COMMONWEALTH of VIRGINIA

Chesapeake Bay Nutrient and Sediment Reduction
Tributary Strategy for the

Shenandoah and Potomac River Basins

March 2005

COMMONWEALTH *of* VIRGINIA

Office of the Governor

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March 2005

To the Citizens of Virginia:

The Potomac and Shenandoah rivers and the Chesapeake Bay are degraded. Excess amounts of nitrogen, phosphorus and sediment flow into the bay and its tributaries from the land, from the air, from wastewater treatment plants and from industrial facilities. These nutrients and sediment foul our waters and harm the finfish, shellfish, aquatic plants and other organisms that make up the bay's fragile ecosystem. We also suffer economically from impaired waters. The living resources of the rivers and the bay and their economic potential are compromised by poor water quality. Commercial and recreational fisheries will benefit from cleaner water as will the broader economy.

This "Tributary Strategy" document is a first step in meeting the necessary reductions of nutrients and sediments called for in the multi-state effort to improve our waters proposed in the Chesapeake Bay Agreement of 2000. This strategy, along with those being prepared for Virginia's other tributary basins and those by Maryland, Pennsylvania, New York, Delaware, West Virginia and the District of Columbia, define the nutrient and sediment reduction actions necessary across the bay's 64,000 square mile watershed.

This document was first released to the public in April 2004 and has been revised based on public comment and additional work by our natural resource agencies. Individual nutrient and sediment reduction plans for our other tributary basins, the Rappahannock, the York, the James and the bayside creeks and embayment of the Eastern Shore have been developed as well.

This strategy has been constructed within the parameters set by the Chesapeake Bay Program model, and over the preceding months considerable time has been spent "crunching the numbers" so that our plans could be evaluated by the model. While these arithmetic calculations are important to define the suite of management actions we must take in the future, they are only a first step in the implementation process. The model is a tool to assist us in directing our actions. The implementation of our strategies will take place on the ground as we work treatment plant by treatment plant, farm by farm, parking lot by parking lot, and locality by locality. These strategies must have the flexibility to address real world issues, not just the issues raised by the Chesapeake Bay Program model.

Our efforts to improve and refine these tributary strategies will not end with the publication of this document. It will continue as we seek to achieve our reductions and cap those reductions over time. We will learn more in the future and we will continue to refine our strategies to account for new knowledge, emerging technologies and changing conditions. This is a living document that will undergo revisions from time to time.

After you have reviewed this document, I ask that you take this message with you. The restoration of the Shenandoah River, the Potomac River and the Chesapeake Bay is possible; however, it will not come without the commitment of substantial public and private resources and programs that ensure that management practices are adopted and maintained. Without such actions the promises we have made to restore the bay and its rivers have no meaning. Without such actions, the economic and environmental benefits of a restored bay will not be realized.

Thank you for your support of the efforts outlined in this letter and the attached document to improve the health of the Shenandoah River, the Potomac River and the Chesapeake Bay.

With kind regards, I am,

Sincerely,

W. Tayloe Murphy, Jr.

Executive Summary

This ***Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for the Shenandoah and Potomac River Basins*** reflects a continuation of Virginia's commitment to improving local water quality and the water quality and living resources of the Chesapeake Bay. With its roots in the 1983 creation of the Chesapeake Bay Program, the strategy builds on previous efforts and looks to shape actions in a large and diverse watershed over the next five years and beyond. The reduction goals are far greater than any set before.

Developed through a partnership between natural resources agencies and local stakeholders, this strategy provides options for meeting ambitious reductions in nitrogen, phosphorus and sediment and outlines future actions and processes needed to maintain these levels in the face of a growing population. The estimated cost of Virginia's combined tributary strategies is just under $10 billion.

The Potomac River is often referred to as our *nation's river* because it flows through Washington D.C. – the nation's capitol. It is a shared resource between Virginia, Maryland, Washington D.C., West Virginia, and Pennsylvania. The river's watershed area, or land that drains to it, encompasses 14,679 square miles in four states and the District of Columbia. Virginia has the largest drainage area at 5,723 square miles, about six percent of the state's total land base.

The 3,063 square mile Shenandoah River watershed also feeds the Potomac. The main stem begins in Front Royal, at the confluence of the North Fork and the South Fork. The North Fork of the Shenandoah River originates in Rockingham County and the headwaters of the South Fork of the Shenandoah are in August County. The 60-mile-long Shenandoah River empties into the Potomac River at Harper's Ferry, West Virginia, and its watershed comprises almost 5 percent of the Virginia's entire Chesapeake Bay basin.

Captain John Smith explored the Potomac in 1608 and found fish "*lying so thick with their heads above water, that for want of nets, we attempted to catch them with a frying pan*." Times and populations have changed greatly since then, in 2000, the entire population of the watershed was 5.25 million people, with Virginia's portion at slightly more then two million.

A successful nutrient and sediment reduction strategy will have significant impacts on water quality in the creeks, streams and rivers that feed the Shenandoah and Potomac rivers. Likewise, along with strategies being developed for other Bay tributaries in Virginia, Maryland, Pennsylvania, West Virginia, New York and Delaware, they will have a cumulative effect on the waters and living resources of the Chesapeake Bay.

Since its inception in the early 1980s the Bay Program has identified an over abundance of nutrients as the most damaging water quality problem facing the Bay and its tributaries. High levels of nutrients, primarily phosphorus and nitrogen, over-fertilize the Bay waters, causing excess levels of algae. These algae can have a direct impact on submerged aquatic vegetation by blocking light from reaching these plants. More importantly, these algae have an effect on levels of dissolved oxygen in the water needed by oysters, fish, crabs and other aquatic animals.

In 1992, Virginia joined her Chesapeake Bay Program partners in determining that the most effective means of reaching that water quality goal would be to develop tributary-specific strategies in each Chesapeake Bay river basin.

The tributary strategy approach is born of the realization that our actions on the land have a major impact on the waters into which they drain. This is particularly true in the 64, 000 square mile Chesapeake Bay watershed, where the ratio of land to water is 14:1. This approach also allowed stakeholders in each basin to address its mix of pollutants from point sources (i.e. wastewater treatment plants and industrial outflows) and nonpoint sources (runoff from farms, parking lots, streets, lawns, etc.).

Late in 1996, Virginia released its first tributary strategy, the ***Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy***. In 1999 and 2000 stakeholders within Virginia's lower Bay basins published the strategy documents for the Rappahannock, York, James and Eastern Shore basins after several years of collaborative work. The primary purpose of these lower basin strategies was to restore habitat conditions, particularly dissolved oxygen and underwater vegetation, in order to support living resources in the specific river basins.

While progress was being made in removing nutrients from the waters throughout the Chesapeake Bay watershed as the result of tributary strategies, nutrient enrichment remained a problem in the Bay's tidal waters. Beginning in 1998, the U.S. Environmental Protection Agency proposed implementation of a TMDL (Total Maximum Daily Load) regulatory program under Section 303(d) of the Clean Water Act to address nutrient-related problems in much of Virginia's Chesapeake Bay and tidal tributaries. In May 1999, EPA included most of Virginia's portion of the Bay and several tidal tributaries on the federal list of impaired waters based on failure to meet standards for dissolved oxygen and aquatic life use attainment.

The placement of the Bay on the EPA impaired waters list occurred contemporaneously with the entry of a consent decree the provisions of which are binding on Virginia since it was a party to a settlement between EPA and several national environmental organizations. The settlement regards the provisions of the Clean Water Act requiring the establishment of Total Maximum Daily Loads for waters not meeting applicable water quality standards. In June of 1999 the parties entered into a court approved consent decree, which gives Virginia the opportunity to develop a number of identified TMDLs, but requires EPA to establish these TMDLs if Virginia fails to meet the schedule contained in the decree.

In June 2000, members of the Chesapeake Executive Council signed a new comprehensive Bay Agreement. ***Chesapeake 2000, A Watershed Partnership*** is seen as the most aggressive and comprehensive Bay agreement to date. Designed to guide the next decade of Bay watershed restoration**,** ***Chesapeake 2000*** commits to "achieve and maintain the water quality necessary to support the aquatic living resources of the Bay and its tributaries and to protect human health."

This effort has resulted in nutrient reduction goals that are much more protective to the Bay and its tributaries than those agreed to in the past. Bay Program partners have agreed to base their success on the attainment of water quality standards, not simply pollution load reductions. These standards strive to meet established criteria for the Bay's designated uses. Bay partners chose designated uses based on living resources' habitat needs – shallow water, open water, deep water, deep channel, and migratory and spawning areas.

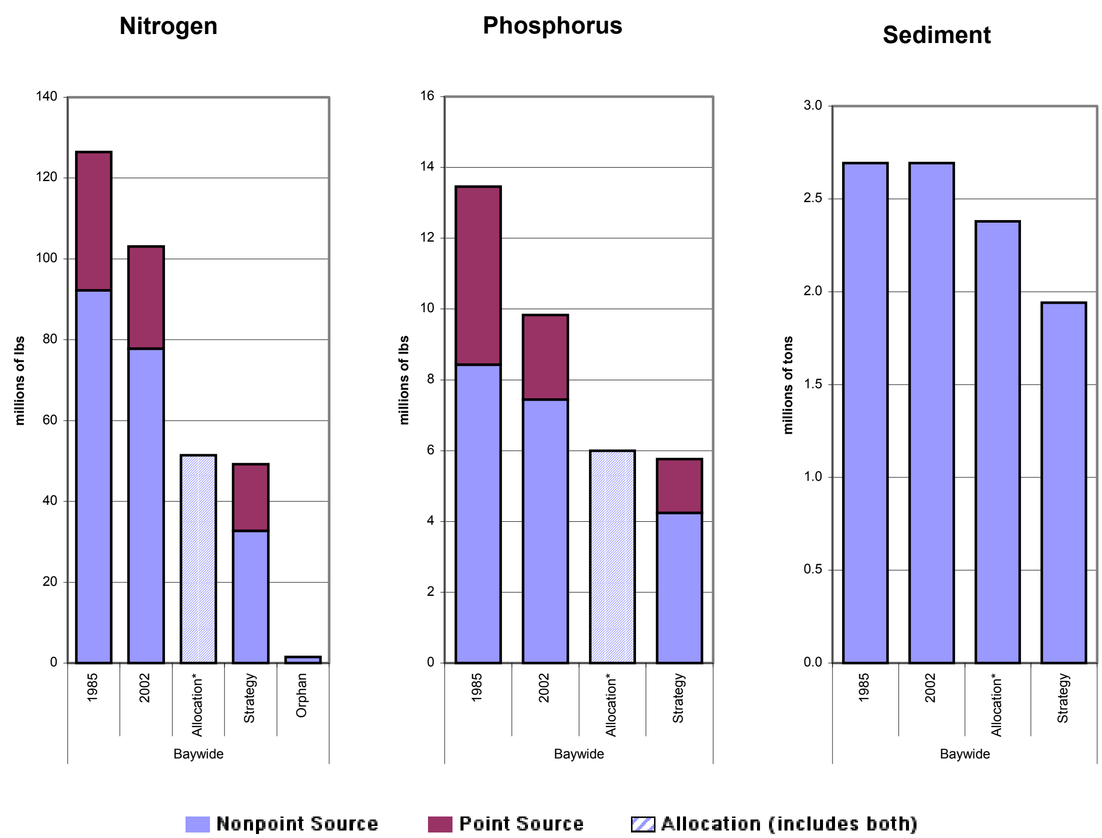
For the first time, partners developed criteria that take into account the varying needs of different plants and animals and the differing conditions found throughout the Bay. The criteria are water clarity, dissolved oxygen and chlorophyll a. In addition to being the focus for the reduction goals or allocations for tributary strategies, these criteria will serve as the basis for the revision of water quality standards for Virginia's tidal waters. This regulatory action is taking place simultaneously to the tributary strategy process.

To determine optimal nutrient and sediment allocations, Bay watershed partners developed several simulations for analysis by the Chesapeake Bay Watershed and Water Quality models. Each simulation, or scenario, allows Bay scientists to predict changes within the Bay ecosystem due to proposed management actions taking place throughout the Bay's 64,000-square-mile watershed.

The resulting nutrient reduction goals, or allocations, call for Bay watershed states to reduce the amount of nitrogen entering the Bay and its tidal tributaries from the current 277 million pounds to no more than 175 million pounds per year, and phosphorus from 19.4 million pounds to no more than 12.8 million pounds per year. When coordinated nutrient reduction efforts began in 1985, 338 million pounds of nitrogen and 27.1 million pounds of phosphorus entered the Bay annually.

At the agreed upon allocations, the model predicts that we will see a Bay similar to that in the 1950s. Proposed water quality standards will be met in 96 percent of the Bay at all times, and the remaining four percent would fall shy of fully meeting the proposed standards for only four months a year.

Virginia Chesapeake Bay Nutrient and Sediment Allocations and Strategy Goals



Note: Because the allocations for the York and James are interim, final total allocations will be established following the adoption of new water quality standards in 2005 for Virginia's tidal waters.

Bay Program partners determined specific allocations for each major basin. Allocations for basins that cover more than one state were divided by jurisdiction. The new cap allocation for total nitrogen in the Virginia's portion of the Bay basin is 51.4 million pounds per year, compared with an actual load of 77.8 million pounds in 2002. The new cap allocation for phosphorus is six million pounds, compared with an actual load of 9.84 million pounds in 2002. The new cap allocation for sediment is 1.94 million tons per year, compared with 2.38 million tons in 2002. This sediment allocation does not include loading from shoreline erosion.

The new nitrogen allocation for the Shenandoah and Virginia's portion of the Potomac is 12.84 million pounds per year, compared with an estimated load of 22.8 million pounds in 2002. The allocation for phosphorus is 1.4 million pounds, compared with an estimated load of 1.96 million pounds in 2002. For sediment the allocation is 617,000 tons per year, compared with an estimated 720,000 tons in 2002. This sediment allocation does not include loading from shoreline erosion in the tidal region of the river basin.
Allocations for the James and York rivers present a special case. Of all of Virginia's rivers, the James and York do not significantly affect dissolved oxygen conditions in the

mainstem of the Chesapeake Bay. Therefore, as was recognized when the total allocations were established through the Chesapeake Bay program, final James and York allocations will be considered *interim* until final water quality standards are adopted by the Virginia State Water Control Board and approved by the United States Environmental Protection Agency. Because the total Virginia allocations for nitrogen and phosphorus are the sum of the allocations for each of Virginia's five basins, the total allocations may change as well.

While each basin had specific nutrient and sediment load allocations to reach, they are a part of overall Virginia Chesapeake Bay nutrient and sediment reduction goals. As the result of the efforts by state staff and stakeholders in all five basins, Virginia has crafted a series of strategies that surpassed Virginia's nitrogen, phosphorus and sediment goals.

To reach these ambitious new reduction goals, the current tributary strategy must build on previous water quality improvements. The strategy looks at the agricultural nonpoint source practices and wastewater treatment plant reductions that were critical to the earlier plans to see where practices could be increased. This strategy also looks more closely at measures involving land use, urban nutrient management and stormwater management that will need to play key roles in meeting the new basin allocations.

Early in the tributary strategy planning process, state staff worked with local stakeholders to develop tributary strategy plans composed of a variety of local pollution abatement techniques, summarized in an "input deck." The objective was to involve and gain support of stakeholders and local governments. Tributary strategy team meetings were held in each basin, during which participants devised strategies they felt were realistically achievable. Once completed input decks were run through the Bay Program's Watershed Model to see if they would meet each basin's nutrient and sediment cap load allocations. If the plans failed to meet the cap load allocations, state staff more familiar with workings of the watershed model incorporated suggestions and concerns of local stakeholders whenever possible into more aggressive input decks.

This draft tributary strategy input deck met or came close to the allocations in all basins and was released as Virginia's draft strategies, open for public comment. The final tributary strategy input decks reflect changes based largely on suggestions received during the public comment period and the expertise of state staff.

Basin wide the nonpoint source input deck calls for BMPs installed and maintained on 92 percent of all available agricultural lands, 85 percent of all mixed open lands, 74 percent on all urban lands and 60 percent of all septic systems.

In August 2004, Virginia Secretary of Natural Resources W. Tayloe Murphy, Jr., issued a statement on revisions to the draft strategies regarding point source controls. A set of "Guiding Principals" were included, which have now been applied as the basis to set annual waste load allocations for the significant nutrient discharges in the Bay watershed. These are reflected in this documents point source input decks.

The point source guiding principles are:

1. Achieve the nutrient reductions necessary to restore the Chesapeake Bay and its tidal tributaries in the timeframe set by the Chesapeake 2000 Agreement;
2. Provide for the full use of existing design capacity at each of the significant municipal and industrial wastewater treatment plants; and,
3. Apply currently available, stringent nutrient reduction technologies at these treatment plants.

This policy directive has been incorporated into revisions that The Virginia Department of Environmental Quality proposes for the Water Quality Management Plan (WQMP) Regulation (9-VAC-25-720), which is now moving through the public process. Annual point source **waste load allocations**, using a combination of **current permitted design capacity** and **the following nutrient concentrations**, have been recalculated for each of the tributary strategy basins, in accordance with the Secretary's statement:

Tributary	**Values Used to Set Waste Load Allocations**	
	Annual Average Nitrogen Concentration	**Annual Average Phosphorus Concentration**
Shenandoah Potomac (above fall line) Rappahannock Eastern Shore	4.0 mg/l	0.3 mg/l
Potomac (below fall line)	3.0 mg/l	0.3 mg/l
James York	To be determined *(load allocations are "interim")*	To be determined *(load allocations are "interim")*

A further discussion of point source implementation is found in Section IV. The Secretary's point source statement is Appendix A.

Unlike point sources where treatment technologies can achieve specified nutrient reductions, nonpoint source controls are much more difficult to implement and maintain. They encompass multiple control strategies and must be placed on land by thousands of landowners, land managers, local governments and others.

In addition to the inherent difficulties in managing nonpoint source controls, the extent of the proposed practices contained in the "input decks" of the proposed strategies go far beyond what current programs with current resources can deliver and well beyond the highest participation levels ever achieved. All of the practices proposed cannot be implemented immediately.

The nonpoint source approach, under the coordination of the Virginia Department of Conservation and Recreation, is to refocus available tools, to steer new resources to Virginia's strongest nonpoint source control programs, and to push them to maximize reductions across the landscape. These efforts will focus on seven programmatic areas:

1. Agricultural Best Management Practices (BMP) Acceleration
2. Expansion of Nutrient Management Planning and Implementation Efforts
3. The Consolidation and Strengthening of the Virginia Stormwater Management Program
4. Enhancing Implementation of the Virginia Erosion and Sediment Control Program
5. Strengthen Implementation of the Chesapeake Bay Preservation Act
6. Enhancement of the NPS Implementation Database Tracking Systems
7. Enhancing outreach, media and education efforts to reduce pollution producing behaviors

These broad implementation approaches set the general direction and provide information on programmatic priorities at the state level. However, more detailed strategic planning will be needed to carry reduction efforts forward. Most of this work will be done at the basin level. State staff will elicit input from existing tributary teams, other stakeholders and citizens of the individual basins. They will then work together to meet these ambitious and necessary nutrient and sediment reductions.

Table of Contents

Summary of Figures

Summary of Tables

I. Introduction and Background

This ***Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for the Shenandoah and Potomac River Basins*** reflects a continuation of Virginia's commitment to improving local water quality and the water quality and living resources of the Chesapeake Bay. With its roots in the 1983 creation of the Chesapeake Bay Program the strategy builds on previous efforts and looks to shape actions in a large and diverse watershed over the next five years and beyond. The reduction goals are far greater than any set before.

Developed as a partnership between natural resources agencies and local stakeholders, this strategy provides options for meeting ambitious reductions in nitrogen, phosphorus and sediment and outlines future actions and processes needed to maintain these levels in the face of a growing population and changing landscape.

The challenges in developing a strategy for such a diverse watershed were many. This watershed stretches from the Allegheny Mountains to the Bay itself. It encompasses the state's most productive farmlands, its most populous suburbs and commercially viable tidal waters. Its stakeholders are as diverse as the landscapes they call home.

A successful nutrient and sediment reduction strategy will have significant impacts on water quality in the creeks, streams and rivers that feed the Shenandoah and Potomac Rivers. Likewise, along with strategies being developed for other Bay tributaries in Virginia, Maryland, Pennsylvania, West Virginia, New York and Delaware, they will have a cumulative effect on the waters and living resources of the Chesapeake Bay.

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

A history of restoration

In the early 1980s, the Chesapeake Bay was a resource in severe decline. Water quality degradation played a key role in the decline of living resources in the Bay and its tidal tributaries.

In 1983 the governors of Virginia, Maryland and Pennsylvania were joined by the mayor of Washington, D.C., the U.S. EPA administrator and the chairman of the tri-state legislative Chesapeake Bay Commission to sign an agreement working toward the restoration of the Chesapeake Bay. This agreement created a multi-jurisdictional, cooperative partnership known as the Chesapeake Bay Program that would proceed through cooperative and shared actions over the next couple of decades.

An over abundance of nutrients was identified as the most damaging water quality problem facing the Bay and its tributaries. High levels of nutrients, primarily phosphorus and nitrogen, over-fertilize the Bay waters, causing excess levels of algae. These algae can have a direct impact on submerged aquatic vegetation by blocking light from reaching these plants. More importantly, these algae have an indirect effect on levels of dissolved oxygen in the water. As algae die off and drop to the bottom, the resulting process of biological decay robs the surrounding bottom waters of oxygen, needed by oysters, fish, crabs and other aquatic animals.

The 1987 Bay Agreement recognized the role nutrients played in the Bay's problems and committed to reducing annual nitrogen and phosphorus loads into Bay waters by 40 percent by 2000. It was estimated that a 40 percent reduction would substantially improve the problem of low dissolved oxygen, which affects the Bay and many of its tributaries.

The signatories recognized that reducing the amount of pollution entering the Bay is a very complex process. In response, the three states and the District of Columbia have worked to adopt and implement interrelated programs including Virginia's Chesapeake Bay Preservation Act program to improve water quality through the regulation of non-point source pollution from land development. The act is a critical element of Virginia's multifaceted response to the Bay Agreement and established a unique cooperative program between state and local government aimed at reducing nonpoint source pollution.

The Bay Act was designed to improve water quality in the Bay and tributaries through wise resource management practices. Since the program recognized that the primary responsibility for land use decisions in Virginia lies with local governments, the act expanded local government authority to manage land development practices to improve water quality. Through local land use ordinances and comprehensive plans, local Bay Act Programs address nonpoint soucre pollution by identifying and preserving environmentally sensitive areas (CBPA's).

Nutrient reduction tributary strategies initiated

In 1992, Virginia joined her Chesapeake Bay Program partners in determining that the most effective means of reaching that water quality goal would be to develop tributary-specific strategies in each Chesapeake Bay river basin.

The tributary strategy approach was born of the realization that our actions on the land have a major impact on the waters into which they drain. This is particularly true in the 64, 000 square mile Chesapeake Bay watershed, where the ratio of land to water in acres is 14:1. This approach also allowed stakeholders in each basin to address its own particular mix of pollutants from point sources (i.e. wastewater treatment plants and industrial outflows) and nonpoint sources (runoff from farms, parking lots, streets, lawns, etc.).

Late in 1996 Virginia released the *Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy.* The result of more than three years of work, the 1996 strategy was the first important step toward reaching our 40 percent nutrient reduction goal in the Shenandoah and Potomac River basins.

Developed cooperatively with local officials, farmers, wastewater treatment plant operators and other representatives of point and nonpoint sources of nutrients in the basin, the strategy set a realistic commitment of reducing nitrogen and phosphorus by approximately 37 percent before the end of the year 2000. As a result of the strong support for this grass-roots approach, the 1997 Virginia General Assembly adopted the Water Quality Improvement Act to provide cost-share funding for implementation of tributary strategies.

Virginia's local governments, farmers, businesses and citizens have been very successful in implementing the ***1996 Shenandoah and Potomac Tributary Strategy***. With a combination of a strong stewardship ethic, and financial assistance under the Water Quality Improvement Fund, the people of the Shenandoah and Potomac watersheds met most of the 1996 strategy's reduction commitments.

Chesapeake 2000, A Watershed Partnership

While progress was being made in removing nutrients from the waters throughout the Chesapeake Bay watershed as the result of tributary strategies, nutrient enrichment remained a problem in the Bay's tidal waters. Beginning in 1998, the U.S. Environmental Protection Agency proposed implementation of a TMDL (Total Maximum Daily Load) regulatory program under Section 303(d) of the Clean Water Act to address nutrient-related problems in much of Virginia's Chesapeake Bay and tidal tributaries. In May 1999, EPA included most of Virginia's portion of the Bay and several tidal tributaries on the federal list of impaired waters based on failure to meet standards for dissolved oxygen and aquatic life use attainment.

The placement of the Bay on the EPA impaired waters list occurred contemporaneously with the entry of a consent decree the provisions of which are binding on Virginia since it was a party to a settlement between EPA and several national environmental organizations. The settlement regards the provisions of the Clean Water Act requiring the establishment of Total Maximum Daily Loads for waters not meeting applicable water quality standards. In June of 1999 the parties entered into a court approved consent decree, which gives Virginia the opportunity to develop a number of identified TMDLs, but requires EPA to establish these TMDLs if Virginia fails to meet the schedule contained in the decree.

In June 2000, members of the Chesapeake Executive Council signed a new comprehensive Bay Agreement. ***Chesapeake 2000, A Watershed Partnership*** is seen as the most aggressive and comprehensive Bay agreement to date. Designed to guide the next decade of Bay watershed restoration**,** ***Chesapeake 2000*** commits to "achieve and maintain the water quality necessary to support the aquatic living resources of the Bay and its tributaries and to protect human health."

A living resources based approach

The new Bay agreement set out a process for achieving its water quality commitments that included setting increased nutrient reduction goals and the first Bay-wide sediment reduction goals.

This effort has resulted in nutrient reduction goals that are much more protective than those agreed to in the past. Bay Program partners have agreed to base their success on the attainment of water quality standards, not simply pollution load reductions. These standards strive to meet established criteria for the Bay's designated uses. Bay partners chose designated uses based on living resources' habitat needs – shallow water, open water, deep water, deep channel and migratory and spawning areas.

For the first time, partners developed criteria that take into account the varying needs of different plants and animals and the various conditions found throughout the Bay. The criteria are:

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

In addition to being the focus for the reduction goals or allocations for tributary strategies, these criteria will serve as the basis for the revision of water quality standards for Virginia's tidal waters, which is now underway.

Using computer models to determine allocations

To determine optimal nutrient and sediment allocations, Bay watershed partners Developed several simulations for analysis by the Chesapeake Bay Watershed and Water Quality models. Each simulation, or scenario, allows Bay scientists to predict changes within the Bay ecosystem due to proposed management actions taking place throughout the Bay's 64,000-square-mile watershed.

Information is entered into the Watershed Model, which details likely results of proposed management actions. These actions include improving wastewater treatment technology, reducing fertilizer and manure application on agricultural lands, implementing sound land use programs and planting streamside forest buffers.

Next, these results are run through the Bay Water Quality Model, a complex mathematical model that provides Bay scientists with a visualization of future Bay and river water quality conditions resulting from each scenario. Throughout the development of the new Bay water quality criteria, more than 70 Water Quality Model runs were conducted.

As described above, the Chesapeake Bay Watershed and Water Quality models are powerful tools that help guide the level of effort and the types of actions needed to restore the health of the Bay and its tributaries. Understanding the strengths and limitations of these models is critical to efficiently and effectively targeting implementation efforts.

Estimating existing and future nitrogen and phosphorus loads is a key application of the watershed model. Incorporating good data and monitoring information, this model is well suited to provide these estimates.

Due, in part, to data limitations, sediment transport is simplified and sediment loads from eroding stream banks are not well captured. These limitations will be addressed in future model versions. Moreover, these limitations need to be considered in determining ongoing implementation priorities. For example, storm water retrofits and stream restoration efforts may be more effective than is currently indicated by the model.

Regardless of certain limitations, the Chesapeake Bay Watershed and Water Quality models provide a good basis for making basin restoration decisions. Moreover, these models compliment and support other tools such as water quality assessment and watershed planning activities.

The resulting nutrient reduction goals, or allocations, call for Bay watershed states to reduce the amount of nitrogen entering the Bay and its tidal tributaries from the current 277 million pounds to no more than 175 million pounds per year, and phosphorus from 19.4 million pounds to no more than 12.8 million pounds per year. When coordinated nutrient reduction efforts began in 1985 it is estimated that 338 million pounds of nitrogen and 27.1 million pounds of phosphorus entered the Bay annually from all sources.

At the agreed upon allocations, the model predicts that we will see a Bay similar to that in the 1950s. Proposed water quality standards will be met in 96 percent of the Bay at all times, and the remaining four percent would fall shy of fully meeting the proposed standards for portions of four months a year in one portion of the bay's mainstem.

The Virginia tributary strategy approach

Bay Program partners determined specific allocations for each major basin. Allocations for basins that cover more than one state were divided by jurisdiction. The new cap allocation for total nitrogen in the Virginia's portion of the Bay basin is 51.4 million pounds per year, compared with an actual load of 77.8 million pounds in 2002. The new cap allocation for phosphorus is six million pounds, compared with an estimated load of 9.84 million pounds in 2002. The new cap allocation for sediment is 1.94 million tons per year, compared with 2.38 million tons in 2002. This sediment allocation does not include loading from shoreline erosion.

While each basin had specific nutrient and sediment load allocations to reach, they are a part of overall Virginia Chesapeake Bay nutrient and sediment reduction goals. As the result of the efforts by state staff and stakeholders in all five basins, Virginia has crafted a series of strategies that surpassed Virginia's nitrogen, phosphorus and sediment goals.

The new nitrogen allocation for the Shenandoah and Virginia's portion of the Potomac is 12.84 million pounds per year, compared with an estimated load of 22.8 million pounds in 2002. The allocation for phosphorus is 1.4 million pounds, compared with an estimated load of 1.96 million pounds in 2002. For sediment the allocation is 617,000 tons per year, compared with an estimated 720,000 tons in 2002. This sediment allocation does not include loading from shoreline erosion in the tidal region of the river basin.

To reach these ambitious new reduction goals, the current tributary strategy must build on what has gone before, in particular the 1996 Shenandoah and Potomac Nutrient Reduction Strategy. Many of the stakeholder groups involved in developing the previous strategy were active in working with state natural resource agency staff in crafting this nutrient and sediment reduction plan.

The strategy looks at the agricultural nonpoint source practices and wastewater treatment plant reductions that were critical to the 1996 plan to see where practices could be increased. This strategy also looks more closely at measures involving land use, urban nutrient management and stormwater management that will need to play key roles in meeting the new basin allocations.

