely with Conservation Security Program or similar program to offer bonus incentives for forest buffers and recruit augmented payments for forest buffer • Develop CELC and/or NAWCA proposal to conserve priority area for forest buffers • Develop a tax credit program for forest buffer conservation with model conservation easement	2005 2007 2008	MD DNR Forest Service, NRCS, CBF Stream ReLeaf committee and staff Stream ReLeaf committee and staff
Fund Buffer Maintenance	Develop assistance and funding for maintaining new buffers for several years (volunteer crew, low-cost materials, cost-share payments)	2006	CBF, MD DNR, ACB
Training and Education			

Training for local govts and organizations	• Offer annual training, 1 day on general RFB establishment, 1 day on specific technical topic such as maintenance, invasive control • Develop self-study materials/course, augmenting and coordinating existing digitally available resources,	Annual 2007	Extension Service, DNR, USFS, ACB, community colleges for both
Training for trainers	Offer regional annual or biannual training (not always in Maryland, rotating technical topic) Develop training and partnerships for 3rd-party technical assistance providers	2006, 8, 10 2006	USFS CBP
Information for general public	Develop general brochure on RFB benefits and contacts	2005	MD DNR Forest Service
Student involvement	Update or expand module on RFBs for middle school, creating options for student service learning, revised curricula, and outdoor experiences	2007	MD DNR, MD Dept. of Education, others

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Appendices:

Appendix A: Stream ReLeaf Prioritization Framework

Local Restoration Parameters			**Ranking**				**Weight**
Parameter	**Data Source**	**Scale**	**3 - highest priority**	**2**	**1**	**0 - lowest priority**	
Proximity to water	USGS NHD where avail. MGS Shoreline	Mixed (1:24k hydro / 12k shore)	0 - 30 m	30 - 60 m	60 - 90 m	> 90	**5**
Soil Erodibility / Slope/Kfact Composite	SSURGO, Local, NSG	Mixed (1:20k/ 100k)	Highly Erodible	Potentially Highly Erodible		Other	**4**
Prior converted wetlands/wetland proximity	Mixed (DNR,SSURGO,Local, NSG)	Mixed (12k-100k)	0	0-30m	30 - 90 m	> 90	**3**
Fema Floodplain	FEMA	1:24k	100-Year		500-Year	Non-Fema	**2**
Land Cover	Resac LULC	30m pixels	Open/Ag	UrbPerv	Urb Impv	For/Wet	**5**
Regional/Watershed Parameters			**Ranking**				**Weight**
Parameter	**Data Source**	**Scale**	**3**	**2**	**1**	**0**	
% Impervious Surface	RESAC 2000	30m pixel	5 to 14.9%	0 - 4.9%, 15 to 24.9%		> 25%	**2**
% Riparian Forest Buffer	RESAC land cover	30m pixel	<60%	60-75%	75-85%	>85%	**4**
Water Quality-NPS	Sparrow 1997	1:100K	Low (poor)	Mid-Low	Mid-High	High (Best)	**4**
% Forested	Resac LULC	30m pixels	< 50%	50 - 65 %	65 - 80%	80 - 100%	**3**
Programmatic Parameters			**Ranking**				**Weight**
Parameter	**Data Source**	**Scale**	**3**	**2**	**1**	**0**	
Ag Soil Productivity	Mixed (DNR,SSURGO,Local, NSG)	Mixed (12k-100k)	Non Prime Farmland	Prime if Drained/ Irrigated	Prime	Signif-icant Farm-land	**1**
Drinking Water Intakes	MDE, Watershed File		Immediate Watershed	Adjacent Upstream Watershed		Other	**2**

Appendix B. Acronyms used

ACB- Alliance for the Chesapeake Bay

CBF- Chesapeake Bay Foundation

CBP- Chesapeake Bay Program

CELC- Coastal and Estuarine Land Conservation Program

CREP- Conservation Reserve Enhancement Program

CSO- Combined Sewer Overflows

CSP- Conservation Security Program

DNR- Maryland Department of Natural Resources

FEMA-Federal Emergency Management Administration

FSA- Farm Service Agency

GIS- geographic information system

GPS- geographic positioning system

LULC- Land Use Land Cover data

MDE- Maryland Department of the Environment

MGS- Maryland Geological Survey

MS4 permits- Municipal separate storm sewer system permits required to control pollutants carried in stormwater runoff

NAWCA- North American Wetlands Conservation Act

NHD- National Hydrologic Database

NRCS- Natural Resources Conservation Service

NSG- Natural Soils Groups, digital soils data of general soil types available statewide

RESAC- Remote Earth Sensing and Application Center, University of Maryland

RFB- riparian forest buffer

SPARROW- spatially distributed regression model for predicting water quality basic on monitored nitrogen and phosphorus

SSL- student service learning

SSURGO-digital soils data with specific soil series available in some counties

TMDL- Total Maximum Daily Load

USFS- United States Forest Service

USGS- United State Geologic Survey

WRAS- Watershed Restoration Action Strategy, local watershed plans for 11-digit state subwatersheds

Appendix C: Internet Information Resources on Riparian Forest Buffers

Some excellent sources of information on RFBs are currently available, listed below for reference. Sources that are readily available on the Internet and most relevant to Maryland were selected preferentially.