This strategy identifies a number of nonpoint source best management practices and point source treatment levels that can be implemented to meet the Shenandoah and Potomac's allocations. However, the strategy also recognizes the need for reduction efforts to grow and expand in order to meet the 2010 goal and to maintain or cap the allocation once it is achieved. In short, implementation plans that improve local water quality throughout the Chesapeake Bay basins will be a continuous process into the future.

In this regard the strategy outlines processes that need to be developed in order to facilitate implementation between now, 2010, and beyond. There will be annual progress updates and a more thorough, Bay-wide evaluation of advancement towards the 2010 goals when an updated version of the Model becomes available in 2006.

Implementation planning as outlined in this strategy needs to be continually refined by state and local stakeholders, addressing both point and nonpoint sources. It must identify roles and responsibilities for federal, state and local governments, the private sector, nonprofits and the average citizen. The strategy addresses the need to establish timeframes and make cost estimates, and identify potential funding sources.

Tributary strategy implementation will be an iterative process bringing greater consideration of water quality issues to many sectors in each community. Recognizing how land use and lifestyle can impact water quality, and finding alternatives to reduce those impacts, are objectives of tributary strategies. Marketing social change of this magnitude is a challenge that Virginia will deal with steadily using a variety of approaches. Reaching millions of individuals with these messages will take time and money, and there must be enduring popular support among the citizens and elected leaders across the watershed.

Ongoing tributary strategy implementation cannot be seen as a process that is separate from other ongoing water quality initiatives. In fact, tributary strategies should be seen as a way to connect and incorporate local water quality initiatives.

For example, many counties, some aided by local conservation nonprofit organizations, are developing local watershed management plans in their communities. These plans look at sub-watersheds of the tributary as a whole when planning new development or assessing other impacts on land and water resources. Planning at this scale reveals where individual BMPs are needed within each community in the basin. Locations for the many nonpoint sources BMPs in the tributary strategy can be determined using this technique. These local watershed plans can play key roles as a part of the implementation for a basin wide tributary strategy.

Likewise, mandated plans to restore stream segments on the federal impaired waters list, known as TMDLs (Total Maximum Daily Loads) can also be part of a larger tributary strategy. These TMDLs deal with stream segments that violate water quality standards for specific impairments such as bacteria, pH or dissolved oxygen. They do not specifically address nutrient or sediment impairments. However, the implementation plans for upstream TMDLs will also lessen nutrient and sediment loads. So, those measures included in TMDL implementation may be incorporated into the larger tributary strategy for that river basin.

Virginia partnerships

Meeting the *Chesapeake 2000* commitments requires an unprecedented level of communication, consultation and coordination among federal, state and local governments as well as community and watershed organizations. These interactions relative to the 2000 Agreement are well established between state and federal agencies.

Effective and sustainable connections with local governments and other organizations within a regional perspective are, however, still emerging. In addition to the state and federal partnerships, many effective state agency relationships exist with individual local governments relative to specific agency programs. Further, the Virginia Association of Counties and the Virginia Municipal League provide contacts among localities statewide. All of these relationships, while effective for their initial purpose, do not address the need for more extensive and effective watershed level communication and coordination.

Throughout Virginia's Bay basin, planning district commissions, watershed conservation roundtables and soil and water conservation districts are in place to support local initiatives that help to meet Bay agreement commitments. These regional entities, depending on location and level of involvement, perform various communication and coordination activities, some collectively and others individually.

Bay-wide coordination

Virginia Secretary of Natural Resources – The Office of the Secretary oversees state agencies within its purview to make sure resources and programs are well coordinated. This is done through direct interaction of agency heads across the full spectrum of natural resource issues.

Virginia Watershed Planning and Permitting Task Force – The task force consists of directors, or their designees, from the Virginia departments of Environmental Quality (DEQ), Conservation and Recreation (DCR), Forestry (DOF), Mines, Minerals and Energy (DMME) and the commissioner, or his designee, of the Virginia Department of Agriculture and Consumer Services (DACS). "The task force shall undertake such measures and activities it deems necessary and appropriate to see that the functions of the agencies represented therein, and to the extent practicable of other agencies of the Commonwealth, and the efforts of state and local agencies and authorities in watershed planning and watershed permitting are coordinated and promoted." (§ 10.1-1194)

Nonpoint Source Advisory Committee (NPSAC) – This committee was formed in the 1980s to bring about a coordinated statewide approach to nonpoint source pollution control programs. It is chaired by DCR, Virginia's lead nonpoint source agency. A variety of state and federal agencies serve on the committee, all of which have significant nonpoint source water quality responsibilities.

Members include staff from DEQ, Virginia Marine Resource Commission (VMRC), Virginia Department of Game and Inland Fisheries (DGIF), DOF, DACS, Virginia Department of Transportation (VDOT), Virginia Cooperative Extension Service (VCES), U.S.D.A. Natural Resources Conservation Service and the U.S. Geological Survey. The committee guides implementation of the Virginia's Nonpoint Source Management Program, a strategy required under the Clean Water Act to ensure that states give a high priority to the water quality problems resulting from runoff and other diffuse sources.

Because of NPSAC's meetings and grant review activities, state and federal agency members pursue partnerships with other groups and organizations working to prevent nonpoint source pollution.

Virginia Chesapeake Bay Interagency Workgroup – This workgroup consists of technical and managerial staff from the critical state agencies that help implement the *Chesapeake 2000* agreement. It is further supported by intra-agency workgroups established by the agencies as needed.

Virginia Association of Counties (VACo) and Virginia Municipal League (VML) – VACo and VML are associations of Virginia cities, towns and counties. The groups foster a wide range of communication and coordination among the localities. Both engage in local government representation, advocacy and education. The Chesapeake Bay Program is an area of common interest to these groups, hence they are engaged in the process described above.

Regional coordination

Planning District Commissions (PDCs) – These are legally constituted under the Regional Cooperation Act as political subdivisions and formally established by the local governments in defined areas. Twenty-one PDCs have been established and have been in operation for 30 years or more. Approximately 14 PDCs are wholly within the Chesapeake Bay watershed. These regional entities are formed and operate within political boundaries. PDCs function to inform and receive collective input from local governments and transfer information. Specifically, PDCs' statutory duties are to:

- Conduct studies on issues and problems of regional significance.
- Identify and study potential opportunities for state and local cost saving…through coordinated government efforts.
- Identify mechanisms for the coordination of state and local interests.
- Serve as liaison between localities and state agencies.
- Conduct strategic planning for its region.
- Develop regional functional area plans.
- Help state agencies, on request, write local and regional plans.

All of these duties support and are consistent with finding ways to realistically address the major dependence of the *Chesapeake 2000* agreement on local governments for successful, long-term implementation of the that agreement.

Watershed Conservation Roundtables – Established under the Water Quality Improvement Act, Nonpoint Source Cooperative Programs have been underway since early 1999. These voluntary groups, or roundtables, consist of stakeholders, local governments, community and watershed organizations, and other community interests that discuss and address watershed stewardship issues. The primary role of roundtables at this point is to provide advice to state agencies and to increase coordination among the active stakeholders on watershed based initiatives. Roundtables, while authorized under the WQIA, are not legally constituted and consequently are not afforded distinct functions beyond an advisory role.

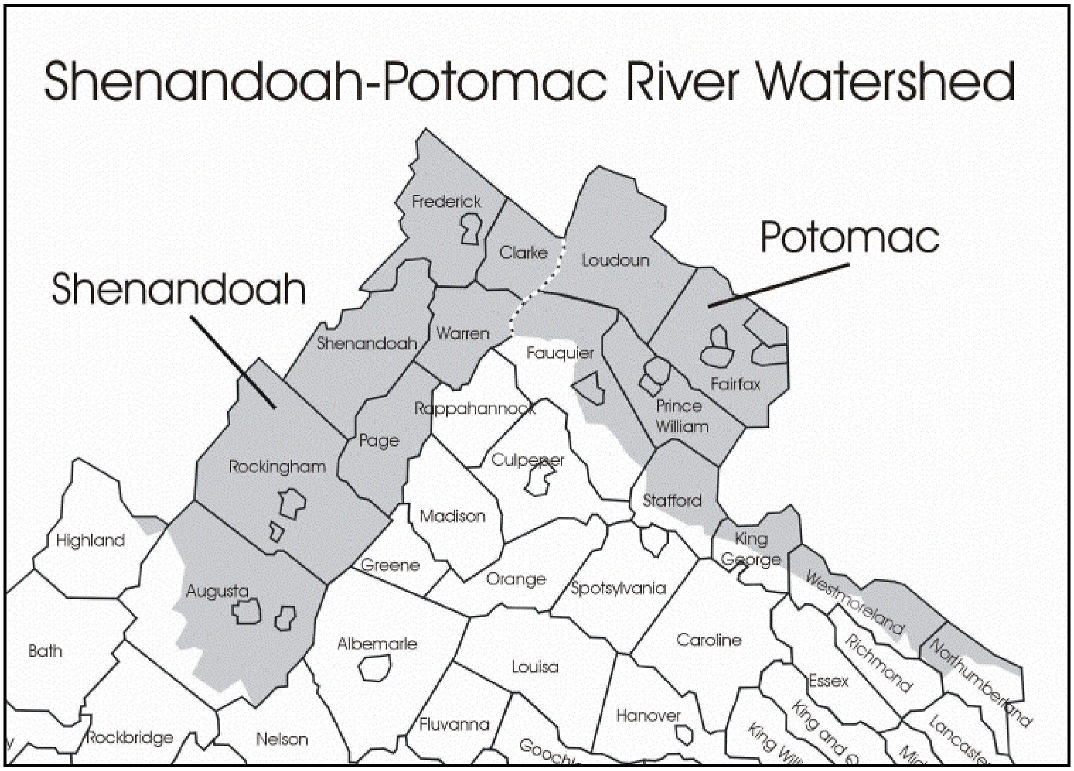
Local Government Activities Supporting Implementation of the Agreement – Local governments obviously play a key role in implementing *Chesapeake 2000*, as they do for most other significant environmental enhancement efforts. Legislators and other interests generally are aware of the range of activities carried out by local governments. The following is a list of routine activities that contribute directly to implementation of the Bay agreement.

- Meeting applicable provisions of the Chesapeake Bay Preservation Act
- Meeting provisions of the state Erosion and Sediment Control Act
- Meeting DEQ permit requirements, such as complying with sewage treatment plant effluent limitations and other regulated discharges
- Complying with Safe Drinking Water Act provisions
- Meeting provisions of the Virginia wetlands programs
- Carrying out floodplain management
- Adopting and implementing stormwater management measures
- Conducting activities through the local Soil and Water Conservation Districts

Virginia Soil and Water Conservation Districts – Established by the Code of Virginia, districts have operated in the Commonwealth for more than 70 years. Today, there are 47 districts covering most all of Virginia's counties and cities. They are constituted as political subdivisions of state government and are governed by locally elected and appointed boards of directors. Districts employ professional, technical expertise to deliver integrated and comprehensive programs and services that conserve soil resources, improve water quality, enhance watershed protection, and prevent soil erosion, stormwater runoff and flooding. Some of the specific responsibilities, duties and programs include:

- Deliver the Virginia DCR Agricultural BMP Cost Share and Tax Credit Program;
- Deliver urban BMP technical services, projects and programs;
- Implement, assist and deliver local erosion and sediment control ordinances;
- Plan, assist and approve conservation plans required by the federal Farm Bill;
- Deliver conservation planning and services related to local Bay Act requirements;
- Assist the Virginia Department of Agriculture and Consumer Services with the Virginia Agricultural Stewardship Act;
- Administer the state funding and delivery of the Conservation Reserve Enhancement Program;
- Provide the local leadership for planning and implementing programs related to impaired water designations through the DEQ and DCR TMDL requirements;
- Provide technical expertise for conservation practices voluntarily implemented by farmers and agriculture operators;
- Educate citizens and government officials on wide-ranging natural resource conservation issues.

II. Virginia's Shenandoah and Potomac River Basins



The Shenandoah and Potomac Fast Facts

- *Drainage in Acres: 3,649,195 (1,768,841 in Potomac, 1,880,354 in Shenandoah)*
- *Square Miles: 5,723 (2,763 in Potomac, 2,960 in Shenandoah)*
- *About 13.4 percent of Virginia's land*
- *Length: Potomac – 383 miles (W.Va., Md., D.C., Va.)*
  Shenandoah – 60 miles
  Shenandoah Headwaters – The river's north fork originates in Rockingham County, its south fork in Augusta County. The main stem begins in Front Royal where the forks meet.
- *Counties: 16 (Shenandoah: Frederick, Clarke, Warren, Shenandoah, Rockingham, Page, Augusta; Potomac: Arlington, Loudoun, Fairfax, Prince William, Fauquier, Stafford, King George, Westmoreland, Northumberland)*
- *Cities: Nine (Shenandoah: Staunton, Waynesboro, Harrisonburg, Winchester; Potomac: Alexandria, Fairfax, Falls Church, Manassas, Manassas Park)*
- *2000 Population: 2,333,429 (Shenandoah: 322,331; Potomac: 2,011,098)*
- *Larger Tributaries: Potomac – Occoquan River, Bull Run, Four Mile Run, Difficult Run, Quantico Creek, Aquia Creek, Potomac Creek; Shenandoah – Christians Creek, Middle*

The Potomac River is often referred to as our *nation's river* because it flows through Washington D.C. – the nation's capitol. It is a shared resource between Virginia, Maryland, Washington D.C., West Virginia, and Pennsylvania. The river's watershed area, or land that drains to it, encompasses 14,679 square miles in four states and the

District of Columbia. Virginia has the largest drainage area at 5,723 square miles, about 6 percent of the state's total land base.

The 3,063 square mile Shenandoah River watershed also feeds the Potomac. The main stem begins in Front Royal, at the confluence of the North Fork and the South Fork. The North Fork of the Shenandoah River originates in Rockingham County and the headwaters of the South Fork of the Shenandoah are in Augusta County. The 60-mile-long Shenandoah River empties into the Potomac River at Harper's Ferry, West Virginia, and its watershed comprises almost 5 percent of the Virginia's entire Chesapeake Bay basin.

Captain John Smith explored the Potomac1608 and found fish "*lying so thick with their heads above water, that for want of nets, we attempted to catch them with a frying pan*." Times and populations have changed greatly since then, in 2000, the entire population of the watershed was 5.25 million people, with Virginia's portion at slightly more then two million.

The Potomac runs 383 miles from its beginnings at Fairfax Stone, West Virginia, to where it joins the Shenandoah River at Harper's Ferry, then plunges dramatically to sea level at Great Falls and then meanders slowly past Washington D.C. to where it empties into the Chesapeake Bay at Point Lookout, Maryland. The majority of the watershed is covered in forests, about 57 percent, followed by agriculture at 32 percent and urban at roughly five percent. In recent years, urban land use has been increasing, with both forest and agriculture decreasing. Larger tributaries include the Occoquan River, Bull Run, Four Mile Run, Difficult Run, Quantico Creek, Aquia Creek, and Potomac Creek. The Potomac basin contains some of the most highly populated and fastest growing localities in the state, if not the nation. Land use patterns are shifting from agriculture and forest towards urban development. This has profound impacts on wastewater treatment flows and the type of land available for best management practices to mitigate water pollution.

In the Shenandoah, farms still account for as much as 37 percent of land in the watershed, despite the region's growing population and proximity to urban centers. About 58 percent of the watershed is forested, 38 percent is agricultural, and nearly 3 percent is urbanized. The population of the Shenandoah River watershed in 2000 was estimated at 328,985 and a 20 percent increase in population is expected over the next 30 years. With that population increase can be expected significant change in land use patterns, especially the conversion of agricultural land to urban land. While the Shenandoah basin is seeing pressure from development, farming – in particular poultry, beef cattle and dairy – is the predominant land use.

Throughout the Shenandoah River watershed, an extensive and varied agriculture industry thrives. Corn, hay, and orchards dominate its cropland, while densely populated livestock operations including poultry, dairy, beef, and swine utilize untilled land. Several counties in the Shenandoah Valley are the top agriculture-producing counties in Virginia.

The resources of the watershed fulfill an important recreational function as well. Over 200 miles of the Shenandoah River and tributaries are designated trout-fishing waters and provide enjoyment to hundreds of fishermen each year. Also, thousands of people swim and float down the river on rafts, inner tubes, canoes, and kayaks.

The Virginia portion of the Potomac watershed encompasses in whole the counties and independent cities of Alexandria City, Arlington, Fairfax, Fairfax City, Falls Church City, Loudoun, Manassas City, Manassas Park City, and Prince William; as well as substantial portions of Fauquier, King George, Northumberland, Stafford and Westmoreland. The Shenandoah watershed covers Frederick, Clarke, Warren, Shenandoah, Rockingham, Page and Augusta counties plus the cities of Staunton, Waynesboro, Harrisonburg, and Winchester.

Major pollutants

As with other watersheds, major water pollutants affecting the Shenandoah and Potomac are nitrogen, phosphorus, and sediment. Many local governments and water quality experts cite both point source discharges such as municipal and industrial wastewater treatment plants and nonpoint sources such as farm and turf fertilizer overuse and misuse, insufficient farm conservation practices, failing on-site systems, even urban sprawl and uncontrolled development as the main pollutant sources. In general, the middle portion of the Potomac is dominated by point sources and urban land use loadings, while the Shenandoah and lower portion of the Potomac tend to be influenced more by agricultural, forested or those non-agricultural open lands known as “mixed-open” nonpoint sources of pollution. Mixed open areas include parks, athletic fields, golf courses and similar land not otherwise classified as urban.

Not all of the nutrients entering the Bay are considered to be controllable. The nonpoint source loads that naturally occur from forested areas in the basin are not considered to be part of the controllable fractions. The remaining nutrient loads both from point and nonpoint sources, that enter the Bay are considered to be “controllable” to varying degrees and can therefore be reduced through nutrient reduction practices.

Water quality status and trends

This section presents a very general overview of selected water quality conditions in the tidal portions of the Virginia Chesapeake Bay and its major tributary basins, with a focus on the Potomac.

It is difficult to adequately summarize the water quality conditions of the Shenandoah-Potomac basin in such a short document. Much more comprehensive and detailed analyses are available for each major Bay basin, and the reader is encouraged to supplement this brief status and trends information with several reports available through the DEQ Chesapeake Bay Program website at http://www.deq.virginia.gov/bay/wqifdown.html and the DEQ Water Programs' Reports webpage at http://www.deq.virginia.gov/water/reports.html.

Water quality conditions are presented through a combination of the current status and long-term trends for nitrogen, phosphorus, chlorophyll, dissolved oxygen, water clarity, and suspended solids. These are the indicators most directly affected by nutrient and sediment reduction strategies. Environmental information regarding other important conditions in Chesapeake Bay (e.g., underwater grasses, fisheries, chemical contaminants) are available in the 2004 biennial report, "Results of Monitoring Programs And Status of Resources", available via the webpage for the Secretary of Natural Resources at www.naturalresources.virginia.gov

The Virginia Chesapeake Bay and its tidal tributaries continue to show trends that indicate progress toward restoration and a more balanced and healthy ecosystem. However, the Bay system remains stressed and some areas and indicators show continuing degradation. Progress in reducing nutrient inputs has made measurable improvements and it is expected that continued progress toward nutrient reduction goals, along with appropriate fisheries management and chemical contaminant controls, will result in additional Bay improvements. Findings from the last 18 years (1985 through 2002) of the monitoring programs are discussed in the following sections.

Nutrients (nitrogen and phosphorus) influence the growth of phytoplankton in the water column. Elevated concentrations of these nutrients often result in excessive phytoplankton production (i.e., chlorophyll). Decomposition of the resulting excess organic material during the summer can result in low levels of dissolved oxygen (D.O.) in bottom waters. These low D.O. levels can cause fish kills and drastic declines in benthic communities, which are the food base for many fish populations. Low-D.O. waters also adversely affect fish and crab population levels by limiting the physical area available where these organisms can live.

FIGURE 2-1. *Phosphorus*: This figure shows the current status and long-term trends in phosphorus concentrations. Some of Virginia's Bay waters have the poorest conditions in relation to the rest of the Chesapeake Bay system. Other downstream segments of rivers are fair but the mainstem Chesapeake Bay and the upper portions of the tidal rivers have relatively good conditions.

The "watershed input" stations shown in the figure below shows provide information about the success of nutrient control efforts. Results at these watershed input monitoring stations are flow-adjusted in order to remove the effects of river flow and assess only the effect of nutrient management actions (e.g., point source discharge treatment improvements and BMPs to reduce nonpoint source runoff). Several input stations show improving concentration trends, but unfortunately a degrading trend for the Potomac watershed is still present.

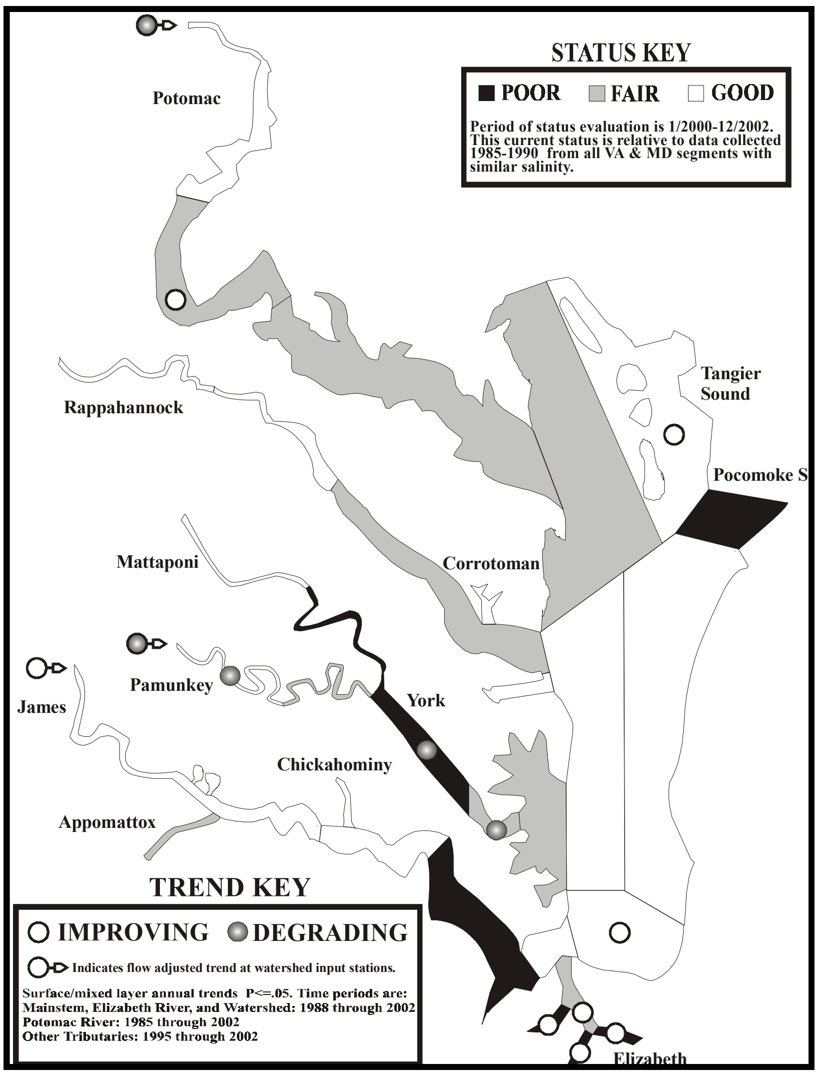


FIGURE 2-2. *Nitrogen*: This figure shows the status and long-term trends in nitrogen concentrations. As with phosphorus, management actions to reduce nitrogen have been effective as indicated by improving trends at the Potomac River watershed input station. The improving trend of nitrogen at the watershed input station of the Potomac River as well as large reductions from point sources in the Washington, D.C. area has resulted in improving trends in several tidal areas of that river. Most of Virginia's Chesapeake Bay is also showing improving trends in nitrogen. Status of nitrogen in the upper Potomac River is worse than status in the other major tributaries (Rappahannock, York, and James) and the Virginia Chesapeake Bay.

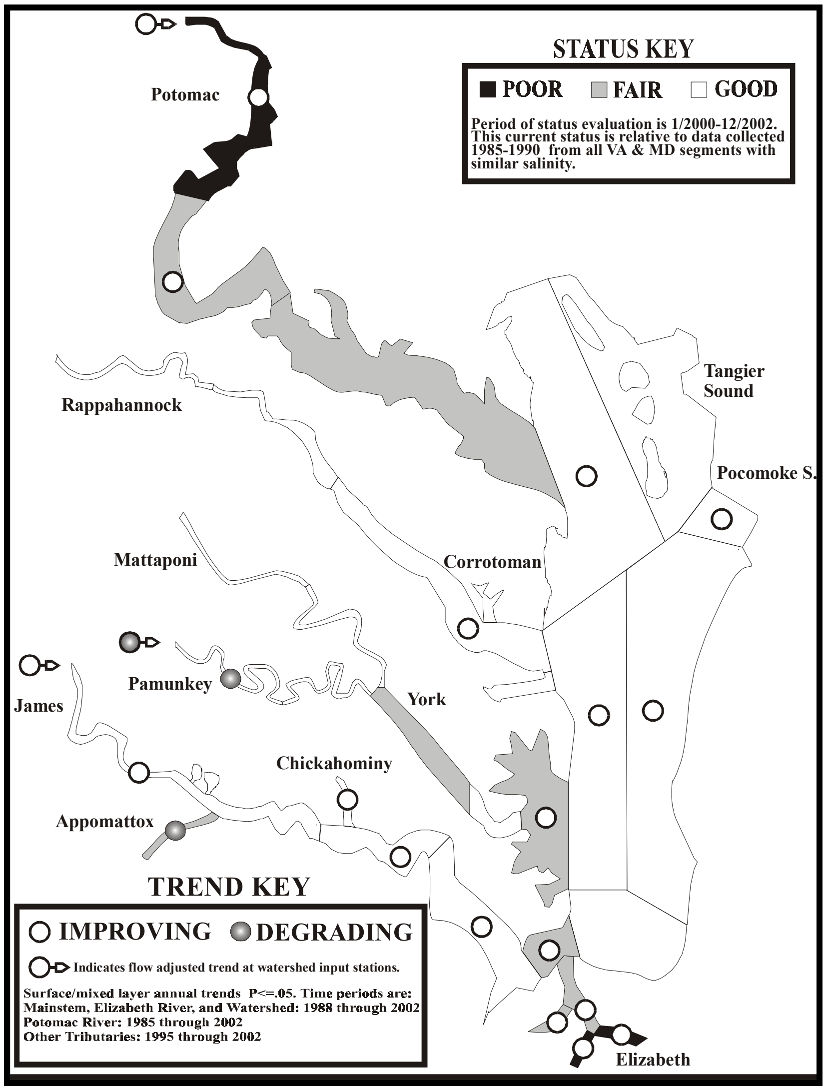


FIGURE 2-3. *Chlorophyll*: Chlorophyll is a measure of algal biomass (i.e., phytoplankton) in the water. High chlorophyll levels are an indicator of poor water quality because they can lead to low D.O. conditions when the organic material sinks into bottom waters and is decomposed. High algal levels can also reduce water clarity, which decreases available light required to support photosynthesis in underwater grasses. High algal levels also can be indicative of problems with the food web such as decreased food quality for some filter-feeding fish and shellfish. Finally, high levels of chlorophyll may indicate large-scale blooms of toxic or nuisance forms of algae.

The figure below shows the current status and long term trends in chlorophyll concentrations. Parts of all of the major Virginia tributaries have poor status in relation to Bay-wide conditions. A degrading trend in chlorophyll was detected in the upper tidal fresh portions of the Potomac, while an improving trend was observed in the lower Potomac River.

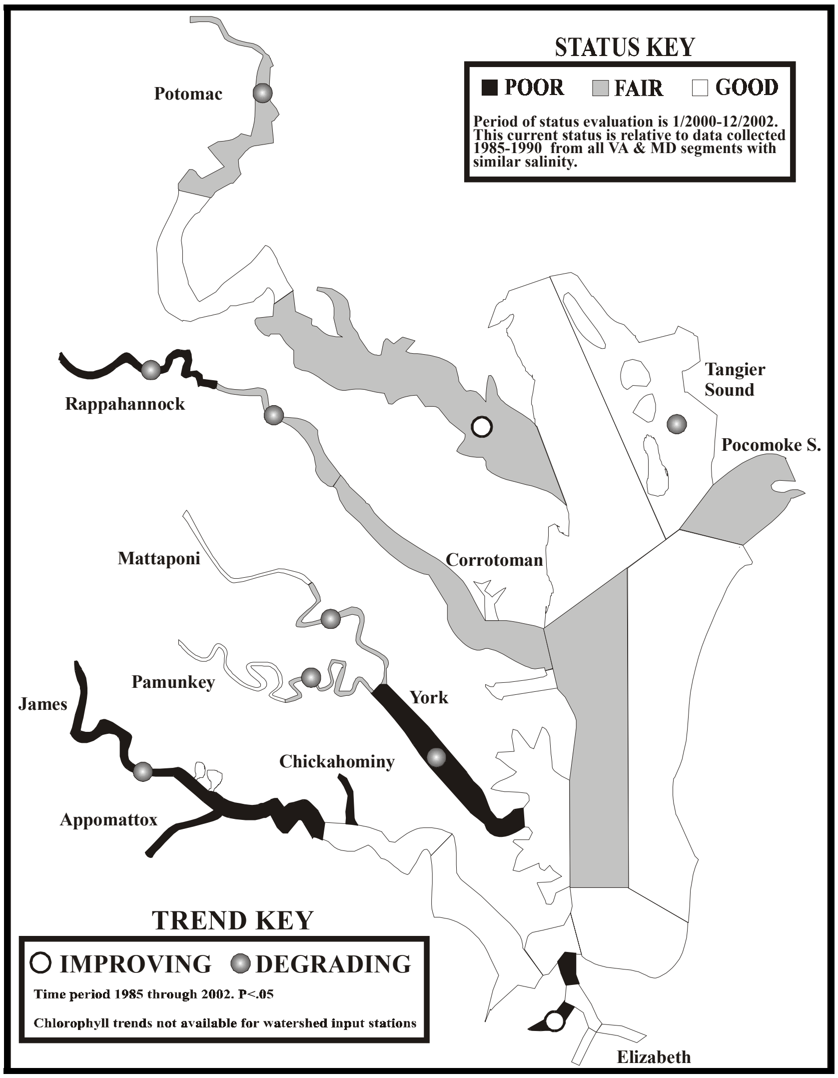


FIGURE 2-4. *Dissolved Oxygen:* Bottom dissolved oxygen levels are an important factor affecting the survival, distribution, and productivity of aquatic living resources. Figure 4 shows the current status and long term trends in dissolved oxygen concentrations. Status is given in relation to dissolved oxygen levels supportive or stressful to living resources. About half of the Virginia Chesapeake Bay and smaller portions of the tidal tributaries had only fair status. The lower Potomac River and northernmost Virginia Chesapeake Bay segments are indicated as poor or fair status, partly because of low D.O. concentrations found in the mid-channel trenches. These mid-channel trenches have naturally lower D.O. levels, but the area affected and duration of low dissolved oxygen levels has been made worse by anthropogenic nutrient inputs.

There are scattered areas of improving conditions for dissolved oxygen and no areas of degrading trends. All of the tributaries have areas of improving conditions. These improvements are a result of both the nutrient management efforts and natural factors, such as declining riverflow, which in turn has lead to naturally less nutrient inputs and concurrently higher influxes of cleaner oceanic water.

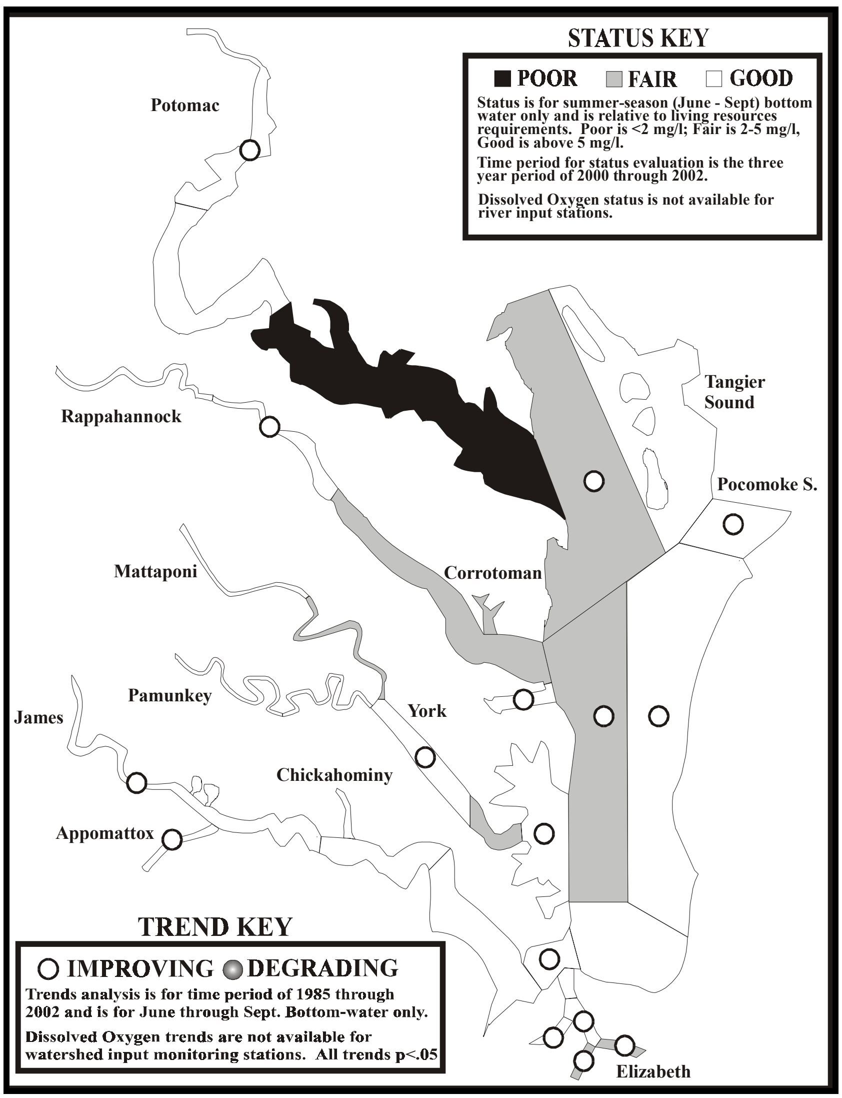


FIGURE 2-5. *Water Clarity:* Water clarity is a measure of the depth to which sunlight penetrates through the water column. Poor water clarity is an indication that conditions are inadequate for the growth and survival of underwater grasses. Poor water clarity can also affect the health and distributions of fish populations by reducing their ability to capture prey or avoid predators. The major factors that affect water clarity include: 1) concentrations of particulate inorganic mineral particles (i.e., sand, silt and clays), 2) concentrations of algae, 3) concentrations of particulate organic detritus (small particles of dead algae and/or decaying marsh grasses), and 4) dissolved substances which "color" the water (e.g., brown humic acids generated by plant decay). The degree to which each of these factors most greatly influence water clarity varies both seasonally and spatially.

This figure shows the current status and long term trends in water clarity. Status of many segments within the tributaries and the Chesapeake Bay mainstem are only fair or poor. This suggests that poor water clarity is one of the major environmental factors inhibiting the resurgence of SAV growth in Chesapeake Bay. Degrading trends in water clarity were detected in segments located over a wide geographic area within the Virginia tributaries and Virginia Chesapeake Bay. These degrading trends represent a substantial impediment to the recovery of SAV beds within Chesapeake Bay. Possible causes of the degrading trends include increased shoreline erosion as a result of waterside development, loss of wetlands, increased abundance of phytoplankton, or a combination of sea level rise and land subsistence.

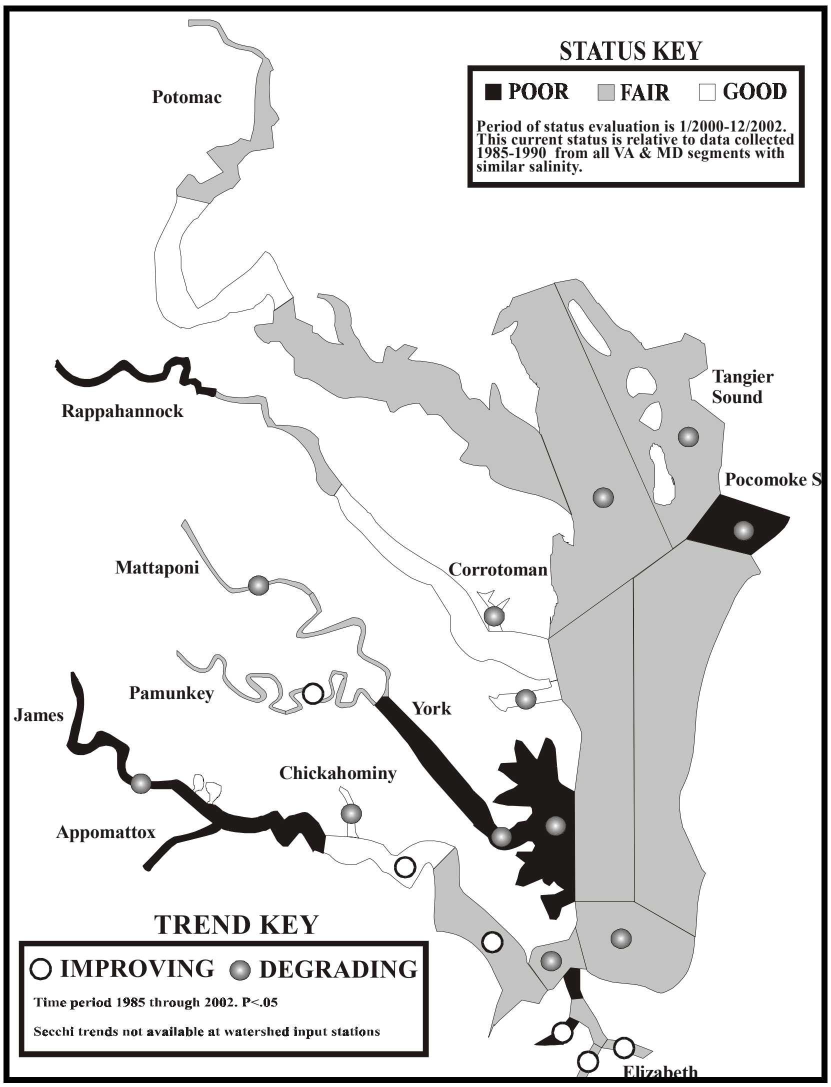
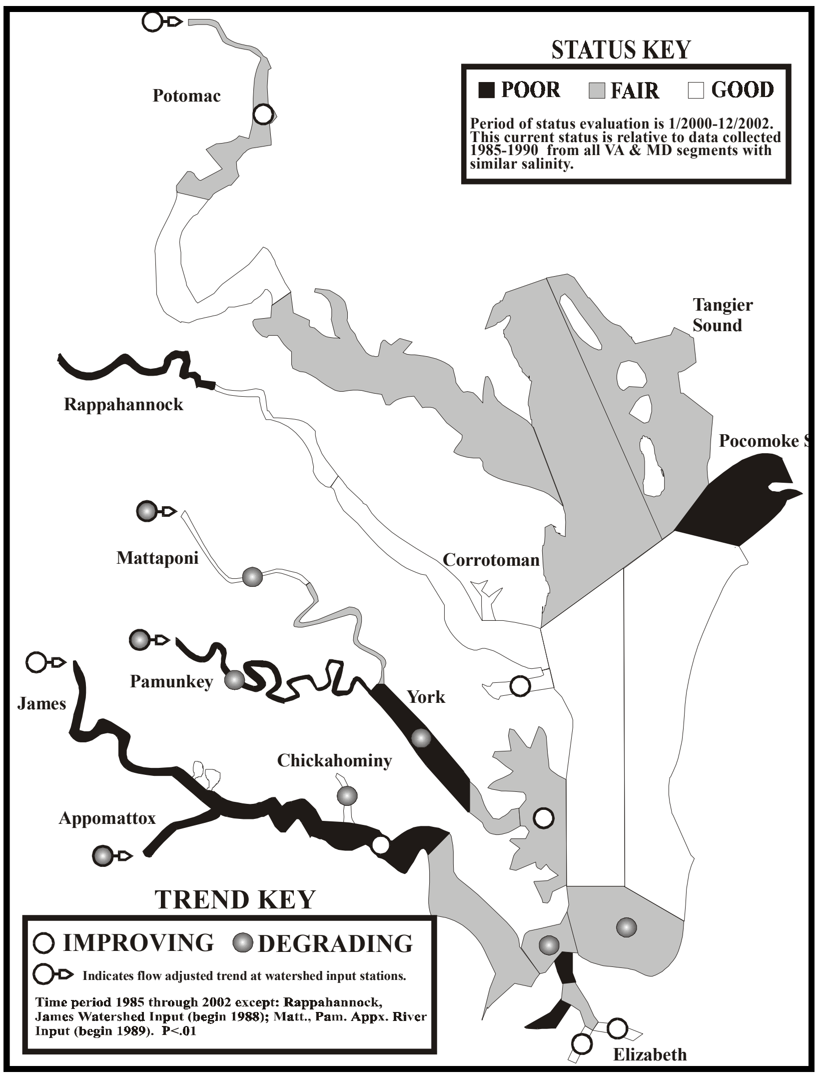


FIGURE 2-6. *Suspended Solids:* Suspended solids are a measure of particulates in the water column including inorganic mineral particles, planktonic organisms and detritus that directly controls water clarity. Elevated suspended solids can also be detrimental to the survival of oysters and other aquatic animals. Young oysters can be smothered by deposition of material and filter-feeding fish such as menhaden can be negatively affected by high concentrations of suspended solids. In addition, since suspended solids are comprised of organic and mineral particles that may contain nitrogen and phosphorus, increases in suspended solids can result in an increase of nutrient concentrations.

The following figure shows the current status and long term trends in suspended solids concentrations. All of the major Virginia tributaries have segments that are fair or poor in status. An improving trend in the flow-adjusted concentrations at the Potomac River watershed input station suggests that management actions to reduce NPS sediment loads may be having a positive effect.



Building on accomplishments

The initial *Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy* released in December 1996, committed to reducing nitrogen and phosphorus entering the Bay by 40 percent by the year 2000. Stakeholders, working through a public process, relied heavily on agricultural controls and wastewater treatment plant upgrades to achieve an "across the board" 40 percent reduction in nitrogen and phosphorus from each basin locality. The major non-point source components included agricultural BMPs and agricultural nutrient management planning. The agricultural BMPs have been implemented through Virginia's Agricultural Best Management Practices Cost Share Program, which is administered locally by soil and water conservation districts (SWCDs). Nutrient management planning has been accomplished through the combined efforts of DCR nutrient management staff, local SWCD staff, and through private certified nutrient management planners.

Implementation of the 1996 Shenandoah and Potomac Tributary Strategy provided important lessons for the basin's continued efforts to reduce and cap nutrients and sediment. Many of these lessons, which were initially described in the March 2001 *Draft Interim Nutrient Cap Strategy for the Shenandoah and Potomac River Basins*, continue to present significant challenges today, and are summarized below:

- Stakeholders will do their share towards water quality restoration when financial incentives are provided.
- Continued commitment to the tributary strategies by the Commonwealth through financial and program support is critical for success.
- Adequate technical staff must be provided to market and support the installation of agricultural conservation practices.
- The program and technical components of the strategies must be flexible enough to reflect new and changing opportunities for nutrient and sediment reductions.
- Strategy components must be linked to local water quality concerns to obtain and maintain local stakeholder involvement and support.
- Maintaining nutrient and sediment reductions as population increases must be addressed.
- Sustained effort is needed to refine and update significant best management practices and their corresponding removal rates and cost efficiencies so that resources can be targeted in the most effective manner and meaningful comparisons can be made between point and non-point source options.

In addition to these lessons, the 2001 Interim Cap Strategy noted that achieving additional reductions and maintaining those reductions would require the Commonwealth to shift the emphasis for reductions to areas other than agriculture. Managing stormwater runoff and implementing nutrient management on the Commonwealth's expanding urban lands were identified as priority targets in the 2001 document, and continue to provide a focal point for achieving and maintaining nutrient and sediment reductions. Although useful in its analysis, the document was never finalized due to the impending need for an updated tributary strategy in 2004.

The changing emphasis cited in the 2001 Interim Cap Strategy is the direct result of the changing landscapes of the Shenandoah-Potomac basin and the change in nitrogen, phosphorus and sediment loadings resulting from those land changes. These changing landscapes and the nutrient and sediment loads associated with them will continue to play a role in determining the future direction of tributary strategy actions. Figures 2-7 through 2-15 show estimated loading changes since 1985.

Figure 2-7

1985 Shenandoah-Potomac Nitrogen by Source

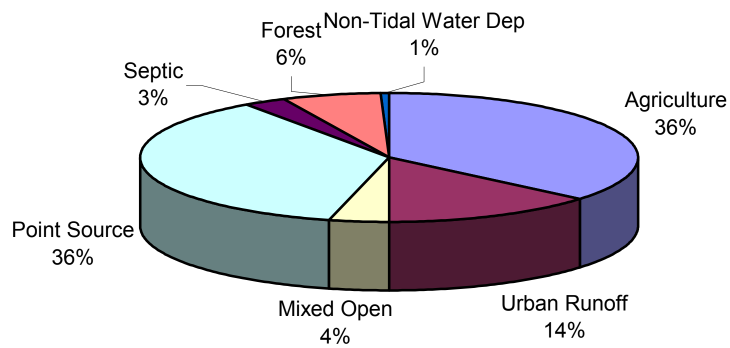


Figure 2-8

2002 Shenandoah-Potomac Nitrogen by Source

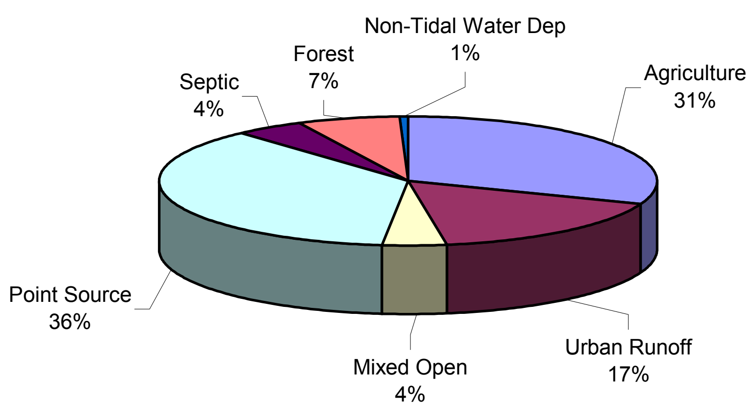


Figure 2-9
2010 Shenandoah-Potomac Nitrogen by Source

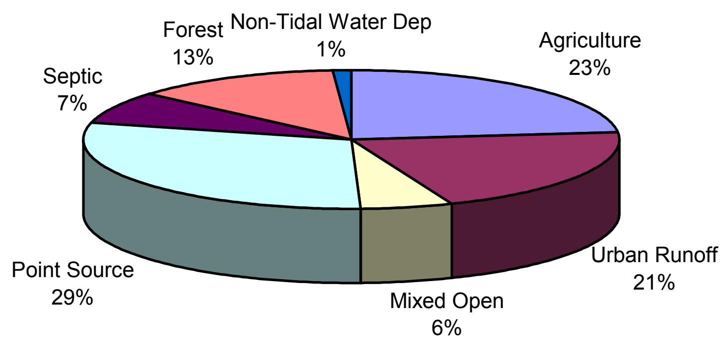


Figure 2-10
1985 Shenandoah-Potomac Phosphorus by Source

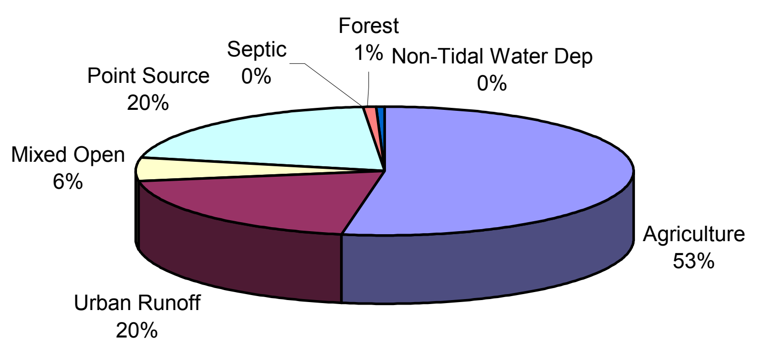


Figure 2-11
2002 Shenandoah-Potomac Phosphorus by Source

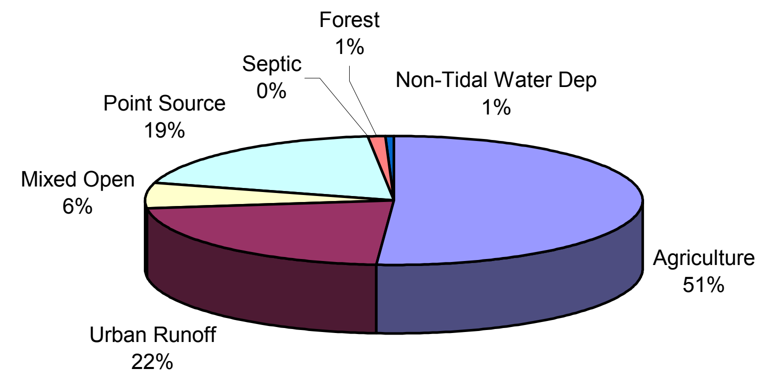


Figure 2-12
2010 Shenandoah-Potomac Phosphorus by Source

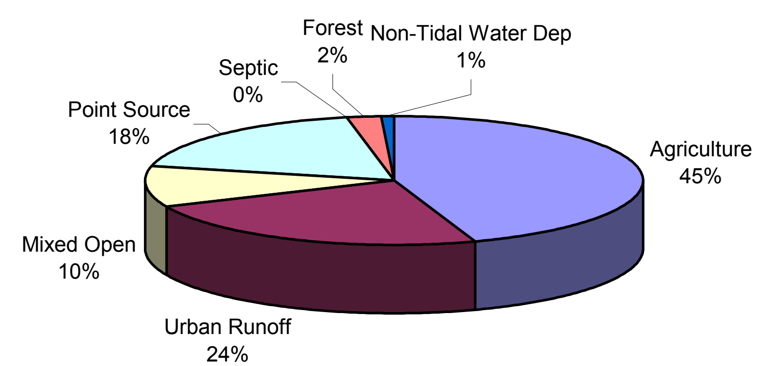


Figure 2-13
1985 Shenandoah-Potomac Sediment by Source

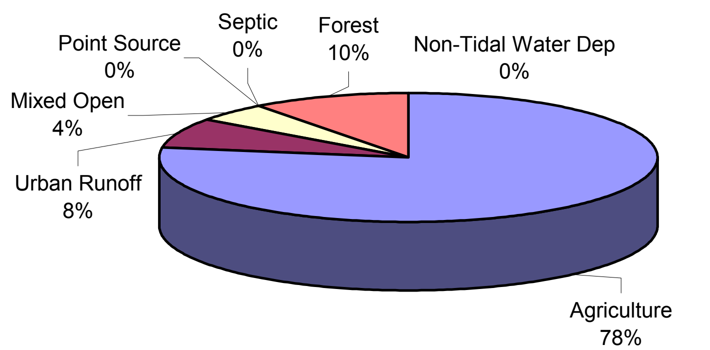


Figure 2-14
2002 Shenandoah-Potomac Sediment by Source

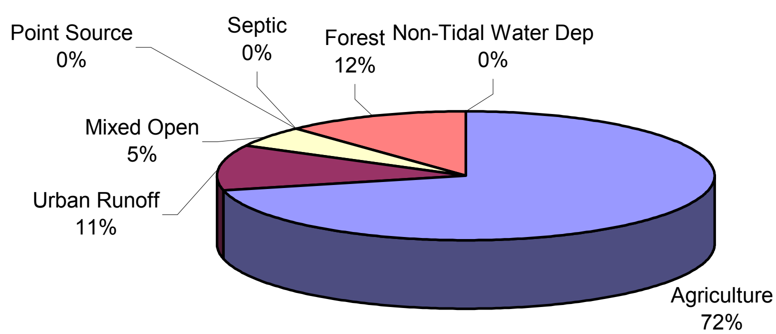
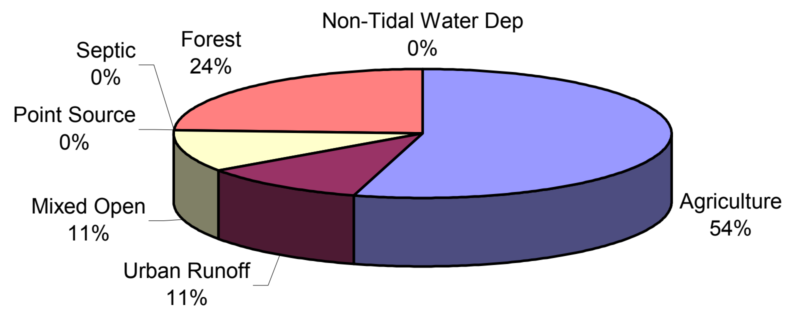


Figure 2-15
2010 Shenandoah-Potomac Sediment by Source



III. Strategy Practices and Treatments

Nutrient and sediment allocations and reduction goals

The Shenandoah-Potomac strategy is one of five strategies developed for Virginia's Chesapeake Bay basins. While each basin had specific load allocations for nitrogen, phosphorus and sediment to reach by 2010, each is part of an overall Virginia Chesapeake Bay nutrient and sediment reduction goal. Table 3-1 illustrates for each constituent by basin the baseline for measurement in 1985, progress as of 2002, what the individual basin strategies propose to achieve by 2010, and the 2010 cap load allocation received from the Chesapeake Bay Program. As the result of the efforts by state staff and stakeholders in all five basins, Virginia has crafted a series of strategies that surpass Virginia's nutrient and sediment allocation goals.

Table 3-1: 1985 Baseline, 2002 Progress, Tributary Strategy and Cap Load Allocations (Nitrogen (TN), Phosphorus (TP) and Sediment (SED)

	TN (LBS/YR) 1985 Baseline	TN (LBS/YR) 2002 Progress	TN (LBS/YR) 2010 VA Strategy	TN (LBS/YR) 2010 Cap Load Allocation
Potomac	24,243,869	22,844,023	12,904,649	12,839,755
Rappahannock	9,731,632	7,899,245	4,821,513	5,238,771
York	8,928,555	7,679,383	5,131,859	5,700,000
James	46,863,387	37,258,742	25,366,420	27,900,000
Eastern Shore VA	2,472,513	2,122,892	965,501	1,222,317
VA TOTAL	92,239,955	77,804,285	49,189,942	51,400,843 *

	TP (LBS/YR) 1985 Baseline	TP (LBS/YR) 2002 Progress	TP (LBS/YR) 2010 VA Strategy	TP (LBS/YR) 2010 Cap Load Allocation
Potomac	2,312,339	1,951,741	1,120,665	1,401,813
Rappahannock	1,271,262	954,358	595,670	620,000
York	1,151,400	749,445	481,130	480,000
James	8,491,165	5,952,375	3,480,078	3,410,000
Eastern Shore VA	232,516	227,205	82,853	84,448
VA TOTAL	13,458,682	9,835,124	5,760,395	5,996,261

	SED (TONS/YR) 1985 Baseline	SED (TONS/YR) 2002 Progress	SED (TONS/YR) 2010 VA Strategy	SED (TONS/YR) 2010 Cap Load Allocation
Potomac	827,718	720,462	391,829	616,622
Rappahannock	417,914	335,183	208,294	288,498
York	157,667	126,987	90,235	102,534
James	1,266,279	1,174,351	810,900	924,711
Eastern Shore VA	23,414	22,036	8,168	8,485
VA TOTAL	2,692,992	2,379,018	1,509,426	1,940,850

* includes the 1.5 million pound load originally assigned to the James basin

- Please note: The allocations for the York and James Rivers are considered interim pending final adoption of water quality standards.

Strategy development

As soon as allocations were received, stakeholder teams were formed in each of Virginia's major Chesapeake Bay tributary basins to assist in preparing a strategy to meet the ambitious allocations. While the Shenandoah and Potomac basins are being addressed in this document as one comprehensive strategy, separate tributary teams were created in both basins to develop strategies for both. This was seen as the most efficient way to develop a workable, stakeholder-driven process given the size, distinctive land uses and corresponding water quality issues found in the two basins.

While there were some very real differences in the two basins, many principles of the strategy development were similar. In both basins, efforts were made to ensure that the tributary teams were representative of the diverse stakeholder interests of both the Shenandoah and Potomac basins. Team representatives included citizens, farmers, soil and water conservation district staff, private industry, environmental groups, wastewater treatment plant operators, and local, state, and federal government agencies concerned with nonpoint and point sources of pollution. Appendices A and B have a complete list of members and their affiliations.

Team members worked with state agency staff to review existing basin conditions before recommending a particular mix of nonpoint source practices and point source treatment levels. They considered the existing structure, responsibilities and workload of the governmental and private entities that would be involved in implementing these practices. They worked within the framework of existing state laws, regulations and authorities. Even assuming unlimited funding, both teams' initial mix of practices came up short of the basin nutrient and sediment load allocations.

State agency staff then took the stakeholders' work and added practices and treatments restricted only by existing technologies, land availability, animal units and other variables related to the practices themselves. They did not factor in government responsibilities, infrastructure or availability of funding.

This analysis showed that it is feasible to meet cap allocation goals set for each basin. There are, however, significant barriers and impediments to implementation that must be addressed for this process moves forward. This document begins that exploration in Section IV.

Scenario results

Table 3-2: Shenandoah-Potomac Basin Allocations

		All Sources	NPS	PS
TN (lbs/yr)	Cap Allocation	12,839,755		
	Tributary Strategy	12,904,649	9,107,149	3,797,501
	2002 Progress	22,844,023	14,462,660	8,381,362
	1985	24,243,869	15,429,714	8,814,155
TP (lbs/yr)	Cap Allocation	1,401,813		
	Tributary Strategy	12,904,649	9,107,149	3,797,501
	2002 Progress	1,951,741	1,581,043	370,698
	1985	2,312,339	1,841,415	470,924
Sed (tons/yr)	Cap Allocation	616,622	616,622	
	Tributary Strategy	391,829	391,829	
	2002 Progress	720,462	720,462	
	1985	827,718	827,718	

Table 3-2 summarizes nutrient and sediment information specific to the Shenandoah-Potomac basin from 1985 to the present. The year 1985 is when official record keeping began for nutrients entering the Bay, and is thus considered the baseline year. The latest year for which data are available from the CBPO is 2002; this year is therefore used as a progress year to illustrate where we now are regarding nutrient and sediment levels. Despite population and land use changes in this basin, nitrogen and phosphorus levels were *less* in 2002 than in 1985. This is attributed to past implementation of BMPs on farmland as well as upgrades at sewage treatment plants. The 2010 cap load allocation numbers were received from the CBPO in April 2003 for the three tributary strategy constituents. The numbers represent the maximum pollutant loads of nitrogen, phosphorus and sediment that can be received by the Bay to protect living resource goals and prevent the Shenandoah-Potomac from being listed as an impaired water. The remaining three columns show the total results from the tributary strategy and the amounts contributed by point sources and non-point sources.

It also shows the nutrient and sediment cap load allocations as provided by the Chesapeake Bay Program Office in April 2003, showing the amount of nitrogen, phosphorus and sediment that the Potomac and Shenandoah will be allocated to discharge in to the Bay yearly in millions of pounds. These limits illustrate the amounts of pollutants that, it is believed, the Bay can handle from the Shenandoah- Potomac basins and still provide acceptable habitat for the Bay's living resources, such as fish and submerged aquatic vegetation. The table also provides information for nitrogen on the "baseline" established in 1985 as well as the 2002 progress to date. The 1985 baseline nutrient load is the sum of point source discharges and nonpoint nutrient runoff associated with 1985 land uses calculated for an average rainfall year. Although baseline and progress numbers are similar, it is considered progress towards "holding the line" on nutrients given the high rates of urban growth that have occurred during the 17-years between 1985 and 2002.

The remainder of this section will further analyze the strategy by looking at the list of recommended practices and treatments. These lists are referred to as "input decks." These input decks were submitted to modelers for use in the watershed model.

Point Source Input Deck Summary

In August 2004, Virginia Secretary of Natural Resources W. Tayloe Murphy, Jr., issued a statement on revisions to the draft strategies regarding point source controls. A set of "Guiding Principals" were included, which have now been applied as the basis to set annual waste load allocations for the significant nutrient discharges in the Bay watershed as outlined in the chart below. A further discussion of these principles and point source nutrient reduction proposals can be found in Section IV of this document. The Secretary's entire point source statement is also found as Appendix A.