Introduction to forest buffer benefits and techniques: RFB Fact Sheets (set of 9 at www.naturalresources.umd.edu)

Web site that is central point of information on forest buffers in Maryland: www.riparianbuffers.umd.edu Includes slide show, forest buffer fact sheet, and plant material suppliers, and compilations of buffer-related references and other web sites.

Comprehensive manual for Chesapeake Bay forest buffer restoration: Sections on the three-zone buffer, physiographic provinces, functions and values of RFBs, soils, buffer design, buffer width, establishment, streambank stabilization, farm considerations, forestry considerations, developed area considerations, economics, and education strategies. Appendices include native plant selection guide. Palone, R.S. and A.H. Todd (eds.) 1997. Chesapeake Bay riparian handbook: a guide for establishing and maintaining riparian forest buffers. USDA Forest Service Northeastern Area State and Private Forestry NA-TP-02-97. Radnor, PA. Available for download from internet, or as DVD set with buffer video from the Chesapeake Bay Program. www.chesapeakebay.net/pubs/subcommittee/nsc/forest/handbook.htm

Modeling riparian functions: Riparian Ecosystem Management Model (REMM), developed by the Southeast Watershed Research Lab, Agricultural Research Service, calibrated and validated for Georgia Piedmont, not yet for Mid-Atlantic. http://sacs.cpes.peachnet.edu/remmwww/

USDA National Agroforestry Center- Resources: Riparian Forest Buffers. Links to national publications on buffers and the national conservation practice job sheet. http://www.unl.edu/nac/riparian.html

Additional technical resources for designing and maintaining buffers

PLANTS database- http://plants.usda.gov/ information on plant characteristics, growth habits, shade, soil, and salt tolerances, ability to sprout from cuttings, whether US native plant and much more. Advanced search features allows generation of a plant list for a set of site or plant characteristics.

Invasive Plants of the Eastern United States: Identification and Control. Images of invasive plants, distribution map from PLANTS database, links to ID and control in other manuals, below. Most comprehensive species list. http://www.invasive.org/eastern/

Nonnative invasive plants of southern forests: A field guide to identification and control. Images of invasive plants by season, detailed descriptions, habitat, similar species, and control recommendations. http://www.invasive.org/eastern/srs/index.html

Biological control of Invasive Plants in the Eastern U.S. Information on pest status, nature of damage, distribution, taxonomy, biology, natural enemies, options for biological control (not using herbicides) including biology of enemies and likely effectiveness of biocontrol options.
http://www.invasive.org/eastern/biocontrol/index.html

Plant Invaders of Mid-Atlantic Natural Areas. Brief information on origin, background, distribution, ecological threat, description and biology, prevention and control. Also highlights native alternatives to invasive plants commonly used in landscaping.
http://www.invasive.org/eastern/midatlantic/index.html

Southeast Exotic Pest Plant Council Invasive Plant Manual. Line drawings and images for identification, descriptions, origin and distribution, similar species, life history, habitat, and mechanical and herbicidal control. Detailed herbicide recommendations.
http://www.invasive.org/eastern/eppc/index.html

Weeds Gone Wild: Alien Plant Invaders of Natural Areas. Brief information on native range, description, ecological threat, distribution and habitat in U.S., background, biology and spread, and detailed information on management options.
http://www.nps.gov/plants/alien

Technical manual on stream hydrology and restoration approaches:
http://www.nrcs.usda.gov/technical/stream_restoration/newtofc.htm

Maryland Department of Natural Resources, Forest Service. Information on forest buffer survival, see "Riparian Forest Buffer Survival and Success in Maryland," April 2001.
http://dnrweb.dnr.state.md.us/download/forests/rfb_survival.pdf

National Academies Press. All about riparian buffers: history, ecologic and environmental function and management. "Riparian Areas: Functions and Strategies for Management." http://www.nap.edu/books/0309082951/html

Virginia Department of Forestry on the value of riparian forest buffers: "Riparian Forest Buffers." http://vdof.org/rfb

Virginia Cooperative Extension. Fairly comprehensive document on value, establishment and maintenance. "Forestry, Fisheries, and Wildlife: Riparian Forest Buffers."
http://www.ext.vt.edu/cgi-bin/WebObjects/Docs.woa/wa/getcat?cat=ir-for-rfb

National Association of Conservation Districts. Highlights and success stories including forest buffers. "Buffer Notes Newsletter."
http://www.nacdnet.org/buffers

Urban buffers by Jennifer Leavit, University of Washington. Master's thesis on the value of riparian buffers in urban watersheds. "The Functions of Riparian Buffers in Urban Watersheds." http://depts.washington.edu/cuwrm/research/buffers.pdf