Table 3-3: Point Source Waste Load Allocations

Tributary	Values Used to Set Waste Load Allocations	
	Annual Average Nitrogen Concentration	**Annual Average Phosphorus Concentration**
Shenandoah Potomac (above fall line) Rappahannock Eastern Shore	4.0 mg/l	0.3 mg/l
Potomac (below fall line)	3.0 mg/l	0.3 mg/l
James York	To be determined *(load allocations are "interim")*	To be determined *(load allocations are "interim")*

Table 3-4 - Shenandoah Point Source Tributary Strategy Input Deck

Facility	WSM Segment	Design Flow (MGD)	Trib Strat 2010 Flow (MGD)	Trib Strat TN Conc. (mg/l)	2010 TN Load Cap (lbs/yr)	Trib Strat TP Conc. (mg/l)	2010 TP Load Cap (lbs/yr)
Coors	190	4.50	0.70	4.00	54,820	0.30	4,112
Fishersville	190	2.00	1.71	4.00	24,364	0.30	1,827
Invista-Waynesboro	190	2.97	2.97	3.21	29,035	0.14	1,266
Luray	190	1.60	1.50	4.00	19,492	0.30	1,462
Massanutten	190	1.50	0.75	4.00	18,273	0.30	1,371
Merck	190	10.09	10.09	3.13	96,184	0.50	15,365
Middle River	190	6.80	5.10	4.00	82,839	0.30	6,213
North River	190	16.00	13.10	4.00	194,916	0.30	14,619
Pilgrims Pride-Hinton	190	1.50	0.70	6.00	27,410	0.30	1,371
Stuarts Draft	190	2.40	1.50	4.00	29,237	0.30	2,193
Waynesboro	190	4.00	2.81	4.00	48,729	0.30	3,655
Weyers Cave	190	0.50	0.40	4.00	6,091	0.30	457
Subtotal 190 =		53.86	41.33		631,391		53,909
Berryville	200	0.45	0.50	4.00	5,482	0.30	411
Front Royal	200	4.00	2.76	4.00	48,729	0.30	3,655
Georges Chicken	200	1.70	1.21	6.00	31,065	0.30	1,553
Mt. Jackson	200	0.60		4.00	7,309	0.30	548
New Market	200	0.50	0.50	4.00	6,091	0.30	457
SIL MRRS	200	1.92	1.56	4.00	23,390	0.30	1,754
Stoney Creek	200	0.60	0.39	4.00	7,309	0.30	548
Strasburg	200	0.98	0.85	4.00	11,939	0.30	895
Woodstock	200	0.80	0.50	4.00	9,746	0.30	731
Subtotal 200 =		11.55	8.27		151,060		10,553
Opequon	740	8.40	6.80	4.00	102,336	0.30	7,675
Parkins Mill	740	2.10	2.10	4.00	25,583	0.30	1,919
Subtotal 740 =		10.50	8.90		127,919		9,594
Total		75.91	58.50		910,370		74,055

Table 3-5 - Potomac Point Source Tributary Strategy Input Deck

Facility	WSM Segment	Design Flow (MGD)	Trib Strat 2010 Flow (MGD)	Trib Strat TN Conc (mg/l)	2010 TN Load Cap (lbs/yr)	Trib Strat TP Conc (mg/l)	2010 TP Load Cap (lbs/yr)
Purcellville	220	1.00	0.42	4.00	12,182	0.30	914
Broad Run*	220	10.00	5.00	4.00	121,822	0.10	3,046
Leesburg	220	10.00	6.00	4.00	121,822	0.30	9,137
Round Hill	220	0.50	0.15	4.00	6,091	0.30	457
Subtotal 220 =		20.50	11.15		261,918		13,553
DSC #1*	550	4.00	3.06	3.00	36,547	0.18	2,193
DSC #8*	550	4.00	2.85	3.00	36,547	0.18	2,193
HL Mooney*	550	24.00	15.50	3.00	219,280	0.18	13,157
UOSA*	550	54.00	35.00	8.00	1,315,682	0.10	16,446
Vint Hill	550	0.60	0.25	3.00	5,482	0.30	548
Subtotal 550 =		86.60	56.66		1,613,538		34,537
Alexandria S.A.*	900	54.00	37.94	3.00	493,381	0.18	29,603
Arlington*	900	40.00	35.29	3.00	365,467	0.18	21,928
Noman-Cole*	900	67.00	53.50	3.00	612,158	0.18	36,729
Subtotal 900 =		161.00	126.73		1,471,005		88,260
Blue Plains (VA Share)*	910	47.73	44.40	4.00	581,458	0.18	26,166
Subtotal 910 =		47.73	44.40		581,458		26,166
Quantico*	970	2.20	1.38	3.00	20,101	0.18	1,206
Subtotal 970 =		2.20	1.38		20,101		1,206
Aquia*	980	6.50	5.60	3.00	59,388	0.18	3,563
Colonial Beach	980	2.00	0.85	3.00	18,273	0.30	1,827
Dahlgren SD	980	1.00	0.36	3.00	9,137	0.30	914
Fairview Beach	980	0.20	0.10	3.00	1,827	0.30	183
NSWC-Dahlgren	980	0.72	0.43	3.00	6,578	0.30	658
Widewater WWTP*	980	0.50	0.10	3.00	4,568	0.18	274
Subtotal 980 =		10.92	7.44		99,773		7,419
Total		328.95	247.76		4,047,793		171,140

Nonpoint Source Input Deck - Shenandoah and Potomac

Table 3-6 is the combined input deck for the Shenandoah and Potomac Basins. Individual nonpoint source input decks for the Shenandoah and Potomac can be found in Appendix H.

Early in the tributary strategy planning process, state staff worked with local stakeholders to develop tributary strategy plans composed of a variety of local pollution abatement techniques, summarized in an "input deck." The objective was to involve and gain the support of stakeholders and local governments. Tributary strategy team meetings were held in the basin, during which participants devised strategies they felt were realistically achievable. In certain cases, state staff augmented these strategies with additional best management practices (BMPs) to help the plan achieve greater pollution reductions.

Once these plans (input decks) were completed, they were run through the Chesapeake Bay Program's Watershed Model to see if they would meet each basin's nutrient and sediment cap load allocations. If the plans did not meet the cap load allocations, state staff more familiar with the workings of the watershed model incorporated suggestions and concerns of local stakeholders whenever possible into more aggressive input decks.

This draft tributary strategy input deck met or came close to the allocations in all basins and was released as Virginia's draft strategies, open for public comment. The final tributary strategy input deck reflects changes based largely on suggestions received during the public comment period and the expertise of state staff.

Some practices the public wanted included now have been added, such as structural and non-structural shoreline erosion control, stream stabilization/restoration and continuous no-till. Wetland restoration, tree planting, and stream protection with fencing BMPs were increased to offset the loss of forested buffers that had been reduced to lower costs and because of comments about its potentially excessive use in the drafts. Septic denitrification systems and horse pasture management were removed to lower the cost of the strategies and to reduce the excess total nitrogen that had been achieved in the draft strategies.

Once revisions were made, the revised input deck was run through the model again. This time the allocations were met or exceeded in all basins, and the final strategies were adopted.

Table 3-6 - Virginia Shenandoah and Potomac Basin Nonpoint Source Input Deck

Shenandoah - Potomac Basin	Land Use	Available Units	2002 BMP Progress	2010 BMP Goal	Remaining BMP Need
Forestry BMPs					
Forest Harvesting Practices	Forest	1,587,498	0	8,448	8,448
Agricultural BMPs					
Buffers Forested	Hay	314,867	558	31,486	30,928
Nutrient Management Plan Implementation	Hay	314,867	149,612	208,192	58,580
Retirement Highly Erodible Land	Hay	314,867	0	1,253	1,253
Soil Conservation Water Quality Plans	Hay	314,867	60,956	208,192	147,236
Tree Planting	Hay	314,867	0	31,486	31,486
Wetland Restoration	Hay	314,867	93	31,486	31,393
Yield Reserve	Hay	314,867	0	4,382	4,382
Buffers Forested	Cropland*	193,714	766	4,382	3,616
Buffers Grass	Cropland*	193,714	179	39,665	39,486
Cover Crops	Cropland*	193,714	2,626	133,310	130,684
Continuous No-Till	Cropland*	193,714	0	0	0
Conservation Tillage	Cropland*	193,714	128,601	128,601	0
Nutrient Management Plan Implementation	Cropland*	193,714	136,403	133,310	0
Retirement Highly Erodible Land	Cropland*	193,714	11,320	0	0
Soil Conservation Water Quality Plans	Cropland*	193,714	78,065	133,310	55,245
Tree Planting	Cropland*	193,714	0	877	877

Wetland Restoration	Cropland*	193,714	152	877	725
Yield Reserve	Cropland*	193,714	0	2,274	2,274
Animal Waste Management Systems/Barnyard Runoff Control	Manure	475	343	474	131
Poultry Litter Alternative Use/Transported (Dry Tons)	Manure	576,784	0	114,878	114,878
Buffers Forested	Pasture	529,560	0	52,956	52,956
Grazing Land Protection	Pasture	529,560	43,232	40,535	0
Soil Conservation Water Quality Plans	Pasture	529,560	111,988	387,011	275,023
Stream Protection with Fencing	Pasture	529,560	2,342	215,890	213,548
Stream Protection without Fencing	Pasture	529,560	0	105,872	105,872
Stream Stabilization/Restoration (linear feet)	Pasture	na	0	53,500	53,500
Tree Planting	Pasture	529,560	0	52,956	52,956
Urban BMPs					
Buffers Forested	Pervious Urban	463,939	0	18,513	18,513
Erosion Sediment Control	Impervious Urban	194,324	0	39,009	39,009
Erosion Sediment Control	Pervious Urban	463,939	0	76,733	76,733
Nutrient Management Plan Implementation	Pervious Urban	463,939	21,083	140,689	119,606
Non Structural Shoreline Erosion Control (linear feet)	Pervious Urban	na	0	46,000	46,000
Stream Restoration (linear feet)	Impervious Urban	na	0	34,000	34,000
Stream Restoration (linear feet)	Pervious Urban	na	0	48,750	48,750
Structural Shoreline Erosion Control (linear feet)	Pervious Urban	na	0	4,600	4,600
Storm Water Management - Filtering Practices	Impervious Urban	194,324	4	27,797	27,793
Storm Water Management - Filtering Practices	Pervious Urban	463,939	10	66,444	66,434
Storm Water Management - Infiltration Practices	Impervious Urban	194,324	1	27,797	27,796
Storm Water Management - Infiltration Practices	Pervious Urban	463,939	3	66,444	66,441
Storm Water Management - Wet Ponds/Wetlands	Pervious Urban	463,939	1,811	63,278	61,467
Storm Water Management - Wet Ponds/Wetlands	Impervious Urban	194,324	868	27,797	26,929
Tree Planting	Pervious Urban	463,939	0	18,513	18,513
Mixed Open BMPs					
Buffers Forested	Mixed Open	307,525	0	15,422	15,422
Nutrient Management Plan Implementation	Mixed Open	307,525	0	203,502	203,502
Non Structural Shoreline Erosion Control (linear feet)	Mixed Open	na	0	26,000	26,000
Structural Shoreline Erosion Control (linear feet)	Mixed Open	na	0	2,600	2,600
Tree Planting	Mixed Open	307,525	0	15,422	15,422
Wetland Restoration	Mixed Open	307,525	0	15,422	15,422
Septic BMPs					
Septic Connections (systems)	Septic	131,188	0	13,931	13,931
Septic Pumping (systems)	Septic	131,188	0	85,049	85,049

All implementation units are acres unless otherwise noted.

BMPs in bold letters are conversion practices. Once converted, no additional BMPs can be applied.

BMPs not in bold letters are non-conversion practices and can have multiple BMPs applied per acre.

*Acres available for high-till and low-till are combined in this table, providing one figure for total acres of cropland available.

Shenandoah and Potomac Input Deck Highlights

The following highlights describe, in general terms, the key nonpoint source best management practices being promoted in the Shenandoah and Potomac basins. Actual acres for any particular practice in a given basin can be found in the individual input decks.

Urban - This strategy assumes acres under *Urban Nutrient Management* greatly expanded in the Shenandoah and Potomac for both pervious urban and mixed open land uses, especially on government owned lands. Urban nutrient management involves reduced fertilizer use on turf areas including home lawns, businesses and public lands such as municipal parks, playing fields, schools and rights-of-way. This would be accomplished through Department of Conservation and Recreation nutrient management staff in cooperation with local governments, businesses, homeowners associations and local Virginia Cooperative Extension staff.

Low Impact Development practices such as swales and bio-retention areas (rain gardens) that capture and temporarily store water quality volume and pass it through a filter function as excellent pollutant treatment and recharge. Additionally, practices that promote infiltration of stormwater runoff also are beneficial. This strategy seeks to accelerate the adoption of these innovative practices in developing areas.

Erosion and Sediment Control is a required practice that seeks to protect water resources from increased pollution and runoff associated with land development activities. Examples of practices include silt fences, slope drains and permanent vegetation. This strategy assumes that all acres under development in the Shenandoah and Potomac will be developed with appropriate erosion and sediment controls.

Enforcement of existing five-year *Septic Tank Pump Out* requirement for localities subject to the requirements of The Chesapeake Bay Preservation Act helps achieve nutrient reductions. This strategy considers that slightly more than 85,000 on-site systems in the Shenandoah and Potomac will be pumped out by 2010.

Agriculture – A *Nutrient Management Plan* is a comprehensive plan that describes for the farmer the optimum use of nutrients to minimize nutrient loss while maintaining yield. Plans are generally revised every two to three years. This strategy proposes to bring substantial hay and cropland acres in the Shenandoah and Potomac under such plans by 2010.

Stream Protection, both with and without fencing, requires the use of alternative drinking water troughs away from streams. The effectiveness of this practice reflects at least the partial removal of livestock from stream areas and relocation of animal waste and traffic areas to more upland locations. This strategy proposes to accelerate this practice in both the Shenandoah and Potomac with the assistance of Soil and Water Conservation District partners.

Riparian Grass and Forest Buffers are linear strips of grass or wooded area along rivers, stream and shorelines. They are very effective at filtering nutrients, sediments and other pollutants from runoff. This strategy proposes to greatly enhance acres protected by buffers in the Shenandoah and Potomac.

Conservation Tillage involves planting and growing crops with minimal disturbance of surface soil. No-till, continuous no-till and minimum tillage farming are forms of conservation tillage. This strategy looks to greatly expand conservation tillage to in the Shenandoah and Potomac.

Cover Crops reduce erosion and the leaching of nutrients by maintaining a vegetative cover on cropland and holding nutrients within the root zone. The crop is seeded directly into vegetative cover or crop residue with little disturbance of the surface soil. This strategy expands this beneficial practice in the Shenandoah and Potomac.

The following bar charts compare implementation rates from 1985 to 2002 with those the strategy calls for during the five years through 2010 for several key nonpoint source best management practices in the Shenandoah and Potomac River basin. Implementation rates for all of these practices and many others will need to increase dramatically. The use of practices already heavily used also will still need to be increased. In some cases the strategy calls for practices that have previously seen little or no implementation in the basin. While the strategy looked at the whole suite of BMPs available, there are a few practices in each basin that are not being used. In these cases either land use or some other condition did not make that particular BMP applicable to that basin. However every effort was made to identify and maximize the use of all applicable practices.

Figure 3-1: Key Shenandoah-Potomac Nonpoint Source Practices

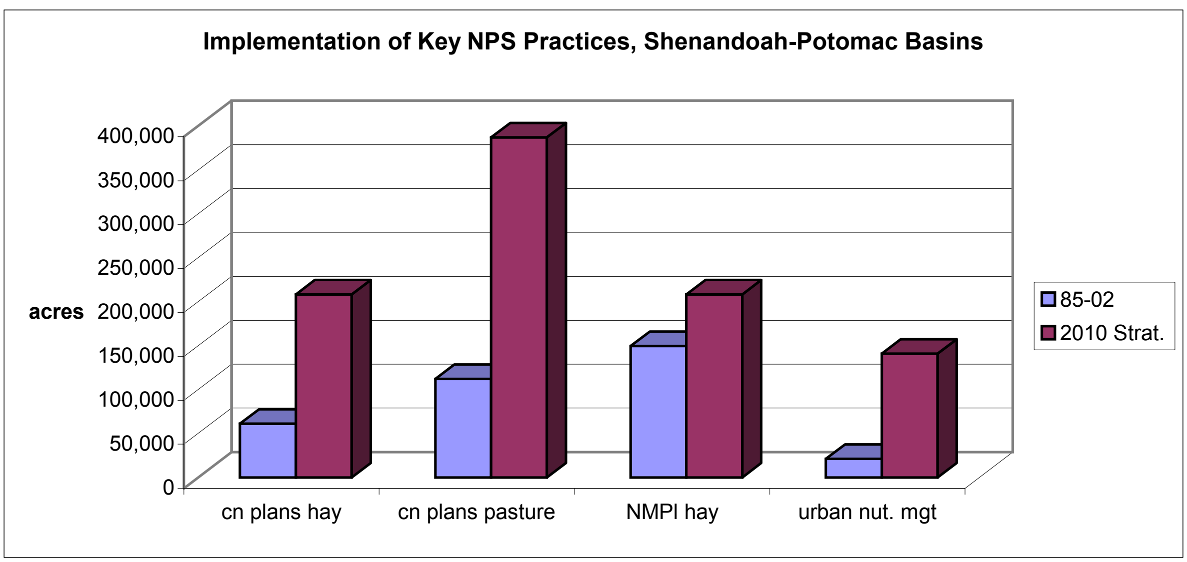
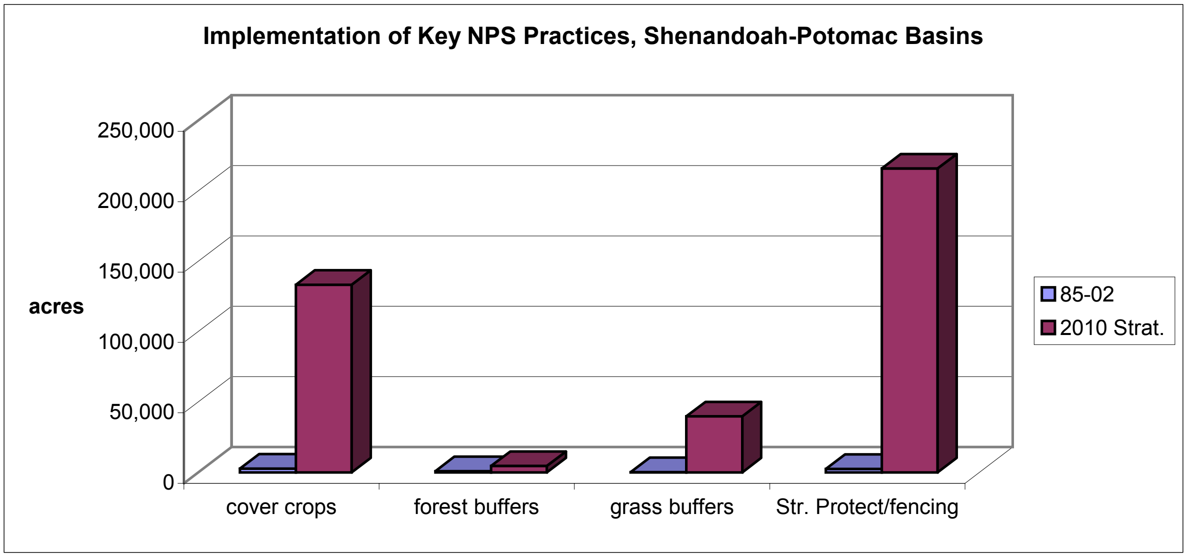


Figure 3-2: Key Shenandoah-Potomac Nonpoint Source Practices



IV. Implementing the Strategies

The strategies prepared for Virginia's Chesapeake Bay tributaries propose a suite of nonpoint source best management practices, sewage treatment plant upgrades and other actions necessary to achieve the specified nutrient and sediment reductions. The analysis and practices contained in this strategy are an important first step. However, as the input decks outlined in the previous section of this document make clear, achieving the necessary implementation levels go far beyond what we have previously seen. In order for these strategies to be meaningful, we must identify what additional resources and tools are necessary to achieve and cap these nutrient reductions in the timeframe called for by the Chesapeake 2000 Agreement. We must also further refine these strategies over time as new information becomes available.

The citizens of Virginia should receive this clear message. Restoration of the Chesapeake Bay is possible but it will not come without substantial public and private resources and programs that ensure that management practices are adopted and maintained. Without such actions, the promises we have made have no meaning. Without such actions, the economic and environmental benefits of a restored bay will not be realized.

The purpose of this chapter is to outline the implementation framework for both point and nonpoint sources of pollution. In the case of point sources, a set of guiding principles have been established that will be used to set annual waste load allocations for the significant nutrient discharges in the Bay watershed, and constitute the implementation plan for the point source elements of Virginia's tributary strategies.

For nonpoint sources the implementation approach is to refocus available tools, to steer new resources to Virginia's strongest nonpoint source control programs, and to push them to maximize reductions across the landscape. A series of seven areas of emphasis provide the framework for action.

These broad implementation approaches set the general direction, but more detailed strategic planning will be needed to carry them forward. Most of this work will be done at the basin level. State staff will elicit input from existing tributary teams, other stakeholders and citizens of the individual basins. They will then work together in meeting these ambitious and necessary nutrient and sediment reductions.

Point Source Nutrient Reduction Implementation Plan

The original draft tributary strategies, released for public review in April 2004, presented an approach for point source nutrient reduction that took into consideration several factors such as:

- Equity among significant dischargers
- Feasibility of implementing nutrient control technology
- The magnitude of point source nutrient loads from various Bay watershed regions
- The 'delivery' of loads from above the fall line

- Cost effectiveness of controls
- Unique conditions at several facilities (e.g., high-strength influent, combined sewers)

As a result, varying concentration levels for effluent total nitrogen and total phosphorus were proposed across the tributary basins, coupled with projected wastewater flows for the year 2010. Numerous comments were received about the use of 2010 flow projections, raising concerns about the accuracy of predictions and potential loss of existing design capacity in order to maintain waste load allocations in the future.

In August 2004, Virginia Secretary of Natural Resources W. Tayloe Murphy, Jr., issued a statement (see Appendix A) on revisions to the draft strategies regarding point source controls. A set of "Guiding Principals" were included, which have now been applied as the basis to set annual waste load allocations for the significant nutrient discharges in the Bay watershed, and constitute the implementation plan for the point source elements of Virginia's tributary strategies. These principals are:

- Achieve the nutrient reductions necessary to restore the Chesapeake Bay and its tidal tributaries in the timeframe set by the Chesapeake 2000 Agreement;
- Provide for the full use of existing design capacity at each of the significant municipal and industrial wastewater treatment plants; and,
- Apply currently available, stringent nutrient reduction technologies at these treatment plants.

This policy directive has been incorporated into revisions that DEQ proposes for the <u>Water Quality Management Plan (WQMP) Regulation</u> (9-VAC-25-720), which is now moving through the public process. Annual point source **waste load allocations**, using a combination of **current permitted design capacity** and **the following nutrient concentrations**, have been recalculated for each of the Tributary Strategy basins, in accordance with the Secretary's statement:

Tributary	**Values Used to Set Waste Load Allocations**	
	Annual Average Nitrogen Concentration	**Annual Average Phosphorus Concentration**
Shenandoah Potomac (above fall line) Rappahannock Eastern Shore	4.0 mg/l	0.3 mg/l
Potomac (below fall line)	3.0 mg/l	0.3 mg/l
James York	To be determined *(load allocations are "interim")*	To be determined *(load allocations are "interim")*

If a facility is currently subject to more stringent permit requirements than shown above, the more restrictive concentrations still apply. The allocations assigned to the York and James basins are considered "interim" until the adoption of the amendments to the Virginia Water Quality Standards currently undergoing the public rulemaking process. Therefore, the point source allocations in those basins will remain essentially the same as proposed in the draft strategies published in April 2004. After the standards are adopted and the river basin allocations are established, the final point source allocations will be assigned to the significant dischargers in those basins. Standards are expected to be adopted by the end of 2005.

Proposed revisions to the WQMP Regulation also include provisions for the use of point source trading and offsets. This watershed-based approach would allow allocation trading among significant dischargers within the same basin, and offsets for future load increases resulting from rising wastewater flows. A combination of point source trades and nonpoint source offsets (through the installation, operation and maintenance of Best Management Practices), is being considered, all of which would be governed under a facility's VPDES permit.

In addition to the waste load allocations, DEQ is proceeding with a companion rulemaking to establish concentration-based limits for point source nutrient discharges. The objective of this regulation is to ensure that all wastewater treatment plants have some minimum role in the nutrient reduction efforts within the Virginia Bay watershed. The Regulation for Nutrient Enriched Waters and Dischargers within the Chesapeake Bay Watershed (9-VAC-25-40) proposes technology-based, annual average limits for nitrogen and phosphorus. It states as a policy of the State Water Control Board that point source dischargers within Chesapeake Bay watershed will utilize Biological Nutrient Removal treatment or its equivalent whenever feasible. Annual average concentration limits of 8.0 mg/l for nitrogen, and 1.0 mg/l for phosphorus, are proposed for existing discharges. For new or expanded discharges, annual average concentration limits of 3.0 mg/l for nitrogen and 0.3 mg/l for phosphorus are proposed. Point sources must also meet the annual waste load allocations in the WQMP Regulation. Whichever of these two requirements (concentration or waste load) is the most stringent will dictate the actual effluent nutrient levels discharged at a particular facility.

Details about both point source nutrient discharge rulemakings are available via the DEQ Chesapeake Bay Program webpage: **http://www.deq.virginia.gov/bay/multi.html.**

In January 2005, EPA issued a permit approach for discharges within the Chesapeake Bay watershed. It describes how permits will be issued to wastewater treatment plants once water quality standards are adopted by Maryland and Virginia. DEQ will incorporate this approach into the tributary strategies implementation plan.

Nonpoint Source: A Programmatic Approach

Unlike point sources where treatment technologies can achieve specified nutrient reductions, nonpoint source controls are much more difficult to implement and maintain. They encompass multiple control strategies and must be placed on land by thousands of landowners, land managers, local governments and others. They include a mix of voluntary and regulatory programs and can be greatly affected by climatic events. In short, the management framework for nonpoint source is quite different than for point sources.

In addition to the inherent difficulties in managing nonpoint source controls, the extent of the proposed practices contained in the "input decks" of the proposed strategies go far beyond what current programs with current resources can deliver and well beyond the highest participation levels ever achieved. All of the practices proposed cannot be implemented immediately.

The Virginia Department of Conservation and Recreation (DCR), designated as the state's lead nonpoint source control agency in the Commonwealth, is responsible for all nonpoint source initiatives contained in these tributary strategies. While DCR has the lead in these efforts, the cooperation and participation of other state and federal agencies, local governments, farmers, developers, homeowners, businesses and many others will be absolutely necessary if Virginia is to meet these ambitious Bay improvement goals.

The DCR approach is to refocus available tools, to steer new resources to Virginia's strongest nonpoint source control programs, and to push them to maximize reductions across the landscape. The following summaries briefly outline this approach on a programmatic basis. It outlines program need, specific actions that will be taken in the next two years and beyond. This compilation will serve as the general framework for implementation of proposed nonpoint management practices in each of Virginia's Chesapeake Bay basins and as a resource for those developing basin, sub-basin or regional reduction actions.

Specific strategies and timelines may be modified to account for the natural resource needs, resources available and specific land use issues in each basin. Input will be solicited from the tributary teams in each basin to assist in tailoring these programmatic strategies to local needs.

A discussion of nonpoint source costs appears in Section V this document. Many of the costs associated with carrying out these programmatic goals are included in the input deck costs. Others such as the enhancement of nonpoint source tracking systems and expanded outreach and the use of media to reduce nonpoint source pollution are not fully covered in the previous discussions of costs. The ability to meet those challenges and to maintain the timeframe for implementation provided in the following summaries is dependent on the availability of resources now and in the future.

1. Agricultural Best Management Practices (BMP) Acceleration

Implementation of agricultural BMPs will achieve the most significant and cost effective reduction of nutrients and sediments from nonpoint sources. Agricultural BMPs include establishing field buffers (trees and grasses), maintaining cover crops and minimizing field tillage, managing nutrients (from commercial and animal waste sources) and managing grazing livestock. Implementing these BMPs requires significant investments of time and labor. While farmers voluntarily implement some amount of BMPs at no direct cost to the Commonwealth, Virginia's tax credit opportunities and availability of cost-share dollars create incentives for the installation of many other much needed water quality related practices on farms. Possibly the most significant motivators for installation of agricultural BMPs are financial incentive programs such as Virginia's Agricultural BMP Cost-Share Program and the federal USDA EQIP (Environmental Quality Incentive Program).

Accelerating installation of BMPs to achieve and maintain nonpoint source pollution reduction goals from agriculture sources will require a substantial increase in state cost share funding and the effective use of these new funds. Creative new approaches, increased targeting and stronger accountability requirements will also be needed. The analysis that follows focuses on more effective use of Virginia's Agricultural BMP Cost-Share Program as the means to achieve desired reductions.

Current status and projected needs to achieve Tributary Strategy Goals

Virginia's Agricultural BMP Cost-Share Program provides financial incentives to agricultural operators throughout Virginia that encourage the voluntary installation of BMPs that reduce agricultural nonpoint source pollutants. The program focuses on BMPs that reduce sediment and nutrient laden runoff from both commercial fertilizers and animal wastes. Funds are made available on a shared-cost basis (i.e. 75 percent of authorized costs borne by program funds with 25 percent contributed by the participant) or through flat rate incentive payments.

Virginia tributary strategies specify a level of increased voluntary participation in agricultural BMP implementation that is of historic levels. Currently, only 30 percent of the agricultural lands in the watershed are covered by conservation BMPs. The tributary strategies call for 92 percent of these lands to be treated. Reaching this level will require corresponding increases in cost-share funds, as well as costs associated with program delivery (technical and administrative).

Meeting the tributary strategy goals for agricultural BMP implementation will require new and more aggressive approaches to delivery of the Agricultural BMP Cost-Share program. In addition, greater levels of state and local service delivery will need to be in place. In order to make the continual progress required in the tributary strategies, the base funding level for BMPs must remain stable as opposed to the as opposed to the ebb and flow of past years. Finally, greater prioritization and targeting of the most cost-effective BMPs will be absolutely necessary to make substantial progress.

Challenges

To achieve the agricultural BMP goals consideration must be given to:

- Substantially increasing Agricultural BMP Cost-Share program base funding to stimulate greater voluntary participation by farmers and support the costs of program delivery by DCR and the state's soil and water conservation districts.
- Examining levels of financial incentives for implementation of priority agricultural BMPs to determine whether existing levels of cost share assistance

will stimulate the increase needed in participation or if program changes are necessary

- Increasing usage of remote sensing, GIS systems and targeting techniques to identify specific agricultural operations with high pollution value in need of BMP implementation
- Examining and identifying more effective recruitment approaches to better target non-participating agricultural operations.
- Increasing technical assistance in the field to better service and assist with BMP implementation by farmers.
- Targeting of state and federal cost share program dollars to increase nutrient reductions.
- Improving estimates of the effectiveness of BMPs offered through the cost-share programs.
- Expanding educational programs for agricultural BMPs that address implementation incentives, water quality benefits, farm profitability and other issues.
- Identifying and tracking voluntarily installed BMPs
- Developing innovative approaches for involving religious groups engaged in agriculture that currently do not participate in existing government cost share programs because they are contrary to their traditions and beliefs.
- Identifying nutrient and sediment reductions methodologies to track NPS reductions of all BMPs.
- Coordinating and facilitating agreement between the Virginia Agricultural BMP Cost-Share program NPS reductions and the Chesapeake Bay Program Watershed model on reduction levels achieved by BMPs, so that all BMPs implemented receive appropriate credit for reductions accomplished.

Overview of Best Management Practices 2010 Program Needs

In order for Virginia to meet the goals laid out in the tributary strategies in 2010, the following Best Management Practices conditions must be met:

- NPS pollutant reduction estimates will need to be generated for all BMPs implemented under the cost-share program.
- All state owned, operated or leased agricultural lands need to implement appropriate BMPs that minimize runoff of nutrients and sediments.
- Build capability for the Commonwealth to certify the satisfactory installation of the structural BMPs (BMPs not placed on agricultural lands) that require engineering expertise. Presently Virginia's SWCDs rely on assistance from engineers employed by the USDA Natural Resources Conservation Service (NRCS). This arrangement cannot sustain greatly expanded federal and state cost-share incentive programs
- Fulfill DCR staffing needs to effectively administer cost-share and associated programs; particularly agricultural engineers capable of designing structural BMPs.

- Increased incentives will need to be in place to assure (through voluntary, regulatory and financial incentives) significant increases in the number of farm operations that implement BMPs.
- Better utilization of cost-effective and innovative approaches including widespread use of phytase feed additives to reduce nutrients in animal wastes.
- Increased incentives and authorized alternative uses and transfer options for cost effective and environmentally sound treatment of animal wastes and poultry litter.

Year 2005-2007 Agricultural Best Management Practices Cost-Share Initiatives:

DCR commits to the following actions in support of the tributary strategies:

- Carry out the General Assembly budget bill directives (2004 session) that focus on analysis of agricultural BMP implementation by SWCDs and seek support for implementing recommended study outcomes (final report due December 31, 2005).
- Consider BMP effectiveness analysis performed in support of Chesapeake Bay restoration by the Chesapeake Bay Commission; incorporate in Virginia's Agricultural BMP Cost-Share Program as appropriate.
- Continue to refine expectations of SWCDs implementing nonpoint source agricultural programs and clarify expectations annually through grant agreements between DCR and every SWCD.
- Implement additional Conservation Reserve Enhancement Program (CREP) financial incentives, as funded by the Chesapeake Bay Restoration Fund, to accelerate achievement of program goals in the Chesapeake Bay watershed. Similar actions will be taken in the southern rivers regions of Virginia
- Evaluate current financial incentives offered through the Agricultural BMP Cost-Share Program on agricultural lands and implement revisions to enhance participation in those practices identified as cost effective and priority practices. Revisions could include increases to rates paid for implementation of BMPs.
- Evaluate DCR staffing needs for accelerated BMP implementation and evaluate options for increased technical assistance for engineering structural BMPs including private sector contracting, DCR staff expansion, and other options. Seek support to meet technical assistance needs.
- Examine and consider any needed changes in the delivery of the cost-share program including services and support provided by the SWCDs, NRCS and the Virginia Cooperative Extension (CES) and private sector organizations and personnel.
- Better integrate state and federal programs so that state and federal BMP cost-share funding dovetail to maximize financial incentives to agricultural operators.
- Begin development of an enhanced methodology to report, track, and map BMP implementation.
- Provide enhanced targeting and recruitment resources, e.g. aerial photography interpretation, GPS analysis, county land records search to better identify non-program participants and target their involvement

- Increase SWCD staff to expand recruitment of participants and to provide technical services for BMP installation
- Encourage CREP buffers, nutrient management plans and Riparian Forest Buffer restorations on all state owned, operated, and leased agricultural lands; investigate and consider pursuit of requirements for such BMPs on these lands.
- Increase available cost-share funding for agricultural BMPs within the Bay watershed based on the evaluated need. Funding to be available as a financial incentive for all land uses dependent on evaluation of need and strategies determined.
- Explore educational outreach strategies for BMP usage and ways to reach more land users to encourage voluntary BMP implementation.
- Target individual agricultural operations that have not yet excluded livestock from flowing surface waters.
- Increase grants to local governments to restore Riparian Forest Buffers on all local government owned land.

Year 2008-2010 Agricultural Best Management Practices Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Continue efforts begun in 2005, 2006 and 2007 and seek increases in financial incentives and technical assistance as necessary to meet reduction goals.
- Consider need for further approaches to exclude livestock from surface waters.
- Consider need for further approaches to protect karst recharge areas (sinkhole protection) from agriculturally contaminated runoff.
- Further refine tracking, mapping and reporting of voluntary and cost-shared best management practices and reductions.

2. Expansion of Nutrient Management Planning and Implementation Efforts

Nutrient management planning is a practice to ensure that nutrients used on a variety of farm fields and landscapes are provided at appropriate levels and times needed for crop growth and to ensure protection of ground and surface water, as well as the soil's quality, health and productivity. Nutrient management planning is appropriate for all land uses including agriculture, urban areas, golf courses, nurseries and other areas where crops and vegetation are grown and managed. When properly developed and implemented, nutrient management is a cost effective tool to help farmers and other landowners and to protect water quality. Nutrient management has been identified by the Chesapeake Bay Commission as one of the most cost effective practices available for achieving the nonpoint source nutrient reduction goals.

Current Status and Projected Needs for Nutrient Management Planning to Achieve Tributary Strategy Goals

The tributary strategies identify needed reductions from nutrient management plans for agricultural, urban and mixed open land uses. Mixed open areas include parks, athletic fields, and golf courses and similar land uses not otherwise classified as urban land use areas. The current status and projected nutrient management planning needs for these areas is outlined in the following:

	2002 credited Bay Program nutrient mgt. acres	% Credited Acres of available land needing nut. mgt.	Trib Strat goal for nutrient mgt. acres	Trib. Strat. Goal - % of available land needing nutrient mgt.
Hayland	257,097	33.0%	522,305	90.4%
Cropland	367,316	47.8%	487,290	90.0%
Total Agricultural Land	624,413	40.3%	1,009,595	90.2%
Urban Land	34,307	2.9%	337,667	99.3%
Mixed Open Land	0	0%	970,735	78.4%

The last column of the table indicates that meeting the tributary strategy goal for nutrient management for all land uses, except mixed open, will need to exceed 90 percent of the land available for nutrient management. About 40 percent of these lands are currently utilizing nutrient management planning. The additional coverage will need to be achieved while revising nutrient management plans on those acres already covered. In addition, 78.4 percent of the lands classified as mixed open will require nutrient management. This is significant since the Bay Program credited no mixed open lands in 2002 as having nutrient management. While nutrient management on mixed open lands have not been a priority, some practices do exist. However, they are not credited because no system to track and report them to Bay Program modelers exists. Similarly, the Bay Program credits only a small percentage of urban lands with nutrient management.

In November 2004, the Joint Legislative Audit and Review Commission (JLARC), the state's legislative evaluation agency completed its ***Review of Nutrient Management Planning in Virginia.*** It includes a discussion of the tributary planning nutrient management goals and some options to be considered in addressing these goals. As the JLARC report states, "The tributary strategy nutrient reduction goals for 2010 are very challenging." The report further states, "Virginia Tributary Strategies indicate a level of increase in agriculture NMP coverage on a voluntary basis that may be unrealistic" and that "Tributary Strategies goals for urban nutrient management seem unrealistic."
It is clear that meeting the tributary strategy goals will require new and more aggressive approaches in order to achieve greater acreage covered by nutrient management planning in Virginia. The options considered in the JLARC report were analyzed in developing the implementation options outlined below. All of these have been considered by DCR and other agencies for sometime:

- Increased financial incentives for nutrient management planning.

- Better enforcement of existing requirements for nutrient management planning.
- Requiring more acreage to be managed under a nutrient management plan.
- Financial and other support for alternate uses for animal wastes.
- Educational programs concerning proper nutrient application on all lands
- Enhanced technical assistance for nutrient management planning to land users.
- Better capabilities to estimate and target most cost effective nutrient management pollutant reductions and track accomplishments.

The options begin with an overview of program strategies needing to be implemented by 2010 and follows with a timetable to achieving those strategies.

Overview of Nutrient Management 2010 Program Needs

In order for Virginia to meet the goals laid out in the tributary strategies in 2010, the following nutrient management conditions must be met:

- Cost share will need to be provided for a broader range of nutrient management planning and practices on a land uses to include agricultural lands and targeted urban and mixed open land uses where nutrient load reductions are possible.
- Increased incentives will need to be in place to encourage a significant increase in lands placed under nutrient management planning.
- As recommended in the JLARC report, all state owned or operated lands should be managed with nutrient management practices and these lands should serve as a model for proper nutrient management.
- Alternative uses of animal waste such as burning as fuel or packaging as gardening fertilizer for homeowners and options transferring waste to other areas of the state or country for use as agricultural fertilizer that are cost effective and environmentally sound will be implemented.
- Implement nutrient management based on both nitrogen and phosphorus crop needs and environmental concerns (many are now only nitrogen based) to address all sources of nutrients.
- Use of all nutrients on land, including biosolids, will need to be done in accordance with nutrient management plans.
- Implementation of all nutrient management plans will need to be fully achieved and continued.

Year 2005-2007 Nutrient Management Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Evaluate current financial incentives provided for nutrient management planning on agricultural lands and implement revisions to enhance participation. Revisions could include increases to rates paid per acre for nutrient planning and increases in amounts paid for revised plans and incentives for keeping plans current.
- Increase available cost share funding for nutrient management planning for the Bay watershed based on the evaluated need. Funding to be available as a financial

incentive for all land uses depending upon the evaluation of need and strategies determined.

- Evaluate DCR staffing needs for accelerated nutrient management and evaluate options for increased technical assistance for nutrient management including contracting with SWCDs and private sector planners, DCR staff expansion, and other options. Seek legislative support to meet technical assistance needs.
- Evaluate appropriate roles for conservation partners in nutrient management to include the SWCDs, the NRCS and the CES and private sector organizations and personnel.
- Complete revisions to nutrient management training and certification regulations to address phosphorus management requirements, timing of nutrient applications and other required revisions to improve the quality of nutrient management plans.
- Develop framework for expanded nutrient management programs for urban and mixed open land uses and estimate staffing and financial resources required to implement the expanded programs.
- Begin the development of an enhanced methodology to track accomplishments in nutrient management planning by determining the land areas requiring treatment and tracking and reporting acres planned and estimated nutrient reductions achieved.
- Evaluate educational outreach strategies for nutrient management planning and ways to reach more land users to encourage voluntary nutrient management implementation.
- Require implementation of nutrient management planning on all state owned and operated lands including state universities and colleges.
- Enhance utilization of phytase by poultry producers to reduce phosphorus content of poultry waste as a pollution prevention strategy.
- Support enactment of an urban fertilizer label law providing users with nutrient management information.
- Consider the merits and risks of implementing a yield reserve program for cropland to reduce nutrient application rates to levels 15 percent below those contained in nutrient management plans.
- Based on available staff and financial resources, continue development of new strategies and begin implementation of enhanced nutrient management programs on priority land uses within the watershed.
- Evaluate effectiveness of new approaches and track accomplishments and associated nutrient reductions from all activities.
- Participate with industry in at least one pilot project aimed at developing alternative uses for poultry litter or animal manure.

Year 2008-2010 Nutrient Management Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Continue efforts begun in 2005-2007 period and increase financial incentives and technical assistance as appropriate to meet program goals.

- Consider whether the need for additional incentives or regulatory approaches are warranted to enhance nutrient management plan implementation in order to meet tributary goals.
- Enhance utilization of phytase by poultry producers to reduce phosphorus content of poultry waste.
- Require nutrient management practices as part of erosion and sediment control plans for land disturbing activities.
- Develop and implement alternative uses and transfer options for animal wastes.
- Requirements and options for alternative waste uses and animal waste transfer will be fully evaluated and implemented as appropriate.
- Improve regulation and implementation of biosolids nutrient management.
- Improve tracking and reporting of nutrient management practices and reductions.

3. The Consolidation and Strengthening of the Virginia Stormwater Management Program

Virginia's stormwater management program is aimed at reducing pollutant loads from urban and suburban land uses and developing areas.

Current Status and Projected Needs

The 2004 Virginia legislature passed into law House Bill 1177, which consolidated the Commonwealth's stormwater programs under the Department of Conservation and Recreation. As part of this consolidation, DCR has become responsible, in partnership with localities, for regulating discharges from both municipal separate stormwater sewers (MS4s) and construction activities greater than one-acre (greater than 2,500 square feet in all areas designated by a locality as being subject to the Chesapeake Bay Preservation Act).

This new law greatly strengthens Virginia's ability to meet its stormwater related tributary strategy goals by requiring certain municipalities to adopt stormwater management and construction permitting programs by July 1, 2006. This change applies to municipalities covered by the CBPA and localities regulated as MS4s. All other localities will be authorized to opt-into the program; otherwise DCR will issue stormwater permits in these localities without a program. In addition, the new law gives DCR the ability to share funding from state permit fees to localities with approved programs. The enhancement of the Virginia Stormwater Management and Erosion and Sediment Control programs is expected to reduce the sediment load to streams statewide by 972,000 tons, the phosphorus load by 466,000 pounds and the nitrogen load by 710,000 pounds annually.

In order to successfully meet its 2010 strategic goals for pollutant reductions in stormwater, Virginia will need to develop strong relationships with local governments as much of the strategic implementation will be at the local level. Sufficient state staffing will be needed to allow effective interaction with local government to develop local programs that are compliant with existing regulation and aid in meeting Virginia's goals. Regulations will need to be flexible enough to address specific watershed problems and allow localities to address the Bay tributary strategy goals.

Challenges

The new Virginia Stormwater Management Act offers an opportunity to better address the impacts from land development that have been inconsistently addressed to date. The major challenge will be the time it will take to put a fully implemented program in place at both the state and local levels.

Year 2005-2007 Stormwater Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Strive to have a minimum of 60 percent of regulated land disturbing activities complying with the general permit requirements for construction activities. There is a 20-25 percent compliance rate currently.
- Ensure 100 percent registration under the existing general permit for MS4 Phase II localities and entities.
- Ensure 100 percent coverage by an individual permit for all MS4 Phase I localities.
- Develop guidelines on what is an acceptable stormwater management program so localities with MS4s, localities located in the CBPA area and localities electing to adopt stormwater management programs may utilize the guidelines in developing their programs for delegation by July 1, 2006.
- Issue the general permits for stormwater discharges from construction activities in those localities not delegated stormwater program authority.
- Begin the process to further consolidate the stormwater and erosion and sediment control regulations into one program and enhance enforcement and compliance capabilities.
- Revise the existing Stormwater and ESC handbooks to integrate the program areas and incorporate new local government tools such as stormwater and LID planning and design principles.
- Develop and implement a statewide BMP reporting and tracking system and database
- Work with localities not electing to accept delegation of the general permitting authority to identify the benefits of accepting local delegation.

Year 2008-2010 Stormwater Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Strive to have 100 percent of regulated land disturbing activities covered by the general permit for construction activities.

- Develop review procedures to implement local stormwater program reviews on at least a five-year cycle.
- MS4 programs, both Phase I and Phase II, will be examined to determine, what if any, improvements will be needed to increase the emphasis on meeting specific watershed goals.
- Develop and publish on the DCR website an annual local SWM program compliance report describing local program efforts to reach consistency and develop a recognition program for effective programs.
- Continue to refine regulatory programs as necessary to meet program and tributary goals.
- Continue to work with local entities in implementing innovative strategies and programs at both local and watershed levels to improve water quality in the Bay.
- Establish a training and certification classification type for local stormwater program management that equips local government staff to adequately implement MS4 and construction site permitting programs.

4. Enhancing Implementation of the Virginia Erosion and Sediment Control Program

The Virginia Erosion and Sediment Control Program was established by the Virginia Erosion and Sediment Control Law (§10.1-560 et seq. of the *Code of Virginia*) and is implemented through the Virginia Erosion and Sediment Control. The law and regulations establish minimum standards for both on-the-ground compliance and overall program compliance. Virginia's cities, counties and towns implement the ESC Program locally through ordinances and other local documents. The Virginia Soil and Water Conservation Board and the Virginia Department of Conservation and Recreation provide state leadership and oversight of the local programs. Local program staff is required to be certified in specific program areas of administration, ESC plan review, and inspection. Certified contractors are required for each regulated land disturbance project. Regulated activities must have an approved erosion and sediment control plan that meets the minimum standards and land disturbance must be undertaken in accordance with the approved plan. Statewide, approximately 50,000 acres of land disturbance fall under the jurisdiction of the program annually.

The Virginia Erosion and Sediment Control Program is a foundational program, supporting a number of other program areas. The General Stormwater Permit for Construction Activities requires that an approved erosion and sediment control plan be in place prior to commencement of construction activities on sites of one acre and larger. The Municipal Separate Storm Sewer Systems (MS4s) Individual and General Stormwater Permits require the presence of a consistent erosion and sediment control program within the regulated community. Similarly, the Chesapeake Bay Preservation Act regulations require that affected local governments implement a consistent erosion and sediment control program.

Current Status and Projected Needs to Meet Tributary Strategy Goals

Currently 115 counties, cities and towns in the Chesapeake Bay watershed manage approved ESC programs in accordance with state law and regulations. Approximately 55 percent of the recently reviewed programs were judged consistent with the law and regulations. Of the programs evaluated as inconsistent, several trends were evident. Primary areas of concern include incomplete local ordinances, lack of staff certifications, inconsistent plan review and inspection activities, and weak enforcement. As Virginia continues to grow in population, erosion and sediment control measures will continue to be critical to the protection and maintenance of water quality and habitat within the Bay watershed.

Full and consistent implementation of the Virginia Erosion and Sediment Control Program at the local level is key to meeting the tributary strategy goals. Therefore, full implementation of the programs by localities is essential to the Commonwealth's meeting the tributary goals.

Challenges

To accomplish full implementation, a series of program refinements will be necessary. These will be staged over time to allow local programs to fully incorporate initial improvements before tackling additional ones. The goal is to create an environment that enhances on-going program improvements through regional networking and technology sharing.

Year 2005-2007 Erosion and Sediment Control Enhancements

DCR commits to the following actions in support of the tributary strategies:

- Complete implementation of the 5-year program compliance review cycle and evaluate its effectiveness in securing local program consistency and for identifying program areas of concern.
- Complete revisions to existing training courses to better prepare certified personnel to adequately implement local ESC programs.
- Building on the concept of government-by-example, improve procedures to ensure state agency project compliance with program requirements, utilize appropriate outreach tools to recognize consistently compliant agencies and localities.
- Continue existing and develop new grant and cost-share programs and other incentives to promote LID and implement BMP retrofits through demonstration projects, local development roundtables and other methods.
- Hold regional workshops for local program administrators, county administrators, and city and town managers to share new technologies and tools, address regional issues, resolve/clarify program concerns.
- Develop and implement a statewide BMP reporting and tracking system and database.

- Develop and publish on the DCR website an annual local ESC program compliance report describing local program efforts to reach consistency and develop a recognition program for effective programs.
- Revise the existing ESC and Stormwater handbooks to integrate the program areas and incorporate new local government tools such as stormwater and LID planning and design principles.
- Improve procedures to ensure compliance of utility projects with program requirements.
- Further consolidate the stormwater and ESC regulations into one program enhancing enforcement and compliance capabilities.

Year 2008-2010 Erosion and Sediment Control Enhancements

DCR commits to the following actions in support of the tributary strategies:

- Implement the procedures and obtain the positions needed to complete a five-year local ESC compliance program review cycle.
- Fund and implement BMP cost-share or other incentive program approaches to accelerate LID and BMP retrofit installation.
- Continue implementation and refinement of statewide BMP reporting and tracking system.
- Continue assessment of local program implementation needs and develop tools and approaches to address.
- Continue development and revisions to the training and certification program to address local program staff needs with respect to ESC and stormwater management.

5. Strengthen Implementation of the Chesapeake Bay Preservation Act

Current Status and Projected Needs to Achieve Tributary Strategy Goals

The Chesapeake Bay Preservation Act (Bay Act) provides a comprehensive approach to addressing nonpoint source pollution resulting from the use, development and redevelopment of land within the eastern portion of Virginia's Bay watershed. The active implementation and enforcement of the Bay Act at the local level is critical to maintaining the nutrient and sediment reduction levels to which the Commonwealth is committed. In maximizing the effectiveness of the Chesapeake Bay Preservation Act, the state will work directly with local governments to enhance land development tools to enable development to occur while preventing further degradation of water quality.

The Bay Act's goal is to successfully reduce the negative impacts on the Bay and its Virginia tributaries from the use and development of land. Through its requirements, the Bay Act reinforces and expands erosion, sediment and stormwater management controls for land disturbing activities that occur within Bay Act areas. In addition, the Bay Act's general performance criteria and development criteria for Resource Protection Areas, including the 100 foot buffer requirements, work to minimize the negative water quality impacts that can result from development and minimize impervious cover. This is achieved by applying sound land use practices and ensuring that the negative impacts of development are avoided resulting in a no net increase of nonpoint source pollution, or in certain instances, an actual decrease in pollution loads.

The following BMPs associated with implementation of the Bay Act will help meet tributary strategy goals.

Forested Buffers: The 100 foot buffer area, which is the landward component of the Resource Protection Area, is deemed to achieve at least 75 percent reduction of sediments and a 40 percent reduction of nutrients. Full implementation of these buffers within the 84 jurisdictions currently covered by the Bay Act in Eastern Virginia (39,669 acres) would achieve 23 percent of the forested buffer goal for urban and mixed open land uses within the watershed. The Bay Act provides a complement to other programs that encourage implementation of buffers on agricultural lands, as it requires buffers along shorelines, tributaries, wetlands and water bodies with perennial flow throughout urban, suburban and mixed open areas.

Stormwater BMPs: Full implementation of Bay Act stormwater management requirements within the jurisdictions covered by the Bay Act for both new development and redevelopment (260,486 total acres) would achieve 37 percent of the stormwater related nutrient and sediment reductions called for in the tributary strategies.

Erosion and Sediment Control: Full implementation of erosion and sediment control practices at a reduced threshold (131,225 total acres) would ensure achievement of 46 percent of the erosion and sediment control related reductions called for in the tributary strategies.

Septic System Pumpout: Full implementation of the five-year septic pumpout requirements (82,491 total acres) would achieve 36 percent of the septic pumpout related reductions called for in the tributary strategies. Currently, this is the only enforceable state level septic pumpout program in the Commonwealth.
It is important to note that these numbers are based on reductions that can be achieved in the jurisdictions that lie east of the fall line in the coastal, tidal portions of Virginia's Chesapeake Bay Watershed. Implementation of the Bay Act or similar principles tailored to the westward portion of the state's Bay watershed would result in additional achievements related to overall tributary strategy implementation.

Challenges

In order to maximize effectiveness of the Chesapeake Bay Preservation Act, the state must ensure that local land development ordinances under the Bay Act meet state law; local governments effectively implement performance measures to prevent an increase in nonpoint source pollution from new development and enable a reduction of nonpoint source pollution from redevelopment; state and federal agencies comply with the Bay Act

requirements; low impact development, sound land use planning and "better site design" are more fully practiced throughout the watershed; and a deeper understanding of the importance of nonpoint source pollution and the Bay Act by affected stakeholders and citizens is achieved to ensure effective implementation.
Initial local program compliance evaluations by Bay Act staff indicate that in order to effectively develop and implement programs that fully comply with the statute and regulations, local programs may need additional state funding support for the development of tracking systems, improving Resource Protection Area and perennial stream designation protocols through training, and additional staffing to address enforcement and programmatic revisions.

Overview of Bay Act 2010 Program Needs

In order for Virginia to meet the goals laid out in the tributary strategies in 2010, the following Bay Act conditions must be met:

- A concerted effort to effectively reach and educate affected stakeholders is a critical step in achieving the Commonwealth's goals. The Bay Act has been in place for 15 years in Virginia, yet many citizens and elected officials still are not fully informed about the program and its purpose.
- Additional enforcement options may be necessary to ensure that better compliance is being achieved.
- Restoration of state grants to localities to ensure that local governments provide ongoing implementation and enforcement of the Bay Act regulations.
- Stronger partnerships between state agencies, local governments and the private sector should be developed and/or enhanced.
- Buffer incentive programs may need to be tied more closely to conservation easements, tax credits and other preservation tools.
- Continued advancement of innovative land use tools and science is needed to inform state decision makers, localities and developers on new techniques.
- Virginia should consider whether and in what form to implement Bay Act land use principles and requirements throughout the Chesapeake Bay watershed.

Year 2005-2007 Program Initiatives

DCR commits to the following actions in support of the tributary strategies:

- During the upcoming regulatory review process, DCR will consider revisions that will improve local government Bay Act implementation options and outcomes.
- Continue compliance reviews of local Bay Act programs and make the compliance status of local programs accessible to the public by posting this information on the department web site and will evaluate the compliance reviews to identify areas where localities need additional guidance and support.
- Seek increased funding for local program implementation.

- Develop an outreach and education plan. Initial components of the plan will be implemented, including the targeting specific audiences; developing a clearinghouse of successful local programs and implementation tools; establishing an awards program for highly innovative Bay communities, development projects, and landscape initiatives.
- Develop a watershed-wide program providing planning assistance that includes voluntary incentives, information pieces, and land planning tools.
- Dedicate resources to partnerships in enhancing research components of the program including development of innovative tools and assisting with perennial water body determinations.
- Support demonstration projects that promote better site design, low impact development practices, cluster development, buffer and easement protection, and other innovative land use practices.
- Work to strengthen partnerships among state agencies and with federal agencies to coordinate Bay Act planning and activities with the TMDL program and the coastal nonpoint source program.
- Support demonstration projects, such as stormwater management retrofits on redevelopment sites or replacement of failing septics with denitrification systems within Bay Act jurisdictions.

Year 2008-2010 Program Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Evaluate initiatives undertaken in 2005-2007 and adjust efforts appropriately.

6. Enhancement of the NPS Implementation Database Tracking Systems

To effectively implement the tributary strategies it will be necessary to develop processes and systems to gather relevant information relating to the installation of practices identified in the strategies. This information will be essential in determining progress in meeting the strategy goals and identifying pollutant reductions achieved and costs.

Current Status and Projected Needs

Currently, DCR has a system to report to the EPA Chesapeake Bay Program agricultural best management practices (BMPs) that are reported by soil and water conservation districts through the Virginia Agricultural Cost-Share Database as well as agricultural BMPs reported by NRCS. These are reported to the Bay Program as an annual progress report. Nutrient management plans written by DCR and private planners acres also reported.

The Department of Forestry began reporting some BMP data for forest harvesting practices in 2003, but historical data is lacking. There is not an adequate reporting system or database to handle urban BMPs, mixed open BMPs, biosolids applications/permits or septic BMPs. Some urban and septic BMPs have been reported to the Bay Program by regional commissions but there is no consistent Bay wide reporting.

An outline of the data tracking and reporting needs would include:

- Establishment of a tracking system that counts all NPS Programs and BMPs is needed. DCR will take the lead in working with a team of partner agencies in developing this tracking system. State partners would include, but not be limited to, DEQ, the Virginia Department of Health and the Virginia Department of Forestry.

- Major components of the tracking system would include the type of BMP, its location, owner or responsible party, date installed, area or units treated, life expectancy, maintenance requirements, costs and reductions expected.

Specific NPS Program Tracking Issues:
Adequacy of existing databases: DCR maintains multiple databases to accomplish the current level of tracking. None of these databases will be adequate to handle the volume of data that needs to be tracked. Separate databases will require merger into a singular database platform for all data sources accessible via the Internet. Some of the specific deficiencies that would need to be addressed in a new tracking system include:

- Historical agricultural data quality and quantity
- Lack BMP installation and maintenance costs
- Ability to define and add newly developed BMPs
- Initiate tracking of mixed open and urban BMPs
- Expand Nutrient Management tracking beyond agricultural uses to incorporate mixed open and urban plans
- Identify and account for voluntary practices
- Onsite Septic Systems/Biosolids

Overview of 2010 NPS Implementation Database Tracking System Needs

In order for Virginia to meet the goals laid out in the tributary strategies in 2010, the following Best Management Practices conditions must be met:

- Virginia will have established a tracking system that can more fully account for conservation activities occurring on all types of lands within the Bay watershed and estimate pollutant reduction contributions to meeting the Bay tributary goals.
- The new tracking system will have the ability to geographically reference conservation activities to assist DCR and other agencies in monitoring progress and targeting programs most effectively.

Year 2005-2007 Tracking Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Identify technological and staffing needs to enhance data tracking capabilities and obtain DCR resources to the extent available or outside expertise to meet these needs to implement the program.
- Develop internal DCR processes to capture accurately all conservation activities that can be accounted towards meeting the tributary strategy goals.
- Enhance capabilities and tracking of DCR nutrient management data in an integrated system.
- DCR will develop and build a database of urban BMP data for new BMPs and develop historical urban BMP data in a suitable manner to track past accomplishments.
- Work with partner conservation agencies/programs to identify needed conservation information to be tracked and reported to a centralized DCR database and establish processes and procedures to implement.
- DCR will develop a reporting and review mechanism to annually report accomplishments achieved in pollutant reductions compared to reductions needed to meet the tributary strategy.
- On an ongoing basis DCR and partner agencies and organizations will evaluate new BMP technologies and expected pollutant reduction efficiencies from existing BMPs to ensure that the database is capturing the most accurate estimates of progress made in pollutant reductions.

Year 2008-2010 Tracking Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Continue to implement and refine the database technology and processes developed in 2005-2007 to accurately reflect program accomplishments.
- During year 2010 provide summary data to analyze the achievement of the 2010 tributary strategy goals.

7. Enhancing Outreach, Media and Education Efforts To Reduce Pollution Producing Behaviors

Over the past 20 years, the state has been successful in reaching out to stakeholders on Bay related issues through various innovative programs and activities. As a result of these efforts there are specific groups of stakeholders who are very involved in related restoration and water quality efforts. The actions of these involved stakeholder groups including soil and water conservation districts, the agricultural community, developers, local governments and others will remain critical to the state’s nutrient reduction efforts.

However, the unprecedented levels of reductions called for in tributary strategies have dramatically increased the need for action by all residents of the Bay watershed. Commitments can no longer be met by working primarily with wastewater treatment authorities, developers and the agricultural community. The public's awareness of their role in improving water quality must be greatly increased if these new commitments are to be met. In addition, efforts with those "traditional" stakeholders must be enhanced.

Taking messages more effectively to engaged stakeholders and alerting and engaging a host of new stakeholders will take both coordination of existing efforts and a variety of new strategies and products.

Current Status and Projected Needs for Outreach and Education to Achieve Tributary Strategy Goals

Despite 20 years of "educational efforts" aimed at alerting the public at large of their impacts on water quality, these efforts must be greatly enhanced to meet the 2010 goals. For example, it is well known by water quality professionals that nonpoint source pollution is the major cause of nutrient and sediment pollution to the Bay. It is also the major water pollution source across the country. Unfortunately, the majority of Americans does not know what nonpoint source pollution is – much less that they contribute to it. A recent nation-wide study conducted by the National Geographic Society showed that 44 percent of the respondents believed that industrial pollution remained the nation's largest pollution problem.

The results of a 2002 survey commissioned by the Chesapeake Bay Program shows that more than 50 percent of all Chesapeake Bay region residents believe that business and industry have the largest impact on water quality in their area.

In fact, in the national survey only **15 percent** realized that runoff pollution – that is, nonpoint source – is actually the largest source of water pollution today.

The Bay survey found that over half **(53 percent)** of those polled did not realize or acknowledge that their daily actions have an impact on their local water quality.

It is clear that additional efforts must be aimed at changing the perception that "someone else" is causing Bay and local water quality problems. As has been repeatedly said, 'we are all part of the problem, but more importantly we can all be part of the solution.'

Challenges

To tackle this overwhelming educational effort, new strategies and new resources will be needed. The Chesapeake Bay Program, with Virginia as a major participant, has funded and have begun initiation of a mass media "Clean Bay" campaign to run in the Washington D.C. media market beginning in February 2005. The campaign is being designed as a pilot so that it can be easily adapted to other media markets in the Bay watershed such as Richmond, Hampton Roads, Lynchburg/Roanoke and Harrisonburg.

The seven-week campaign will target a very specific behavior, lawn fertilization, which impacts the Bay's tidal waters. It is a very focused message to try and elicit a behavior change that will impact the Bay. While focused, it is not insignificant. There are 2.26 million lawns in the Washington D.C. Designated Market Area (DMA), or 840,000 acres. Better nutrient management on these acres would reduce nitrogen loads to the Bay by 1.3 million pounds and phosphorus by 170,000 pounds.

Obviously these types of reductions will not be achieved through a one-time seven-week campaign. This needs to be reoccurring if it is to be successful and it also needs to spread beyond the Washington, D.C./Northern Virginia market. As the campaign grows it can also incorporate other messages such as how to personally reduce stormwater runoff, the use of native landscaping materials, and eventually subjects such as the impacts of increased impervious surface.

A media campaign alone will not be enough to properly inform and engage the public. State agencies and others have developed a variety of programs and tools that would help supplement such a campaign and specifically bring messages and guidance to stakeholders such as local governments, developers, agricultural interests, civic and community groups, and conservation and preservation organizations. However, efforts to reach these stakeholders with the appropriate tools are not often coordinated. Additional staffing and money is needed to facilitate this coordination.

Overview of Outreach and Education 2010 Program Needs

In order for Virginia to meet the goals laid out in the tributary strategies in 2010, the following outreach and educational conditions must be met:

- Continue implementation and evaluation of the Washington market "Clean Bay" campaign.
- Identify funding to continue campaign in the D.C. market. Continue to develop measurements to determine actual reductions achieved.
- Identify funding and modify campaign to other Virginia markets (Richmond, Hampton Roads, Lynchburg/Roanoke, Harrisonburg).
- Use watershed coordinators in each Bay watershed to coordinate existing programs. Bring "Clean Bay" campaign messages and actions "on the ground." This would include working with civic and community groups, coordinating efforts with Virginia Cooperative Extension, Master Gardeners and others. Would work to help build capacity for existing and fledging conservation and watershed groups.
- Fully engage local governments through accelerated support to existing watershed roundtables.

- Coordinate efforts to reach development community, local government officials and planning staff with existing watershed management planning, LID, other tools. Develop new materials as needed.

Year 2005-2007 Outreach Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Evaluate results of the initial Washington DMA "Clean Bay" campaign.
- Establish funding to continue Washington/Northern Virginia campaign; modify based on evaluation.
- Establish funding to bring "Clean Bay" campaign to Richmond market.
- Watershed Coordinators intensify efforts to work with existing and fledgling conservation and watershed groups using Watershed Connections materials and Watershed Management Planning Guides.
- Continue and expand targeted stakeholder outreach using existing conferences, outreach requirements (i.e. Va. Environmental Conference, VACO/VML conferences, MS4 outreach requirements)
- Bring campaign to Hampton Roads, Lynchburg/Roanoke, Fredericksburg and Harrisonburg
- Work with Bay Program on continued analysis of results; determine if results can be measured in terms of actual nutrient reductions.
- Work to coordinate with Virginia Cooperative Extension Service Master Gardeners "on-the-ground" efforts to reach suburban residents in Northern Virginia and Richmond markets.
- Enhance outreach efforts with local governments through direct contact and accelerated support to Bay roundtables.

Year 2008-2010 Outreach Initiatives

DCR commits to the following actions in support of the tributary strategies:

- Continue "Clean Bay" campaign in all major Virginia Bay media markets. As campaign matures, modify to introduce additional messages aimed at improving the Bay and local water quality.
- Work to coordinate with VCE, Master Gardeners "on-the-ground" efforts to reach urban and suburban residents in all Virginia Bay markets.
- Continue support to Bay roundtables.
- Expand direct contact/outreach efforts with public planners and private development community.

V. Estimated Tributary Strategy Costs

The tributary strategies developed by the states involved in the Chesapeake Bay Program (CBP) call for unprecedented levels of effort to reduce and cap the discharge of nutrients and sediments to the Chesapeake Bay and its tributaries. As a result, the costs of implementation of the strategies basin wide are estimated at just under $10 billion.

The estimated cost for the Shenandoah-Potomac River Basin strategy is $3.88 billion. Point sources account for $499 million with nonpoint source practices making up the remaining $3.38 billion. Table 5-2 has cost breakdown in major categories. A more detailed breakdown is found in Appendix C.

This section provides an overview and analysis of projected costs and explains why cost projections have changed since the Secretary of Natural Resources released draft strategies for Virginia's tributaries in April 2004.

In recognition of the significant implementation costs, the Chesapeake Executive Council created a Blue Ribbon Financing Panel to recommend ways to pay for the implementation of the strategies. During the panel's first meeting, it requested that the CBP develop a consistent methodology to determine costs across all jurisdictions in order to assess the financial needs for implementation. The CBP contracted with Science Applications International Corporation (SAIC) to conduct a study of how the costs were determined in each state and to see if a common methodology could be utilized so that costs would be comparable from jurisdiction to jurisdiction. Using this methodology, costs would be recalculated for each jurisdiction. This resulted in the Bay Program Blue Ribbon Panel estimates of capital, operation and maintenance (O&M), and technical assistance (TA) costs totaling $30.21 billion, with the Virginia portion of capital, O&M, and TA estimated to be $10.02 billion.

With this analysis in hand, Virginia agencies proposed several modifications to the nonpoint source estimates which resulted in a final cost estimate of $9.99 billion for capital, O&M, and TA.

April 2004 draft strategy costs

The initial cost estimate of $3.2 billion contained in Virginia's draft tributary strategies, released in April 2004 underestimated total costs for several reasons. First, the initial estimates were based on one-time capital installation costs and did not include the costs of operation and maintenance (O&M) of the specified best management practices (BMPs). Second, additional costs were not included for the renewal of annual or short term BMPs. For example, the planting of cover crops on agricultural lands is an annual practice and the costs were only calculated as a one-time cost. Third, the practices proposed in the initial strategies have changed somewhat to order to achieve the nutrient allocations for each river. Finally, the most significant change came from how the costs of urban stormwater BMPs were calculated. For the April drafts, Virginia used data from the Chesapeake Bay Program's "Use Attainability Analysis". These figures were based on the estimated annual cost per household in the jurisdictions in which the practices were installed rather than the actual cost to install the practice. This change alone accounted for the majority of the difference between the April 2004 estimates and those that have been subsequently developed.

The analysis conducted by SAIC for the Blue Ribbon Finance Panel, which totaled $10.02 billion for Virginia, did not include multiple installation costs for short term and annual BMPs needing reinstallation. It also did not estimate technical assistance (TA) and O&M costs consistent with those used by Virginia. A detailed explanation of the differences between the SAIC/CBP analysis and the Virginia estimates can be found in Appendix C.

Virginia's modified costs

Within the total cost for implementing the strategies statewide of $9.99 billion, approximately $1.14 billion is needed for point source upgrades, operation and maintenance (costs estimated by DEQ), $7.01 billion is needed for capital costs for nonpoint source BMPs (primarily urban stormwater BMP installation costs); $1.26 billion is needed for technical assistance to install non-urban nonpoint source BMPs; $580 million is needed to operate and maintain the various BMPs installed.

Table 5-1: Summary of Estimated Costs

Virginia Statewide Estimated Cost Summary

Estimated costs in Millions of Dollars	Capital Costs	Tech Assistance	O & M	Total Cost
Total Cost for Agricultural BMPs	$740	$74	$45	$859
Total Cost for Urban BMPs	$5,874	$1,118	$528	$7,519
Total Cost for Mixed Open BMPs	$323	$65	$7	$394
Total Costs for Forest BMPs	$2	$0.2	$0	$2
Total Cost for Septic BMPs	$74	$7	$0	$82
Total Costs for Point Source Reductions	$1,099	$0	$42	$1,141
Grand Total				$9,997

Table 5-2: Summary of Shenandoah-Potomac Estimated Costs

Estimated Costs in Millions of Dollars	Capital Costs	Tech Assistance	O & M	Total Cost
Total Cost for Agricultural BMPs	$297	$30	$22	$349
Total Cost for Urban BMPs	$2,300	$437	$195	$2,932
Total Cost for Mixed Open BMPs	$50	$10	$1	$61
Total Costs for Forest BMPs	$0.20	$0.02	$0	$0.2
Total Cost for Septic BMPs	$38	$4	$0	$42
Total Costs for Point Source Reductions	$476	$0	$23	$499
Grand Total				$3,883

A discussion of how these costs were developed by source category (or land use) follows. A breakdown of costs by basin, including separated costs for the Shenandoah and Potomac basins, can be found in Appendix C.

Virginia's modified nonpoint source costs

Agricultural BMP costs

The overall estimated cost for implementing agricultural BMPs (including capital costs, O & M and technical assistance) is approximately $859 million. The installation costs per agricultural BMP was derived using actual VA Agricultural Incentive Program costs, based on state cost share for various BMPs. The costs for program implementation from 1997 through 2002 were analyzed and an average cost per BMP was calculated, based on the actual installation of that BMP average across the state.

Technical assistance costs for agricultural BMP installation is estimated at 10 percent of the cost of the BMP. These costs are usually incurred by soil and water conservation districts that give technical assistance to farmers.

Operation and maintenance costs were estimated based on the cost incurred by the farmer to maintain the practice and were derived from the SAIC/CBP data.

Urban, mixed open, forest and septic BMP costs

Currently, Virginia does not have documented costs for most urban, mixed open and septic BMPs. Since Virginia was lacking consistent information for the cost of urban mixed open and septic BMPs, the state determined that the SAIC/CBP costs would most accurately and consistently represent these costs. For more information about how SAIC/CBP conducted the analysis, and for the analysis results, please visit the Chesapeake Bay Program website at **www.chesapeakebay.net**.

The final estimated cost for urban BMP implementation, statewide, is $7.52 billion. Technical assistance costs were estimated as 20 percent of the cost of BMP installation. The final estimated cost for implementing mixed-open BMPs, statewide, is $394 million.

Operation and maintenance costs were estimated by SAIC/CBP, based on the cost of installing the BMP and the cost to ensure functionality throughout the life of the BMP. The estimated cost for forest harvesting practices is $2.3 million and was estimated by staff with input from the Virginia Department of Forestry. The DOF has consistently been monitoring implementation of this practice.

Implementation of septic pump-outs and connections is expected to cost approximately $82 million. There were no operation and maintenance costs projected for these practices, however technical assistance is estimated to be approximately 10 percent of the practice cost.

While the cost of $8.86 billion is the total estimated cost to implement the nonpoint source pollution portion of all the strategies in Virginia, the distribution of these costs will vary by sector, according to who will pay for BMP installation. The primary distribution of costs considered for this analysis, however, is the amount of implementation that state government will pay versus the amount that will be covered by the private sector (farmers, non-profits, etc.).

State government costs were determined based on the amount of funding that the state currently provides to implement various BMPs or support to program implementation. It was assumed that between five and 10 percent of the all the BMPs would be done on a voluntary basis. That number was removed from the estimated state governmental costs analysis.

In the case of agricultural BMPs the state offers 75 percent cost-share, so the state assumed 75 percent of the cost of agricultural BMPs. The following practices in the strategies are not paid in any portion by the state: erosion and sediment control BMPs, new stormwater management BMPs, forest harvesting BMPs, and septic connections. These practices are part of what is related to ongoing development costs and fulfilling current environmental permits related to that development. The table below illustrates the breakdown between Overall, Development and Permits, State Governmental, and Non-Governmental costs.

Table 5-3: Estimated Nonpoint Source Costs

	Estimated Tributary Strategy NPS Costs (Millions)		
Overall			
	Capital	**TA**	**O&M**
Agriculture	740	74	45
Urban	5,874	1,118	528
Mixed Open	323	65	6.8
Septic	74	7.4	0.0
Forest	2.1	0.2	0.0
Total	**7,013**	**1,265**	**580**
Grand total	**8,858**		
Development and Permits			
	Capital	**TA**	**O&M**
Agriculture	0.0	0.0	0.0
Urban	4,929	929	477
Mixed Open	0.00	0.00	0.0
Septic	29	2.9	0.0
Forest	2.1	0.2	0.0
Total	**4,960**	**932**	**477**
Grand Total	**6,369**		
State Governmental			
	Capital	**TA**	**O&M**
Agriculture	528	52.8	4
Urban	238	48	0.0

Mixed Open	312	62	0.0
Septic	3.9	0.4	0.0
Forest	0.0	0.0	0.0
Total	**1,083**	**163**	**4**
Grand total	**1,250**		

Non-Governmental

	Capital	TA	O&M
Agriculture	212	21	41
Urban	707	141	51
Mixed Open	11	2.1	6.87
Septic	41	4.1	0.0
Forest	0.0	0.0	0.0
Total	**970**	**169**	**99**
Grand total	**1,238**		

Economic benefits of the tributary strategies

The Commonwealth of Virginia has developed a strategy for meeting the water quality goals of the Chesapeake Bay Agreement. Virginia's tributary strategy includes upgrades to wastewater and industrial treatment plants, increased levels of best management practices (BMPs) for farming, and improved septic systems.

How will the strategy affect the economy?

Preliminary information suggests that the planned level of pollution controls will cost about $9.9 billion, although lower cost solutions may also emerge as implementation proceeds. These expenditures are not lost in the economy, rather they are an investment providing jobs and incomes in pollution control and agricultural service industries. Implementing the tributary strategy will increase economic strength in the region.
The Chesapeake Bay Program found that expenditures needed to achieve the water quality goals will result in increases in employment, income, and output in Virginia, compared to levels expected without the clean up. These investments will also maintain and hopefully revitalize income and jobs from industries that depend on a clean Bay, such as commercial and recreational fishing, and tourism, that were not included in the study.

How do economic benefits result from the strategies?

Purchasing wastewater treatment technologies and BMPs is similar to making other infrastructure investments. Just as a highway project provides economic stimulus for the local economy, cleaning up the Bay will also stimulate Virginia's economy. In cleaning up the Bay, the Commonwealth can expect increases in income and employment in:

- wastewater treatment plant design, construction, operation, and repair,
- agricultural services, such as custom work and landscape design, and
- residential septic system construction, maintenance, and repair.

Increases in these environmental service and product sectors represent new opportunities for Virginia's residents. And, because costs to one sector are revenues and incomes in other sectors, a dollar spent on pollution controls can result in the spending of more than a dollar in the overall economy (a ripple effect). The spending in these sectors will ripple through the economy, benefiting the Commonwealth as a whole.

Appendix A: Revisions to Virginia's Tributary Strategies: Point Sources

Statement of Secretary of Natural Resources, W. Tayloe Murphy, Jr.
August 27, 2004

Following public comment and after further analysis by state agency staff, I am announcing today our proposed revisions to the point source elements of Virginia's Chesapeake Bay tributary strategies. In the near future, I will announce final allocations and implementation plans for the nonpoint source elements of the strategies.
The Commonwealth's nutrient and sediment reduction goals we are trying to reach are ambitious and the proposals I am making today are equally challenging. However, in the end, the results will benefit all Virginians.

Use of Capacity with Stringent Treatment

Our guiding principals for establishing point source allocations at wastewater treatment facilities are as follows:

- achieve the nutrient reductions necessary to restore the Chesapeake Bay and its tidal tributaries in the timeframe proposed in the Chesapeake 2000 agreement;
- provide for the full use of existing design capacity at each of the significant municipal and industrial wastewater treatment plants; and
- apply currently available nutrient reduction technologies at these treatment plants.

The point source strategies contained in these revisions will enable Virginia to manage nutrient loadings in the Chesapeake Bay over the long term. The public review drafts of the strategies based treatment levels to the expected 2010 flows at significant sewage treatment plants and industrial facilities; however, based on comments received and after further analysis by agency staff, it became apparent that for certain facilities to fully utilize their current design capacity, while also maintaining the loadings assigned in the public review drafts, would require nutrient treatment at levels beyond existing limits of technology.

Accordingly, by capping loads based on design flow rather than estimated 2010 flows wastewater treatment plants will be able to fully use their capacity and will have greater flexibility in meeting loading goals. Some facilities, because they are far from reaching their design capacity will have more time to implement process improvements. Other facilities will need to begin the process of upgrading more quickly. This approach will also allow some facilities to engage in nutrient trading or use other cost effective methods to achieve and maintain the cap loads for their facilities and for each river basin.
This approach is consistent with the proposal recently announced by the United States Environmental Protection Agency to implement tributary strategy allocations through discharge permits and to cap those loads over time.

Determining Point Source Allocations

Significant municipal facilities located within Virginia's Chesapeake Bay watershed, except as specified below, will be allocated nutrient loads based on annual average effluent concentrations of 4.0 milligrams per liter total nitrogen and 0.3 milligrams per liter total phosphorus calculated at their design flow.
Significant municipal facilities located in the lower Potomac basin [i.e., the Potomac basin below the fall line] will be allocated nutrient loads based on annual average effluent concentrations of 3.0 milligrams per liter total nitrogen and 0.3 milligrams per liter total phosphorus calculated at their design flow unless an existing permit requires lower effluent concentrations.

As discussed in the Allocations and Water Quality Standards section below, the allocations assigned to the York and James basins are considered "interim" until the adoption of the amendments to the Virginia Water Quality Standards. Therefore, the point source allocations in those basins will remain essentially the same as proposed in the draft strategies published earlier this year. After the standards are adopted and the river basin allocations are established, the final point source allocations will be assigned to the significant dischargers in those basins.
Some plants may be given allocations that vary from this policy in order to account for unusual circumstances.

Additionally, because industrial facilities treat wastewater with different characteristics from municipal wastewater, individual determinations have been made about levels of performance and the resulting allocations for those facilities.

Allocating the "Orphan Load"

A number of comments were received regarding the status of the allocations proposed for the York and James River basins, particularly the additional nitrogen reduction, due to the so-called "orphan load", that was assigned to the James River basin.
For the time being, we will remove assignment of the orphan load reduction from the James River basin and reallocate it following adoption of the water quality standards.

Allocation and Water Quality Standards

When the tributary strategy allocations were adopted by the Chesapeake Bay Program, it was recognized that the allocations would provide the basis for tributary strategies, but they may need to be adjusted to reflect final state water quality standards. It was also recognized that the allocations assigned to Virginia's basins are directly tied to dissolved oxygen conditions in the Bay's mainstem, except for the York and James basins. While we developed strategies for the York and James to meet the assigned allocations, we continue to acknowledge that application of the final water quality standards has the potential of affecting the allocations in these two basins due to unique local water quality conditions. Therefore, we consider the allocations for the York and James basins as "interim" until the new water quality standards for dissolved oxygen, chlorophyll "a" and water clarity are adopted. In June 2004, the State Water Control Board approved for public comment revisions to the Virginia Water Quality Standards that incorporate criteria for dissolved oxygen, chlorophyll “a”, and water clarity for the Chesapeake Bay and its tidal tributaries. Once the new water quality standards have been adopted in final form and analysis done to determine necessary nutrient and sediment reductions to meet the new standards, final allocations will be assigned to these two basins.

While we acknowledge that the allocations for the York and James may need to be recalculated, it is also clear that significant nutrient reductions are necessary for the health of these rivers. Therefore, we will continue working to reduce nutrients and sediments in the York and James rivers even before final allocation numbers for each basin are established.

Implementing Point Source Policy

The loadings for wastewater treatment facilities based on the policy above will be proposed in amendments to the Water Quality Management Regulation to be considered by the State Water Control Board on August 31, 2004.

The board will also review a proposed regulation that sets minimum technology based limits for all treatment plants, regardless of size.

Following the requirements of the Administrative Process Act, these proposed regulations will be reviewed by the public during public comments periods and under Virginia law, final action will be responsibility of the board.

Prior to adoption of any final regulations, the Department of Environmental Quality will address nutrient loadings from point sources according to agency guidance issued on July 15, 2004. According to this guidance, each permit issued will include:

1. Monitoring requirements to identify more clearly the amount of nutrients the facilities release;
2. When data is available, caps on the release of nutrients to minimize additional nutrient loading to the Chesapeake Bay and its tributaries;
3. Requirements for a plan to optimize nutrient removal at the existing treatment facilities and development of a Basis of Design report for a range of nutrient removal technologies, including limit of technology, for subsequent design and construction; and,
4. A specific re-opener clause so that DEQ can modify the permits to include more stringent limits before the five-year permit term expires based on regulations adopted by the board.

Following completion of the water quality standards and technology based nutrient limit regulations (projected completion date November 1, 2005), DEQ will issue, re-issue or modify permits in conformance with the provisions of the adopted regulations.

Appendix B: Glossary of terms, Abbreviations, Acronyms and BMP Definitions

Glossary of Terms

A

Agricultural lands - Those lands used for the planting and harvesting of crops or plant growth of any kind in the open, pasture; horticulture; dairying; floriculture; or raising of poultry and/or livestock.

Algae - Simple rootless plants that grow in bodies of water (e.g. estuaries) at rates in relative proportion to the amounts of nutrients (e.g. nitrogen and phosphorus) available in water.

Algal Bloom- A population burst of phytoplankton that remains within a defined part of the water column.

Aquatic - Living in water.

Atmospheric deposition - When the air pollution hits the earth surface. Air pollution washed out of the sky by rain or snow is called "wet deposition." When air pollution deposits without benefit of rain its called "dry deposition."

B

Baseline - The numeric level of nutrient load at a particular point in time that serves to establish nutrient reduction goals and allowances.

Best Management Practices (BMP) - A land practice or combination of practices that provide the most effective and practicable means of controlling point and nonpoint pollutants at levels compatible with environmental quality goals.

Biological Nutrient Removal (BNR) - Wastewater treatment that enhances phosphorus and nitrogen removal by microbial cells instead of traditional chemical addition systems. Nitrogen is removed through a temperature dependent process in which the ammonia nitrogen present in raw wastewater is converted by bacteria first to nitrate nitrogen and then to nitrogen gas. Phosphorus removal is accomplished by creating environmental conditions that encourage the biomass to accumulate increased quantities of phosphorus, which are then settled and removed in the waste sludge.

Bioretention - Bioretention sites, also called "Rain Gardens," are an innovative method for stormwater management that retains stormwater on site and uses plants and layers of soil, sand, and mulch to reduce the amount of nutrients and other pollutants that enter local waterways.

C

Cap - The total nutrient load that is allowed to be discharged into a given water body. The cap is the baseline minus the amount of load reduction needed to meet the goal. The cap is equal, or greater than, the sum of the allowances.

Cap load - Cap loads are the maximum pollutant load of nutrients and sediments that can be allowed and still meet Chesapeake Bay water quality criteria.

Cap load allocations - Based on each tributary's nutrient and sediment input to the Bay, the total Chesapeake Bay load is apportioned to each tributary and jurisdiction. The cap load allocations show where the nutrient and sediment loads will most effectively be reduced to achieve the restoration goal.

Chesapeake Bay Preservation Act (CBPA) - The Act adopted in 1988 by the Virginia General Assembly that establishes the state's Chesapeake Bay preservation efforts, provides authority for local programs to adopt land use standards to protect and improve water quality and established the Chesapeake Local Assistance Board and Department to oversee and assist local planning efforts. Effective July 1, 2004, the Chesapeake Bay Local Assistance Department was merged into the Virginia Department of Conservation and Recreation.

Chlorophyll a - A pigment contained in plants that is used to turn light energy into food. Chlorophyll also gives plants their green color.

Coastal plain - The level land with generally finer and fertile soils downstream of the piedmont and fall line, where tidal influence is felt in the rivers.

D

Denitrification - The conversion of nitrite and nitrate nitrogen (after nitrification) to inert nitrogen gas. This treatment process requires that little or no oxygen be present in the system and that an organic food source be provided to foster growth of another type of bacteria. The organic food source can be either recycled waste activated sludge or methanol. The resultant nitrogen gas is released to the atmosphere.

Department of Conservation and Recreation (DCR) - A state agency under the Secretariat of Natural Resources that includes Virginia State Parks, Soil and Water Conservation, Natural Heritage and Planning and Recreational Resources, Dam Safety and Floodplain Management. As of July 1, 2004, the department is also responsible for implementation of the Chesapeake Bay Preservation Act as the former Chesapeake Bay Local Assistance Department was merged into DCR. Its purpose is to conserve, protect, enhance, and advocate the wise use of the Commonwealth's unique natural, historic, recreational, scenic, and cultural resources.

Department of Environmental Quality (DEQ) - A state agency under the Secretariat of Natural Resources formed in 1994 by the General Assembly and includes Air, Water, and Waste Divisions.

Design Flow – The discharge flow authorized by the VPDES permit and/or the capacity under which the wastewater treatment processes will most likely be operating (9VAC25-790-50) in the year 2010.

Dissolved Oxygen - Microscopic bubbles of oxygen that are mixed in the water and occur between water molecules. Oxygen becomes dissolved into water through diffusion from the atmosphere or surface agitation (i.e., waves). Dissolved oxygen is necessary for healthy lakes, rivers, and estuaries. Most aquatic plants and animals need oxygen to survive. Fish will drown in water when the dissolved oxygen levels get too low. The absence of dissolved oxygen in water is a sign of possible pollution.

EF

Easement - A limited right to make use of a property owned by another, for example, a right of way across the property.

Ecosystem - All the organisms in a particular region and the environment in which they live. The elements of an ecosystem interact with each other in some way, and so depend on each other either directly or indirectly.

Effluent - The discharge to a body of water from a defined source, generally consisting of a mixture of waste and water from industrial or municipal facilities.

Erosion - The disruption and movement of soil particles by wind, water, or ice, either occurring naturally or as a result of land use.

Estuary - A semi enclosed body of water that has a free connection with the open sea and within which seawater (from the ocean) is diluted measurably with freshwater that is derived from land drainage (i.e. the Chesapeake Bay). Brackish estuarine waters are decreasingly salty in the upstream direction and vice versa. The ocean tides are projected upstream to the fall lines.

Eutrophication - The fertilization of surface waters by nutrients that were previously scarce. Eutrophication through nutrient and sediment inflow is a natural aging process by which warm shallow lakes evolve to dry land. Human activities are greatly accelerating the process. The most visible consequence is the proliferation of algae. The increased growth of algae and aquatic weeds can degrade water quality.

Fall Line - A line joining the waterfalls on several rivers that marks the point where each river descends from the upland to the lowland and marks the limit of navigability of each river.

Floodplain – Level land that may be submerged by floodwaters.

GHI

Habitat - The place and conditions in which an organism lives.

Hydrology - The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Integrated pest management (IPM) - A sustainable pest management approach which combines the use of biological, cultural, physical, and chemical tactics in a way that minimizes economic, health and environmental risks. One aspect of IPM involves regular monitoring (scouting) to determine if and when treatments are needed based on biological and/or aesthetic thresholds to keep pest numbers low enough to prevent intolerable damage or annoyance (economic threshold).

Impaired waters list (or impairments) - Impaired waters are waters that do not meet State water quality standards. Under the Clean Water Act, section 303(d), States, territories and authorized tribes are required to develop lists of impaired waters. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters.

Impervious surface - A surface that has been compacted or covered with a layer of material so that it is highly resistant to infiltration by water. Impervious surfaces include, but are not limited to: roofs, buildings, streets, parking areas, and any concrete, asphalt, or compacted gravel surface.

Intertidal - The area of shore located between high and low tides.

JKL

Karst – a landscape resulting to a significant degree from the dissolution of bedrock. Karst landscapes are most commonly underlain by limestone and dolostone bedrock and feature include sinkholes, sinking and losing streams, caves, and large flow springs. They are characterized by underground drainage networks that commonly bypass surface drainage divides.

Land cover - Anything that exists on, and is visible from above, the earth's surface. Examples include vegetation, exposed or barren land, water, snow, and ice.

Land use - The way land is developed and used in terms of the kinds of anthropogenic activities that occur (e.g. agriculture, residential areas, industrial areas).

Low impact development (LID) - A comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. This design approach incorporates strategic planning with micro-management techniques to achieve superior environmental protection, while allowing for development or infrastructure rehabilitation to occur.

MN

Marine - Refers to the ocean.

Native Species - Species which have lived in a particular region or area for an extended period of time.

Nitrification - The process to which bacterial populations under aerobic conditions, gradually oxidize ammonium to nitrate with the intermediate formation of nitrite. Biological nitrification is a key step in nitrogen removal in wastewater treatment systems.

Nitrogen - (N) An essential nutrient primarily used by plants and animals to synthesize protein. Nitrogen enters the ecosystem in several chemical forms and also occurs in other dissolved or particulate forms, such as tissues of living and dead organisms. It will remain readily in a dissolved form and therefore anthropogenic inputs of this nutrient often occur as a result of excess nutrient application.

Nonpoint Source - A diffuse source of pollution that cannot be attributed to a clearly identifiable, specific physical location or a defined discharge channel. This includes the nutrients that runoff the ground from any land use - croplands, feedlots, lawns, parking lots, streets, forests, etc. - and enter waterways. It also includes nutrients that enter through air pollution, through the groundwater, or from septic systems.

Nutrients - Compounds of nitrogen and phosphorus dissolved in water which are essential to both plants and animals. Too much nitrogen and phosphorus act as pollutants and can lead to unwanted consequences - primarily algae blooms that cloud the water and rob it of oxygen critical to most forms of aquatic life. Sewage treatment plants, industries, vehicle exhaust, acid rain, and runoff from agricultural, residential and urban areas are sources of nutrients entering the Bay.

Nutrient removal technology (NRT) - Also known as biological nutrient removal (BNR). The process whereby nutrients are removed from wastewater in addition to the organic content.

Nutrient Trading - The transfer of nutrient reduction credits, specifically those for nitrogen and phosphorus.

OPQ

Outfall – **The outlet of a river, stormwater retention structure, drain or other source of water. Also the water leaving a structure.**

Pervious - porous, able to be penetrated by water.

Pesticides - A general term used to describe chemical substances that are used to destroy or control insect or plant pests. Many of these substances are manufactured and do not occur naturally in the environment. Others are natural toxics that are extracted from plants and animals.

Phosphorus - (P) An essential nutrient for the growth of living organisms, it is a key nutrient in the Bay's ecosystem, phosphorus occurs in dissolved organic and inorganic forms, often attached to particles of sediment. This nutrient is a vital component in the process of converting sunlight into usable energy forms for the production of food and fiber. It is also essential to cellular growth and reproduction for organisms such as phytoplankton and bacteria. Phosphates, the inorganic form is preferred, but organisms will use other forms of phosphorus when phosphates are unavailable. It will readily absorb to sediments and therefore anthropogenic inputs of this nutrient often occur through sediment runoff from agricultural activities or stream bank erosion.

Phytoplankton - Plankton are usually very small organisms that cannot move independently of water currents. Phytoplanktons are any plankton that is capable of making food via photosynthesis.

Piedmont - Uplands or hill country above the "fall line" of coastal rivers where rapids or cataracts tumble down to the level topography where tidal influence begins.

Planning District Commission – A regional planning agency established by the Virginia Development Act.

Point Source - A source of pollution that can be attributed to a specific physical location; an identifiable, end of pipe "point". The vast majority of point source discharges for nutrients are from wastewater treatment plants, although some come from industries.

Pollutants - Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

RS

Riparian area - Riparian refers to the area of land adjacent to a body of water, stream, river, marsh, or shoreline. Riparian areas form the transition between the aquatic and the terrestrial environment.

Riparian Buffers - An area of vegetation, usually a combination of trees, shrubs and other vegetation, that is adjacent to a body of water and is managed to maintain the integrity of stream channels and shorelines, to reduce the impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals, and to supply food, cover, and thermal protection to fish and other wildlife.

Salinity regime - A portion of an estuary distinguished by the amount of tidal influence and salinity of the water. The major salinity regimes are, from least saline to most saline:

- **Tidal Fresh** – Describes waters with salinity between 0 and 0.5 parts per thousand (ppt). These areas are at the extreme reach of tidal influence.
- **Oligohaline** – Describes waters with salinity between 0.5 and 5 ppt. These areas are0 typically in the upper portion of an estuary.
- **Mesohaline** – Describes waters with salinity between 5 and 18 ppt. These areas are typically in the middle portion of an estuary.
- **Polyhaline** – Describes waters with salinity between 18 and 30 ppt. These areas are typically in the lower portion of an estuary, where the ocean and estuary meet.
- **Sediment -** matter that settles and accumulates on the bottom of a body of water or waterway.

Sedimentation - Deposition of soil that has been transported from its site or origin by water, ice, wind, gravity or other natural means as a product of erosion.

Significant Discharger -- According to DEQ the following criteria would qualify as a significant point source discharger: a municipal plant anywhere in the Chesapeake Bay watershed with a design capacity of 0.5 MGD or greater; a municipal plant east of the fall line (direct discharge into tidal waters) with a design capacity of 0.1 MGD or greater; an industrial (or institutional) plant anywhere in the Chesapeake Bay watershed with an annual TN and/or TP load equal to, or greater than, the annual load from a 0.5 MGD municipal plant. The 'equivalent' loads are: TN = 28,460 lbs/yr; TP = 3,800 lbs/yr.
A planned (new) or expanding municipal plant, expected to be operating by 2010 with a permitted design of 0.5 MGD or greater. A municipal plant discharging 0.5 MGD or more (even if the design capacity is currently less than 0.5 MGD).

Siltation - The process by which sedimentary material, or silt, is suspended and deposited in a body of water.

Soil and Water Conservation District (SWCD) - A political subdivision of state government governed by locally elected volunteers who set priorities for identifying and developing programs to improve water quality and reduce erosion.

Stakeholders - A person or persons with an interest or those directly affected by the issue at hand.

Submerged Aquatic Vegetation (SAV) - Rooted vegetation that grows under water in shallow zones where light penetrates, may be permanently underwater or exposed at low tide. They provide food for waterfowl, sediment stabilization and shoreline erosion control, and serve as critical habitat for both juvenile and adult forms of many aquatic animals. Also known as "Bay grasses".

Suspended sediments - Particles of soil, sediment, living material, or detritus suspended in the water column.

TUV

Topography – The configuration of a surface including it relief and the position of its natural and man-made features.

Total Maximum Daily Load (TMDL) - A TMDL is the maximum amount of a pollutant load that a water body can assimilate without causing violations of water quality standards, and allocates the loading between contributing point sources and non-point source categories. Under the Clean Water Act, each state is to determine, write, and implement TMDLs for all waters not meeting water quality standards.

Tributary - A body of water flowing into a larger body of water. For example, the James River is a tributary of the Chesapeake Bay.

Tributary strategies - Tributary strategies are detailed implementation plans to achieve the nutrient and sediment cap load allocations and are developed in cooperation with local watershed stakeholders.

Turbidity - The decreased clarity in a body of water due to the suspension of silt or sedimentary material.

Urban area - Any area which is urban or urbanizing in character, including semi-urban areas and surrounding areas which form am economic and socially related region, taking into consideration such factors as present and future population trends and patterns of urban growth.

U.S. Environmental Protection Agency (USEPA) - A federal agency responsible for administering certain federal environmental regulations. The EPA administers the Clean Water Act and Clean Air Act and is the agency responsible for overseeing the Section 404 wetlands permits program, establishing emission standards for air pollutants and effluent standards for water pollution. EPA is the primary staffing agency for the interstate Chesapeake Bay Program.

W

Wastewater - Water that has been used in homes, industries, and businesses that is not for reuse unless treated by a wastewater facility.

Water clarity - Measurement of light available in the water column. The greater the water clarity, the further you can see through the water. Reduced water clarity can be caused by increases phytoplankton or suspended sediments.

Water quality - The condition of water as is pertains to its ability to sustain life, both aquatic and otherwise and in its use for recreational purposes such as swimming and boating. Water quality can be measured by the amount of pollutants contained in it.

Efforts to reduce or prevent poor water quality are focused on improving its ability to sustain life and improve its recreational use.

Water quality criteria - Criteria are part of a water quality standard, and may be numeric or narrative. Criteria represent a quality of water that supports a particular designated use. When criteria are met, water quality will generally protect the use.

Water quality standards - A provision of State or Federal law consisting of a designated use or uses for a water body and the quantifiable criteria protective of the use(s). Standards may be annual or seasonal, depending on the designated use.

Watershed - A region bounded at the periphery by physical barriers that cause water to flow and ultimately drain to a particular body of water at a lower elevation.

Watershed management - An effort to coordinate and integrate the natural resource based programs, tools, resources, and needs of multiple stakeholder groups within a watershed to conserve, maintain, protect and restore habitat and water quality of the watershed.

Watershed Management Plan -A detailed vision and strategy, usually at the small watershed level, to achieve watershed management. Many times initiated by local governments in conjunction with other local planning efforts. The planning effort identifies specific actions to restore habitat and water quality, identify lands for conservation and development, identify and reduce nonpoint sources of pollution and prioritize pollution reduction actions.

Watershed Model Segment - Any predetermined spatial domain. For example, under Phase 4.3 of the watershed model, the watershed was divided into separate basins and regions of similar characteristics or features of the river reach - this was termed watershed model segment. This resulted in some 94 major model segments averaging 194,000 hectares. Phase 5 segmentation will be divided by county in the entire watershed. Therefore, each model segment will equal a county. According to the Chesapeake Bay Program: "Segmentation is the compartmentalizing of the estuary into subunits based on selected criteria. For diagnosing anthropogenic impacts, segmentation is a way to group regions having similar natural characteristics, so that differences in water quality and biological communities among similar segments can be identified and their source elucidated. For management purposes, segmentation is a way to group similar regions to define a range of water quality and resource objectives, target specific actions and monitor response."

Wetland - Low areas such as swamps, tidal flats, and marshes, which retain moisture.

XYZ

ABBREVIATIONS

BMP	Best Management Practices
BNR	Biological Nutrient Removal
C2K	Chesapeake 2000 Agreement
CBP	Chesapeake Bay Program
CBPA	Chesapeake Bay Preservation Act
CREP	Conservation Reserve Enhancement Program
CWA	Clean Water Act
DCBLA	Division of Chesapeake Bay Local Assistance
DSWC	Division of Soil and Water Conservation
DCR	Department of Conservation and Recreation
DEQ	Department of Environmental Quality
E&S/ESC	Erosion and Sediment Control
EQIP	Environmental Quality Improvement Fund
LOT	Limit of Technology
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer System
NOIRA	Notice of Intended Regulatory Action
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRT	Nutrient Reduction Technology
PDC	Planning District Commission
PS	Point Source
SAV	Submerged Aquatic Vegetation
SWCB	State Water Control Board
SWCD	Soil and Water Conservation District
SWM	Stormwater Management
TMDL	Total Maximum Daily Loads
TN	Total Nitrogen
TP	Total Phosphorus
USEPA	U.S. Environmental Protection Agency
VPDES	Virginia Pollutant Discharge Elimination System
WPM	Watershed Management Plan
WSM	Watershed Model
WQ	Water Quality
VSWCB	Virginia Soil and Water Conservation Board

BMP Definitions

Animal Waste Management System - A planned system designed to manage liquid and solid waste from areas where livestock and poultry are concentrated. This practice is designed to provide facilities for the storage and handling of livestock and poultry waste and the control of surface runoff water to permit the recycling of animal waste onto the land in a way that will abate pollution that would otherwise result from existing livestock or poultry operations. All facilities must have a written operation and management plan to be maintained for ten years, a nutrient management plan to be implemented and maintained for the life of the practice, and a manure test for nutrient analysis once during the first twelve months of operation. Practices include animal waste storage facilities, such as dry stacking, aerobic or anaerobic lagoons, liquid manure tanks, holding ponds, collection basins, settling basins, and similar facilities as well as diversions, channels, waterways, designed filter strips, outlet structures piping, land shaping, and similar measures needed as part of a system on the farm to manage animal wastes.

Barnyard Runoff Control - Prevents those areas exposed to heavy livestock traffic from experiencing excessive manure and soil losses due to the destruction of ground cover. The intent of this practice is to prevent manure and sediment runoff from entering water courses and to capture a portion of the manure as a resource for other uses such as crop fertilizer. This is accomplished by dividing the area into lots. The cattle are rotated from lot to lot as necessary to maintain a vegetative cover. One lot is designated as a sacrifice area for use in periods of wet weather. A minimum of three grasses loafing paddocks are required.

Cover Crops - Reduces the erosion and the leaching of nutrients to groundwater by maintaining a vegetative cover on cropland. A good stand and good growth of winter cover must be obtained in sufficient time to protect the area in the fall and winter. The cover crop must be killed by using mechanical or chemical means or by grazing no earlier than March 15 and no later than May 1. The cover crop residue may be left on the field for conservation purposes; or the cover crop or its residue may be tilled under. Harvesting for hay, haylage, silage, grain, or seed is not permitted. Pasturing consistent with sound agronomic management is permitted as long as a 60 percent cover is maintained through March 14.

Conservation Plans - Comprehensive natural resource management plans, with a focus on the use of erosion and sediment control practices to reduce sediment loss from cropland. Conservation plans address all soil, water, air, plant and animal resource concerns identified on a planning unit to the sustainable level.

Conservation Tillage - Involves planting and growing crops with a minimal disturbance of the surface soil using a non-inversion plowing technique and maintaining a 30 percent minimum crop residue cover on the soil surface.

Dry Detention Ponds and Hydrodynamic Structures - Practices designed to moderate influence on peak flows and drain completely between storm events. Includes dry ponds and underground dry detention facilities.

Dry Extended Detention Ponds - Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets are designed to detain the stormwater runoff from a water quality "storm" for some minimum duration (e.g., 24 hours) which allow sediment particles and associated pollutants to settle out. Unlike wet ponds, dry extended detention ponds do not have a permanent pool. However, dry extended detention ponds are often designed with small pools at the inlet and outlet of the pond, and can also be used to provide flood control by including additional detention storage above the extended detention level. An enhanced extended detention basin has a higher efficiency than an extended detention basin because it incorporates a shallow marsh in the bottom. The shallow marsh provides additional pollutant removal and helps to reduce the resuspension of settled pollutants by trapping them.

Erosion and Sediment Control - Erosion and sediment controls include practices such as sediment ponds and silt fencing. They are applied to construction sites and protect off-site areas from sediment runoff and nutrient pollution.

Filtering Practices - Practices that capture and temporarily store the water quality volume and pass it through a filter bed of sand, organic matter, soil or other media are considered to be filtering practices. Filtered runoff may be collected and returned to the conveyance system. Includes vegetated open channels that are explicitly designed to capture and treat the full water quality volume within dry or wet cells formed by checkdams or other means.

Forest Harvesting Practices - Focus on minimizing the environmental impacts from forest harvesting operations, such as road building, and harvesting and thinning operations. These BMPs reduce soil erosion and the loss nutrients that adhere to eroding soil particles.

Forested Buffers - A protection method along streams to reduce erosion, sedimentation, and the pollution of water from agricultural nonpoint sources. This practice involves a change in land use that establishes a forest buffer that will benefit wildlife and aquatic environments. It is designed for cropland and pastureland that has been in production two out of the past five years. (Forest land being replanted following timber harvest is not included.) The minimum width of the buffer must be 35 feet from the edge of the stream bank, up to one-third of the floodplain, not to exceed 100 feet.

Grassed Buffers - Vegetative buffers adjacent to cropland or animal holding areas that are located along the banks of water courses to filter runoff, anchor soil particles and protect banks against scour and erosion. Filters must be a minimum of 25 feet in width, maximum 100 feet in width except for wider segments of a contoured filter where the contour is typically 25 feet to 100 feet wide. Filters must be located within 100-feet of a live or intermittent waterway, open sinkhole, abandoned well, or Chesapeake Bay Preservation Act Resource Protection Area as defined by local ordinance. They shall be designed and installed to filter sheet flow, rather than concentrated flow.

Impervious Surface Reduction - Reducing the total area impervious area and therefore encouraging stormwater infiltration by maintaining areas such as forests, grasslands and meadows that encourage stormwater infiltration. Includes disconnecting the rooftop drainage pipe and allowing it to infiltrate into the pervious surface thereby reducing the impervious area and directing sheet flow from impervious surfaces, i.e. driveways and sidewalks, to pervious surfaces instead of stormwater drains. Other measures include rain barrels and green roofs that reduce the percentage of impervious surfaces in urban areas.

Infiltration Practices - Practices that capture and temporarily store the water quality volume before allowing it to infiltrate into the soil. Includes excavated trenches and basins that have been back filled with stone to form a subsurface basin and porous pavement that allows storm water to infiltrate into underlying soils promoting pollutant treatment and recharge.

Nutrient Management (Urban and Mixed Open) - Applied lawn, landscape, and other turf activities in urban and suburban areas that have the potential to produce nutrient, especially nitrogen and phosphorus, runoff. Practices include:

- Application of phosphorus according to soil tests and recommendations
- Application of nitrogen to grasses when they are actively growing
- Use of slowly available nitrogen sources; or split and reduced rate applications of readily available sources
- Recycling of grass clippings back to the lawn
- Application of turn BMPs such as proper mowing height for variety, appropriate variety selection when overseeding, core aeration as needed, and avoiding fertilizer application onto hard surfaces and near water bodies.

Nutrient Management Plan - Development of site-specific nutrient management plans with cooperating farmers; components include assisting farmers with manure testing for nutrient levels, calibrating nutrient application equipment, and coordinating soil nitrate testing in agricultural crop fields. Plans also account for crop yields, existing nutrient levels in the soil, application of additional nutrients to maintain optimum soil levels of any particular nutrient, farming practices, and impacts to surface and groundwater.

Retirement of Highly Erodible Land - Land retirement of highly erodible or other sensitive lands by taking agricultural land out of crop production and/or grazing and converting it by planting with a permanent vegetative cover such as grasses, shrubs, and/or trees. Existing cover must be less than 60 percent before conversion.

Roadway Systems - Reducing the total area of impervious cover, thereby reducing the pollutant and sediment load in a given area. Sheet flow is water flowing in a thin layer of the ground surface. Filter strips are a strip of permanent vegetation above ponds, diversions and other structures to retard the flow of runoff, causing deposition of transported material, thereby reducing sedimentation.

Stream Protection with Fencing - Provides protection by fencing along streams to reduce erosion, sedimentation, and the pollution of water from agricultural nonpoint sources. The fencing must be permanent to protect eroding banks from damage by domestic livestock. When no other water source is feasible or exists, a controlled hardened access may be used to provide livestock access to the water. (The installation of livestock crossings and controlled hardened access is limited to small streams.) The fence must be placed a minimum of 20 feet away from the stream, except as designated in areas immediately adjacent to livestock crossings and controlled hardened accesses. Adequate natural or planted vegetation between the fence and stream must exist to serve as an effective filter strip to improve water quality. Both sides of the stream must be fenced, or livestock must be restricted from both sides.

Stream Protection without Fencing - Structural practices that provide an alternative water source for livestock to discourage animal access to streams, which reduces erosion and livestock waste reaching the stream.

Stream Restoration in Urban Areas - A BMP used to restore the natural ecosystem by restoring the stream hydrology and natural landscape. Return of an ecosystem to a close approximation of its condition prior to disturbance. Establishing predisturbance aquatic functions and related physical, chemical and biological characteristics in a stream system.

Street Sweeping and Catch Basin Inlets - A variety of BMPs that provide stormwater treatment for trash, litter, coarse sediment, oil and other debris before proceeding through the stormwater system.

Stormwater Management System - Stormwater management systems include extended detention areas (dry basins or ponds), retention ponds (wet), stormwater wetlands, pond-wetland systems, stormwater retrofits, stormwater conversions (conversion from dry to retention) and sand filters. Nutrient reduction is not the only benefit of stormwater management systems; they also reduce sediment transport and control peak runoff flows.

Tree Planting - Includes any tree plantings on any site except those along rivers and streams. (Plantings along rivers and streams are considered forested buffers and are treated differently by the Model.) The definition of tree planting does not include reforestation. Reforestation replaces trees removed during timber harvest and does not result in an additional nutrient reduction or an increase in forest acreage.

Wetland Restoration - Activities that restore land to the hydraulic condition that existed prior to drainage. Objective is to improve water quality and enhance wildlife habitat.

Wet Ponds and Wetlands- Practices that have a combination of a permanent pool, extended detention or shallow wetland equivalent to the entire water quality storage volume. Practices that include significant shallow wetland areas to treat urban storm water but often may also incorporate small permanent pools and/or extended detention storage.

Appendix C: Explanation of Cost Estimates

The following procedure was utilized in the development of the estimated nonpoint source costs associated with full implementation of the tributary strategies as completed in the fall of 2004 (TS4).

Using the excel spreadsheets developed by SAIC for CBPO as a base DCR staff developed identical sheets for each basin (Shenandoah, Potomac, Shenandoah/Potomac, Rappahannock, York, Eastern Shore, Upper James, Middle James, Lower James, and the overall James). Also developed was a summary sheet that was linked to the individual basin sheets.

The Overall cost estimates were then determined by inserting the final computer model input deck units of Best Management Practices (BMP) into the corresponding cell for each BMP. Certain BMPs (conservation tillage, cover crops, poultry litter transfer) are installed annually. Therefore, the units (acres or tons of litter) of these BMPS from the strategies were multiplied by five to account for practice renewal for each year 2005 till 2010. Additionally, nutrient management plan implementation and yield reserve commonly called enhanced nutrient management were multiplied by two since these plans are good for up to three years. This would account for plan revisions that would be required between 2005 and 2010.

SAIC/CBPO had applied the estimated costs of erosion and sediment control (ESC) as solely operation and maintenance (O&M). DCR staff disagreed with this concept since the practices do not appear without someone paying for the installation. Therefore, the original $2,500 per acre estimated costs applied as O&M was split into capital costs of $2,000 per acre and $500 O&M costs. Additionally, a 10 percent technical assistance cost was applied to the capital costs for each unit of this BMP.

SAIC/CBPO had estimated forest harvesting practices (FHP) at $84 per acre treated and applied this as solely an O&M cost. DCR staff consulted with Virginia DOF and DOF could not determine how the $84 figure was derived but instead supported the original Virginia estimated cost of $21 per acre treated. Nor could DOF support the concept that these costs were O&M since little if any maintenance is done on these practices once installed. Therefore, the cost estimate was moved to the capital cost category and a 10 percent TA cost was also applied to this capital expense.

SAIC/CBPO had applied Conservation Reserve Enhancement Program land rental payments to every acre of forested and grassed riparian buffers as well as wetland restoration on agricultural lands. This is not realistic, as this program will accomplish a very small percentage of the overall implementation goals in the strategies. Therefore, the rental payments estimated by SAIC/CBPO were eliminated.

SAIC/CBPO had applied the associated costs for conservations tillage ($3 per acre) and cover crops ($19 per acre) as incentive payments to be consistent with other jurisdictions. Virginia applied these costs as capital costs in the draft strategies (April 2004) and has applied these costs as capital in the final revisions. Therefore, there are no incentive costs in the Virginia cost analysis.

SAIC/CBPO had applied a 20 percent TA cost across the board for all practices. Virginia had a variable scale on technical assistance in the draft strategies (released in April 2004) related to the level of existing infrastructure. This variable scale was continued since Virginia has Soil and Water Conservation Districts, and most localities have ESC inspectors, and DOF inspects foresting operations, and VDH permits septic systems and pump-out contractors. A 10 percent TA rate was applied to agricultural, ESC, FHP, septic practices. All remaining urban and mixed open practices received a 20 percent TA rate.

The DEQ estimated capital costs for point sources was inserted into the SAIC/CBPO spreadsheet and it generated an O&M estimate by multiplying the capital cost estimate by three percent. Since DEQ had developed estimates for O&M on a facility-by-facility basis their O&M estimated costs were used in the overall estimated costs of the strategies and are not reflected in the detail cost tables in the appendix.

For State Government costs all ESC, FHP, septic connection units were set at zero units. All practices had some percentage five percent to 10 percent of the units eliminated as being done voluntarily. Recent and New storm water practices were eliminated, as were 90 percent of the old. The 10 percent that remained was priced out at 50 percent of the SAIC/CBPO costs. 90 percent of the remaining (after voluntary) septic pump-outs were eliminated and the 10 percent remaining was priced at 50 percent. All agricultural practices had their costs reduced to 75 percent since this is the level that cost share would cover. All associated O&M costs with these BMPs was eliminated and placed in the non-governmental cost estimates since the state does not pay O&M cost on NPS BMPs.

The development and permit estimated costs were based on the BMP units of ESC, FHP, septic connections, and recent and new as well as the 90 percent of the old SWM BMPs (those BMPs eliminated as part of the State governmental cost estimates) as these practices are installed as part of ongoing development or forest harvesting and are generally required under permits issued prior to development or logging.

The non-governmental costs are simply the overall cost minus the development and permits estimated costs and the State governmental estimated costs and reflects the remaining estimated costs not incurred by developers, foresters, and the state government.

Table C-1: Total Estimated Costs

Virginia Statewide Estimated Cost Summary

Agricultural BMPs	Cost Units	Capital $/Unit	Capital Costs	Tech Assistance	O & M	Total Cost
Conservation-Tillage	$/Acre	$0	$6,894,270	$689,427	$0	$7,583,697
Continuous No-Till	$/Acre	$100	$4,168,600	$416,860	$0	$4,585,460
Forest Buffers	$/Acre	$545	$104,144,595	$10,414,460	$3,095,674	$117,654,729
Wetland Restoration	$/Acre	$889	$79,067,660	$7,906,766	$3,301,453	$90,275,879
Land Retirement	$/Acre	$928	$0	$0	$0	$0
Grass Buffers	$/Acre	$175	$19,971,350	$1,997,135	$0	$21,968,485
Tree Planting	$/Acre	$1,284	$262,263,420	$26,226,342	$3,308,931	$291,798,693
Nutrient Management Plans	$/Acre	$7	$14,134,344	$1,413,434	$0	$15,547,778
Enhanced Nutrient Management	$/Acre	$7	$145,740	$14,574	$0	$160,314
20% Poultry Litter Transport	$/Dry Ton/Yr	$0	$0	$0	$7,591,320	$7,591,320
Conservation Plans	$/Acre	$7	$7,565,621	$756,562	$5,512,095	$13,834,278
Cover Crops (Early-Planting)	$/Acre	$0	$39,261,695	$3,926,170	$0	$43,187,865
Off-Stream Watering w/ Fencing	$/Acre	$284	$146,029,392	$14,602,939	$14,973,155	$175,605,486
Off-Stream Watering w/o Fencing	$/Acre	$152	$43,335,960	$4,333,596	$5,987,205	$53,656,761
Off-Stream Watering w/ Fencing & RG	$/Acre	$186	$598,548	$59,855	$118,036	$776,439
Stream Stabilization	$/LinFt	$12	$1,461,000	$146,100	$0	$1,607,100
Animal Waste Management	$/Acre	$32,278	$11,006,798	$1,100,680	$1,228,227	$13,335,705
Total Cost for Agricultural BMPs			**$740,048,993**	**$74,004,899**	**$45,116,097**	**$859,169,989**
Urban BMPs	**Cost Units**	**Capital $/Unit**	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Wet Ponds & Wetlands	$/Acre	$3,363	$782,423,717	$156,484,743	$39,121,186	$978,029,646
Urban Infiltration Practices	$/Acre	$5,285	$1,260,368,024	$252,073,605	$126,036,802	$1,638,478,432
Urban Filtering Practices	$/Acre	$12,719	$3,033,389,707	$606,677,941	$182,003,382	$3,822,071,030
Urban Stream Rest	$/LinFt	$240	$57,446,672	$11,489,334	$0	$68,936,007
Urban Forest Buffers	$/Acre	$1,284	$71,588,136	$14,317,627	$903,215	$86,808,978
Urban Tree Planting	$/Acre	$1,284	$75,663,552	$15,132,710	$954,634	$91,750,896
Urban Nutrient Management	$/Acre	$15	$10,130,010	$2,026,002	$0	$12,156,012
Erosion & Sediment Control	$/Acre	$2,000	$570,848,000	$57,084,800	$179,120,000	$807,052,800
Non-Structural Shoreline Erosion Control	$/LinFt	$45	$6,997,500	$1,399,500	n/a	$8,397,000
Structural Shoreline Erosion Control	$/LinFt	$300	$4,665,000	$933,000	n/a	$5,598,000
Total Cost for Urban BMPs			**$5,873,520,318**	**$1,117,619,264**	**$528,139,219**	**$7,519,278,800**
Mixed Open BMPs	**Cost Units**	**Capital $/Unit**	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Wetland Restoration	$/Acre	$889	$73,210,928.00	$14,642,186	$3,056,906	$90,910,020
Tree Planting	$/Acre	$1,284	$148,784,784	$29,756,957	$1,877,191	$180,418,932
Mixed Open Nutrient Management	$/Acre	$15	$29,122,050	$5,824,410	$0	$34,946,460
Forest Buffers	$/Acre	$545	$63,151,875.00	$12,630,375	$1,877,175	$77,659,425
Non-Structural Shoreline Erosion Control	$/LinFt	$45	$5,062,500	$1,012,500	n/a	$6,075,000
Structural Shoreline Erosion Control	$/LinFt	$300	$3,375,000.00	$675,000	n/a	$4,050,000
Total Cost for Mixed Open BMPs			**$322,707,137**	**$64,541,427**	**$6,811,272**	**$394,059,837**

Forest BMPs	Cost Units	Capital $/Unit	Capital Costs	Tech Assistance	O & M	Total Cost
Forest Harvesting Practices	$/Acre	$21	$2,113,944	$211,394	$0	$2,325,338
Total Costs for Forest BMPs			**$2,113,944**	**$211,394**	**$0**	**$2,325,338**

Septic BMPs	Cost Units	Capital $/Unit	Capital Costs	Tech Assistance	O & M	Total Cost
Septic Pumping	$/System	$200	45,165,800	$4,516,580	$0	$49,682,380
Septic Connections	$/System	$1,500	29,236,500	$2,923,650	$0	$32,160,150
Total Cost for Septic BMPs			**$74,402,300**	**$7,440,230**	**$0**	**$81,842,530**

NPS Current Requirements/Permit Costs (by Source Category)		Development & Permits		
	Capital Costs	Tech Assistance	O& M	Total
Agriculture	$0	$0	$0	$0
Urban	$4,928,547,346	$928,624,669	$477,185,550	$6,334,357,565
Mixed Open	$0	$0	$0	$0
Septic	$29,236,500	$2,923,650	$0	$32,160,150
Forest	$2,113,944	$211,394	$0	$2,325,338
Total	**$4,959,897,790**	**$931,759,713**	**$477,185,550**	**$6,368,843,053**

NPS Governmental Costs (by Source Category)		State Governmental		
	Capital Costs	Tech Assistance	O& M	Total Gov't.
Agriculture	$528,358,577	$52,835,858	$0	$581,194,435
Urban	$238,342,543	$47,668,509	$0	$286,011,052
Mixed Open	$312,109,911	$62,421,982	$0	$374,531,893
Septic	$3,858,100	$385,810	$0	$4,243,910
Forest	$0	$0	$0	$0
Total	**$1,082,669,131**	**$163,312,159**	**$0**	**$1,245,981,290**

NPS Non-Governmental Costs (by Source Category)		Non-Governmental		
	Capital Costs	Tech Assistance	O& M	Total Gov't.
Agriculture	$211,690,417	$21,169,042	$45,116,097	$277,975,556
Urban	$706,630,428	$141,326,086	$50,953,669	$898,910,183
Mixed Open	$10,597,226	$2,119,445	$6,811,273	$19,527,944
Septic	$41,307,700	$4,130,770	$0	$45,438,470
Forest	$0	$0	$0	$0
Total	**$970,225,771**	**$168,745,343**	**$102,881,039**	**$1,241,852,153**
Point Source Reductions	**Capital Costs**	**Tech Assistance**	**O& M**	**Total**
Total*	**$1,098,734,036**	**$0**	**$32,962,021**	**$1,131,696,057**
Total State Gov't	**$507,072,856**	**$0**	**$0**	**$507,072,856**
Total Non-Gov't	**$591,661,180**	**$0**	**$32,962,021**	**$624,623,201**
Basin Total:	**$9,988,372,552**			

*O&M cost displayed here were estimated using the SAIC/CBP cost method.
DEQ has estimated these costs for each facility and overall cost reflect the DEQ estimates.

Table C-2: Total Estimated Shenandoah-Potomac River Basin Costs

Shenandoah/Potomac Basin Estimated Cost Summary

Agricultural BMPs	Cost Units	Capital $/Unit	Capital Costs	Tech Assistance	O & M	Total Cost
Conservation-Tillage	$/Acre	$0	$1,929,015	$192,902	$0	$2,121,917
Continuous No-Till	$/Acre	$100	$0	$0	$0	$0
Forest Buffers	$/Acre	$545	$47,686,955	$4,768,696	$1,417,484	$53,873,134
Wetland Restoration	$/Acre	$889	$28,552,902	$2,855,290	$1,192,220	$32,600,412
Land Retirement	$/Acre	$928	$0	$0	$0	$0
Grass Buffers	$/Acre	$175	$6,910,050	$691,005	$0	$7,601,055
Tree Planting	$/Acre	$1,284	$109,549,596	$10,954,960	$1,382,168	$121,886,723
Nutrient Management Plans	$/Acre	$7	$4,781,028	$478,103	$0	$5,259,131
Enhanced Nutrient Management	$/Acre	$7	$93,184	$9,318	$0	$102,502
20% Poultry Litter Transport	$/Dry Ton/Yr	$0	$0	$0	$6,892,680	$6,892,680
Conservation Plans	$/Acre	$7	$3,342,528	$334,253	$2,435,270	$6,112,051
Cover Crops (Early-Planting)	$/Acre	$0	$12,664,450	$1,266,445	$0	$13,930,895
Off-Stream Watering w/ Fencing	$/Acre	$284	$60,647,632	$6,064,763	$6,218,518	$72,930,913
Off-Stream Watering w/o Fencing	$/Acre	$152	$16,092,544	$1,609,254	$2,223,312	$19,925,110
Off-Stream Watering w/ Fencing & RG	$/Acre	$186	$0	$0	$0	$0
Stream Stabilization	$/LinFt	$12	$642,000	$64,200	$0	$706,200
Animal Waste Management	$/Acre	$32,278	$4,228,418	$422,842	$471,841	$5,123,101
Total Cost for Agricultural BMPs			**$297,120,302**	**$29,712,030**	**$22,233,493**	**$349,065,825**
Urban BMPs	**Cost Units**	**Capital $/Unit**	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Wet Ponds & Wetlands	$/Acre	$3,363	$297,275,074	$59,455,015	$14,863,754	$371,593,842
Urban Infiltration Practices	$/Acre	$5,285	$498,003,352	$99,600,670	$49,800,335	$647,404,358
Urban Filtering Practices	$/Acre	$12,719	$1,198,492,223	$239,698,445	$71,909,533	$1,510,100,202
Urban Stream Rest	$/LinFt	$240	$19,848,485	$3,969,697	$0	$23,818,182
Urban Forest Buffers	$/Acre	$1,284	$23,770,692	$4,754,138	$299,911	$28,824,741
Urban Tree Planting	$/Acre	$1,284	$23,770,692	$4,754,138	$299,911	$28,824,741
Urban Nutrient Management	$/Acre	$15	$4,220,670	$844,134	$0	$5,064,804
Erosion & Sediment Control	$/Acre	$2,000	$231,484,000	$23,148,400	$57,871,000	$312,503,400
Non-Structural Shoreline Erosion Control	$/LinFt	$45	$2,070,000	$414,000	n/a	$2,484,000
Structural Shoreline Erosion Control	$/LinFt	$300	$1,380,000	$276,000	n/a	$1,656,000
Total Cost for Urban BMPs			**$2,300,315,188**	**$436,914,638**	**$195,044,444**	**$2,932,274,270**
Mixed Open BMPs	**Cost Units**	**Capital $/Unit**	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Wetland Restoration	$/Acre	$889	$13,710,158.00	$2,742,032	$572,465	$17,024,654
Tree Planting	$/Acre	$1,284	$19,801,848	$3,960,370	$249,836	$24,012,054
Mixed Open Nutrient Management	$/Acre	$15	$6,105,060	$1,221,012	$0	$7,326,072
Forest Buffers	$/Acre	$545	$8,404,990.00	$1,680,998	$249,836	$10,335,824
Non-Structural Shoreline Erosion Control	$/LinFt	$45	$1,170,000	$234,000	n/a	$1,404,000
Structural Shoreline Erosion Control	$/LinFt	$300	$780,000.00	$156,000	n/a	$936,000
Total Cost for Mixed Open BMPs			**$49,972,056**	**$9,994,411**	**$1,072,137**	**$61,038,605**
Forest BMPs	**Cost Units**	**Capital $/Unit**	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Forest Harvesting Practices	$/Acre	$21	$177,408	$17,741	$0	$195,149
Total Costs for Forest BMPs			**$177,408**	**$17,741**	**$0**	**$195,149**
Septic BMPs	**Cost Units**	**Capital $/Unit**	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Septic Pumping	$/System	$200	17,009,800	$1,700,980	$0	$18,710,780
Septic Connections	$/System	$1,500	20,896,500	$2,089,650	$0	$22,986,150
Total Cost for Septic BMPs			**$37,906,300**	**$3,790,630**	**$0**	**$41,696,930**

NPS Current Requirements/Permit Costs (by Source Category)				
	Development & Permits			
	Capital Costs	Tech Assistance	O& M	Total
Agriculture	$0	$0	$0	$0
Urban	$1,835,051,729	$343,861,946	$167,776,556	$2,346,690,231
Mixed Open	$0	$0	$0	$0
Septic	$20,896,500	$2,089,650	$0	$22,986,150
Forest	$177,408	$17,741	$0	$195,149
Total	**$1,856,125,637**	**$345,969,337**	**$167,776,556**	**$2,369,871,530**
NPS Governmental vs Non-Governmental Costs (by Source Category)				
	State Governmental			
	Capital Costs	Tech Assistance	O& M	Total Gov't.
Agriculture	$211,490,900	$21,149,090	$0	$232,639,990
Urban	$70,026,366	$14,005,273	$0	$84,031,639
Mixed Open	$48,561,897	$9,712,379	$0	$58,274,276
Septic	$765,400	$76,540	$0	$841,940
Forest	$0	$0	$0	$0
Total	**$330,844,563**	**$44,943,283**	**$0**	**$375,787,845**
NPS Governmental vs Non-Governmental Costs (by Source Category)				
	Non-Governmental			
	Capital Costs	Tech Assistance	O& M	Total Non-Gov't.
Agriculture	$85,629,403	$8,562,940	$22,233,493	$116,425,836
Urban	$395,237,094	$79,047,419	$27,267,887	$501,552,400
Mixed Open	$1,410,159	$282,032	$1,072,137	$2,764,328
Septic	$16,244,400	$1,624,440	$0	$17,868,840
Forest	$0	$0	$0	$0
Total	**$498,521,056**	**$89,516,831**	**$50,573,517**	**$638,611,404**
Point Source Reductions	**Capital Costs**	**Tech Assistance**	**O& M**	**Total**
Total*	**$475,913,358**	**$0**	**$14,277,401**	**$490,190,759**
Total State Gov't	**$446,886,778**	**$0**	**$0**	**$446,886,778**
Total Non-Gov't	**$29,026,580**	**$0**	**$14,277,401**	**$43,303,981**
Basin Total:	**$3,874,461,537**			

*O&M cost displayed here were estimated using the SAIC/CBP cost method.
DEQ has estimated these costs for each facility and overall cost reflect the DEQ estimates.

Table C-3: Summary of Estimated Costs by Basins

Tributary Strategy Costs (in Millions of Dollars)

Virginia Statewide Estimated Cost Summary	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Total Cost for Agricultural BMPs	$740	$74	$45	$859
Total Cost for Urban BMPs	$5,874	$1,118	$528	$7,519
Total Cost for Mixed Open BMPs	$323	$65	$7	$394
Total Costs for Forest BMPs	$2	$0.2	$0	$2
Total Cost for Septic BMPs	$74	$7	$0	$82
Total Costs for Point Source Reductions	$1,099	$0	$42	$1,141
Grand Total				$9,997

Shenandoah/Potomac Basin Estimated Cost Summary	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Total Cost for Agricultural BMPs	$297	$30	$22	$349
Total Cost for Urban BMPs	$2,300	$437	$195	$2,932
Total Cost for Mixed Open BMPs	$50	$10	$1	$61
Total Costs for Forest BMPs	$0.20	$0.02	$0	$0.2
Total Cost for Septic BMPs	$38	$4	$0	$42
Total Costs for Point Source Reductions	$476	$0	$23	$499
Grand Total				$3,883

Shenandoah Basin Estimated Cost Summary	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Total Cost for Agricultural BMPs	$181	$18	$17	$216
Total Cost for Urban BMPs	$639	$121	$54	$814
Total Cost for Mixed Open BMPs	$24	$5	$0.5	$29
Total Costs for Forest BMPs	$0.08	$0.01	$0	$0.09
Total Cost for Septic BMPs	$11	$1	$0	$13
Total Costs for Point Source Reductions	$113	$0	$5	$118
Grand Total				$1,190

Potomac Basin Estimated Cost Summary	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Total Cost for Agricultural BMPs	$116	$12	$6	$133
Total Cost for Urban BMPs	$1,662	$316	$141	$2,118
Total Cost for Mixed Open BMPs	$26	$5	$0.5	$32
Total Costs for Forest BMPs	$0.10	$0.01	$0	$0.10
Total Cost for Septic BMPs	$26	$3	$0	$29
Total Costs for Point Source Reductions	$362	$0	$18	$380
Grand Total				$2,692

Rappahannock Basin Estimated Cost Summary	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Total Cost for Agricultural BMPs	$84	$8	$6	$97
Total Cost for Urban BMPs	$420	$80	$34	$534

Total Cost for Mixed Open BMPs	$21	$4	$0.4	$25
Total Costs for Forest BMPs	$0.20	$0.02	$0	$0.30
Total Cost for Septic BMPs	$7	$0.7	$0	$8
Total Costs for Point Source Reductions	$92	$0	$2	$94
Grand Total				$758

York Basin Estimated Cost Summary	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Total Cost for Agricultural BMPs	$57	$6	$2	$65
Total Cost for Urban BMPs	$374	$71	$68	$512
Total Cost for Mixed Open BMPs	$67	$13	$2	$82
Total Costs for Forest BMPs	$0.40	$0.04	$0	$0.40
Total Cost for Septic BMPs	$8	$0.8	$0	$9
Total Costs for Point Source Reductions	$30	$0	$0.9	$31
Grand Total				$699

Tributary Strategy Costs (in Millions of Dollars)

James Basin Estimated Cost Summary	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Total Cost for Agricultural BMPs	$286	$29	$15	$330
Total Cost for Urban BMPs	$2,741	$522	$228	$3,491
Total Cost for Mixed Open BMPs	$179	$36	$4	$218
Total Costs for Forest BMPs	$1	$0.10	$0	$1
Total Cost for Septic BMPs	$21	$2	$0	$23
Total Costs for Point Source Reductions	$487	$0	$15	$501
Grand Total				$4,564

Upper James Basin Estimated Cost Summary	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Total Cost for Agricultural BMPs	$85	$8	$5	$98
Total Cost for Urban BMPs	$240	$46	$20	$306
Total Cost for Mixed Open BMPs	$33	$7	$0.7	$40
Total Costs for Forest BMPs	$0.20	$0.02	$0	$0.20
Total Cost for Septic BMPs	$2	$0.2	$0	$2
Total Costs for Point Source Reductions	$40	$0	$1	$41
Grand Total				$487

Middle James Basin Estimated Cost Summary	**Capital Costs**	**Tech Assistance**	**O & M**	**Total Cost**
Total Cost for Agricultural BMPs	$168	$17	$9	$194
Total Cost for Urban BMPs	$1,511	$288	$125	$1,924
Total Cost for Mixed Open BMPs	$133	$27	$3	$162
Total Costs for Forest BMPs	$0.90	$0.10	$0	$1
Total Cost for Septic BMPs	$14	$1	$0	$16
Total Costs for Point Source Reductions	$235	$0	$7	$242
Grand Total				$2,539

Lower James Basin Estimated Cost Summary	Capital Costs	Tech Assistance	O & M	Total Cost
Total Cost for Agricultural BMPs	$34	$3	$1.0	$38
Total Cost for Urban BMPs	$989	$188	$83	$1,260
Total Cost for Mixed Open BMPs	$14	$2	$0.3	$17
Total Costs for Forest BMPs	$0.20	$0.02	$0	$0.20
Total Cost for Septic BMPs	$5	$0.5	$0	$5
Total Costs for Point Source Reductions	$212	$0	$6	$218
Grand Total				$1,538

Eastern Shore Estimated Cost Summary	Capital Costs	Tech Assistance	O & M	Total Cost
Total Cost for Agricultural BMPs	$16	$2	$0.5	$18
Total Cost for Urban BMPs	$39	$8	$3	$50
Total Cost for Mixed Open BMPs	$6	$1	$0.1	$7
Total Costs for Forest BMPs	$0.04	$0.004	$0	$0.05
Total Cost for Septic BMPs	$0.9	$0.09	$0	$1
Total Costs for Point Source Reductions	$14	$0	$0.5	$15
Grand Total				$91

Appendix D: Summary of Public Comments on April 2004 Draft Shenandoah-Potomac Strategy

The Commonwealth of Virginia solicited comments on its five Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategies during a 30-day comment period that ended May 5, 2004. During this period, 80 individuals or organizations submitted written comments. Many were broad based and pertained to all five strategies. Others were more basin-specific. This appendix includes a summary of comments submitted for the Potomac-Shenandoah basin strategy. There was an estimate of 145 comments for this strategy. The comments were divided into nine categories.

1. Agricultural and forest-related nonpoint source practices found in the strategy.

Summary of Comments: There were several comments and questions regarding agricultural practices and their respective efficiencies in removing nutrients and sediments. Comments received also expressed concern over the land application of bio-solids, increased enforcement of timber harvest and the lack of grass and forest buffers listed as a practice in the strategy, which were noted as being very cost-effective. A majority of the comments addressed the lack of an implementation plan. There was a need expressed to have a better understanding of pollution reduction levels for agricultural and how they would be achieved.

Changes made to the strategy: The new strategies now contain additional information, including efficiencies, on all agricultural and forest BMPs. Also, practices that the public wanted included such as structural and non-structural shoreline erosion control, stream stabilization/restoration and continuous no-till are now included in the strategies. Wetland restoration, tree planting, and stream protection with fencing BMPs were increased to offset the loss of forested buffers that had been reduced to lower costs and based on comments about its potentially excessive use in the drafts. Septic denitrification systems and horse pasture management were removed to lower the cost of the strategies and to reduce the excess total nitrogen that had been achieved in the draft strategies.

2. Urban/suburban nonpoint source practices found in the strategy.

Summary of Comments: There were numerous comments received regarding urban and suburban practices. Comments ranged from concerns about low impact development to the lack of urban stream restoration and urban habitat enhancement not being included. The need for better analysis of available land acres for BMP practices, deleting the erosion and sediment control practice as a cost to bottom line since the practice is done already by localities with no extra cost to the state, the need for an urban BMP tracking system and the need to differentiate between the stormwater management BMPs dealing with retrofits, redevelopment and new construction were also received. There were many requests for an implementation plan that will outline the steps to reach these goals.

Changes made to the strategy: The strategy does discuss basin level implementation and the need for future planning at the sub-watershed level. Cost figures are greatly refined and segmented so categories such as erosion and sediment control can be looked at independently or as part of the total. The strategy also commits to the development of an urban BMP tracking system.

3. Nonpoint source stormwater and land use practices proposed in the strategy.

Summary of Comments: Numerous comments were concerned about the significant use of low impact development since it is a fairly new practice and the level of nutrient removal is largely unknown. Also, counties and localities will need more guidance on low impact development strategies that can be incorporated into their zoning, building permits and soil and erosion control programs.

Changes made to the strategy: The need to expand and assist with low impact development efforts as well as stromwater management is included in three of the seven program plans (Stormwater, Erosion and Sediment Control, Chesapeake Bay Preservation).

4. Level of treatment at wastewater treatment plants or other point source treatments proposed in the strategy.

Summary of Comments: There were a myriad of comments and questions in this section. There were many concerns about the cap allocations for treatment facilities, which focused on the cost associated and the affect it will have on future growth especially for smaller treatment facilities. There were several editorial comments about the numbers associated with 2010 flows, which appeared not to be the most recent and reliable. Overall, the comments expressed discontent with the nutrient and phosphorus allocations for point source especially with regards to the wastewater treatment facilities.

Changes made to the strategy: The original drafts presented an approach for point source nutrient reduction that took into consideration several factors such as:

- equity among significant dischargers
- feasibility of implementing nutrient control technology
- the magnitude of point source nutrient loads from various Bay watershed regions
- the 'delivery' of loads from above the fall line
- cost-effectiveness of controls
- unique conditions at several facilities (e.g., high-strength influent, combined sewers)

As a result, varying concentration levels for effluent total nitrogen and total phosphorus were proposed across the tributary basins, coupled with projected wastewater flows for the year 2010. Numerous comments were received about the use of 2010 flow projections, raising concerns about the accuracy of predictions and potential loss of existing design capacity in order to maintain waste load allocations in the future.

In August 2004, the Secretary of Natural Resources issued a statement on revisions to the draft strategies regarding point source controls. A set of "Guiding Principals" were included, which have now been applied as the basis to set annual waste load allocations for the significant nutrient discharges in the Bay watershed, and constitute the implementation plan for the point source elements of Virginia's Tributary Strategies. These guiding principles and a full discussion of point source controls can be found in Section IV and Appendix A of this document.

5. Implementation strategies including changes in state law, policy, authority and/or statutes.

Summary of comments: Only a few comments were received for this section. Most concerned proposed law changes or commented on the effectiveness of existing policies, especially voluntary ones. Nutrient Trading and the need for a "flush tax" similar to Maryland were suggested as was the need for a mandatory implementation plan and better state involvement in the compliance of local erosion and sediment control programs.

Changes made to the strategy: As written the strategies realize that a mix of voluntary and regulatory actions will be needed to meet the goals of the strategies. Most elements of the implementation plans for nonpoint source efforts provide a timeframe for reviewing progress being made with voluntary incentives and deciding if other measures are needed. Issues related to nutrient trading and innovative funding are being discussed.

6. Funding and potential funding options needed to implement the strategy.

Summary of comments: Most persons commenting referenced the need for additional funding and the concern that local governments not be left to assume the cost without significant help from the state and federal government.

Changes made to the strategy: The development of Virginia's tributary strategies are seen as a necessary early step in the process of pursuing additional funding. The strategy gives more detailed cost estimates and also highlights the work being done by the Chesapeake Bay Blue Ribbon Panel in examining potential state and federal funding sources.

7. Additional efforts to accommodate future growth while maintaining or "capping" the nutrient and sediment allocations.

Summary of comments: Almost all comments addressed some aspect of future growth and "capping" of nutrient and sediment loads. For the most part the comments felt the drafts as written did not provide for future growth, particularly in dealing with wastewater treatment. There were also comments in support of point source trading and basin wide treatment permits.

Changes made to the strategy: The Commonwealth's point source approach has been revised significantly since the drafts were released. These changes, including issues of future growth, allowing for nutrient trading and other point source issues are addressed in Secretary Murphy's August 2004 statement of point sources. A discussion of these changes can be found in Section IV and Secretary Murphy's entire statement is found in Appendix A.

8. Information or initiatives not currently in the draft.

Summary of Comments: The need for expanded outreach and educational efforts on a variety of issues such as toxics, low impact development and the benefits of the strategies to local water quality need to be developed for localities to use locally. Additional comments dealt with the lack of cost-effectiveness information. Some expressed an interest in seeing a list of costs associated for installing and operating various nutrient reduction methods. Lastly, government by example should be pursued through the application of BMPS on state-owned public lands.

Changes made to the strategy: Education and outreach is one of the seven parts of the states implementation plan. It is recognized that much greater efforts with outreach at the basin level will need to occur as the strategies are implemented. Expanded cost information is included in the strategies as is government by example.

9. Other general comments.

Summary of Comments: Many of the questions and comments in this section were editorial in nature; in particular many would like to see better explanation of the charts and graphs in the strategy. Concerns about meeting the allocation with voluntary efforts and little funding were also received, as was the lack of mention of air loads or impacts in the strategy. The majority of the question dealt with implementation issues and specific questions about how the plan will be implemented at the local level.

Changes made to the strategy: Numerous editorial changes have been made for ease of reading and understanding. The strategy does not at the present time recognize any air-related strategies for reducing loads despite the clear benefits to both air and water quality from existing air pollution reduction efforts. The strategy does include a seven-point implementation plan for the state with the acknowledgement that basin specific plans need to be developed next.

Appendix E: BMP Efficiencies

Chesapeake Bay Program Phase 4.3 Watershed Model Nonpoint Source BMPs (12/22/03)							
Agricultural BMPs	**Landuse Applied To or Landuse Conversion**	**Reporting Units * see note 5**	**How Credited**	**TN Efficiency**	**TP Efficiency**	**SED Efficiency**	**Status for Strategy Development**
Conservation Tillage	Conventional-Till to Conservation-Till	Annual/Acres	Landuse Conversion	N/A	N/A	N/A	Final
Riparian Forest Buffers (Agriculture) Efficiencies vary according to the following hydrologic settings	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres	Landuse Conversion + Efficiency				Revision Approved For Use 10/03
Inner Coastal Plain	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		85%	70%	70%	Revision Approved For Use 10/03
Outer Coastal Plain – Well Drained	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		40%	75%	75%	Revision Approved For Use 10/03
Outer Coastal Plain – Poorly Drained	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		70%	65%	65%	Revision Approved For Use 10/03
Tidal Influenced	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		25%	75%	75%	Revision Approved For Use 10/03
Piedmont	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		60%	60%	60%	Revision Approved For Use 10/03
Valley & Ridge – Marble/Limestone	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		45%	50%	50%	Revision Approved For Use 10/03
Valley & Ridge – Sandstone/Shale/Crystalline	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		55%	65%	65%	Revision Approved For Use 10/03
Appalachian Plateau	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		25%	50%	50%	Revision Approved For Use 10/03
Riparian Grass Buffers (Agriculture)	Conventional-Till, Conservation-Till, (Pasture) to Mixed Open	Cumulative/Acres	Landuse Conversion + Efficiency	43%	53%	53%	Revised efficiencies (variable by hydrophysiographic region) will be reviewed by TSWG
Wetland Restoration (Agriculture) Efficiencies vary according to the following hydrologic settings	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres	Currently Solely Landuse Conversion				Revision Approved For Use 10/03
Inner Coastal Plain	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		85%	70%	70%	Revision Approved For Use 10/03
Outer Coastal Plain – Well Drained	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		40%	75%	75%	Revision Approved For Use 10/03
Outer Coastal Plain – Poorly Drained	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		70%	65%	65%	Revision Approved For Use 10/03
Tidal Influenced	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		25%	75%	75%	Revision Approved For Use 10/03
Piedmont	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		60%	60%	60%	Revision Approved For Use 10/03
Valley & Ridge – Marble/Limestone	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		45%	50%	50%	Revision Approved For Use 10/03
Valley & Ridge – Sandstone/Shale/Crystalline	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		55%	65%	65%	Revision Approved For Use 10/03
Appalachian Plateau	Conventional-Till, Conservation-Till, Hay, (Pasture) to Forest	Cumulative/Acres		25%	50%	50%	Revision Approved For Use 10/03
Land Retirement (Agriculture)	Conventional-Till,	Cumulative/Acres	Landuse	N/A	N/A	N/A	Final

	Conservation-Till, (Pasture) to Mixed Open		Conversion				
Tree Planting (Row Crop)	Conventional-Till, Conservation-Till to Forest	Cumulative/Acres	Landuse Conversion	N/A	N/A	N/A	Final
Nutrient Management Plan Implementation (Crop) *see note 1	Conventional-Till, Conservation-Till, Hay	Cumulative/Acres	Built into Simulation	135%	135%	N/A	Revision Approved For Use 10/03
Cover Crops							
Cereal Cover Crops							
Conventional-Till *see note 3	Conventional-Till	Annual/Acres	Efficiency	45%/30%	15%/7%	20%/10%	Revision Approved For Use 10/03
Conservation-Till *see note 3	Conservation-Till	Annual/Acres	Efficiency	45%/30%	0%	0%	Revision Approved For Use 10/03
Commodity Cereal Cover Crops							
Conventional-Till *see note 3	Conventional-Till	Annual/Acres	Efficiency	25%/17%	0%	0%	Revision Approved For Use 10/03
Conservation-Till *see note 3	Conservation-Till	Annual/Acres	Efficiency	25%/17%	0%	0%	Revision Approved For Use 10/03
Conservation Plans							
Conventional-Till	Conventional-Till	Cumulative/Acres	Efficiency	8%	15%	25%	Revision Approved For Use 10/03
Conservation-Till	Conservation-Till	Cumulative/Acres	Efficiency	3%	5%	8%	Revision Approved For Use 10/03
Hay	Hay	Cumulative/Acres	Efficiency	3%	5%	8%	Revision Approved For Use 10/03
Pasture	Pasture	Cumulative/Acres	Efficiency	5%	10%	14%	Revision Approved For Use 10/03
Animal Waste Management Systems Reported by the Following Categories:							
Livestock Systems – Designate types of systems with associations to the number of Animal Units and types of animals each system is handling	Manure Acre	systems	Efficiency	75%	75%	N/A	Revision Approved For Use 10/03
Poultry Systems – Designate types of systems with associations to the number of Animal Units and types of animals each system is handling	Manure Acre	systems	Efficiency	14%	14%	N/A	Revision Approved For Use 10/03
Barnyard Runoff Control - Designate types of runoff controls with associations to the number of Animal Units and types of animals number of Animal Units and types	Manure Acre = 1 system treats waste from 145 AUs	systems	Efficiency	10% Supp./20%	10% Supp./20%	40%	Revision Approved For Use 10/03
of animals each system is handling	Manure Phosphorus Available For Runoff or Application	_	_	N/A	16.26%	N/A	Revision Approved For Use 10/03
Yield Reserve	Cropland/Hayland	Annual/Acres	_	Application Reduction Below Nutrient Management	15% Below Nutrient Management Plans	N/A	Revision Approved For Use 10/03
Alternative Uses of Manure / Manure Transport	lbs of TN/TP removed between model segment (watershed)	Annual/Acres	Built Into Preprocessor				
Stream protection with fencing with off stream watering	Pasture	Cumulative/Acres Linear Feet	Efficiency	60%	60%	75%	Revision Approved For Use 10/03
Off stream watering in pasture without fencing	Pasture	Cumulative/Acres	Efficiency	30%	30%	38%	Revision Approved For Use 10/03
Off stream watering with stream fencing and rotational grazing (pasture)	Pasture	Cumulative/Acres	Efficiency	20%	20%	40%	Revision Approved For Use 10/03

Urban and Mixed Open BMPs	Landuse Applied To or Landuse Conversion	Reporting Units	How Credited	TN Efficiency	TP Efficiency	SED Efficiency	Status for Strategy Development
Stormwater Management Reported by the Following Categories:							
Wet Ponds and Wetlands	Pervious and Impervious Urban	Cumulative/Acres	Efficiency	30%	50%	80%	Final
Dry Detention Ponds and Hydrodynamic Structures	Pervious and Impervious Urban	Cumulative/Acres	Efficiency	5%	10%	10%	Final
Dry Extended Detention Ponds	Pervious and Impervious Urban	Cumulative/Acres	Efficiency	30%	20%	60%	Final
Infiltration Practices	Pervious and Impervious Urban	Cumulative/Acres	Efficiency	50%	70%	90%	Final
Filtering Practices	Pervious and Impervious Urban	Cumulative/Acres	Efficiency	40%	60%	85%	Final
Impervious Surface Reduction / Non-Structural Practices	Impervious Urban to Pervious Urban	Cumulative/Acres	Landuse Conversion	N/A	N/A	N/A	Final
Stream Restoration	Pervious and Impervious Urban	Cumulative/Linear Ft.	Load Reduction	0.02 lbs/ft	0.0035 lbs/ft	2.55 lbs/ft	Final
Erosion and Sediment Control	Pervious and Impervious Urban	Annual/Acres	Efficiency	33%	50%	50%	Final
Nutrient Management (Urban)	Pervious Urban	Cumulative/Acres	Efficiency	17%	22%	N/A	Final
Forest Conservation (Urban)	Pervious Urban, Mixed Open to Forest	Cumulative/Acres	Landuse Conversion	N/A	N/A	N/A	Built Into Landuse Projections
Riparian Forest Buffers (Urban)	Pervious Urban to Forest	acres	Landuse Conversion + Efficiency	25%	50%	50%	Revised efficiencies will be reviewed by Forestry WG
Riparian Forest Buffers (Mixed Open)	Mixed Open to Forest	Cumulative/Acres	Landuse Conversion	N/A	N/A	N/A	Final
Tree Planting (Mixed Open)	Mixed Open to Forest	Cumulative/Acres	Landuse Conversion	N/A	N/A	N/A	Final
Tree Planting (Urban)	Pervious Urban to Forest	Cumulative/Acres	Landuse Conversion	N/A	N/A	N/A	Final
Nutrient Management (Mixed Open)	Mixed Open	Cumulative/Acres	Efficiency	17%	22%	N/A	Final
Abandoned Mine Reclamation	Exposed (Pervious and Impervious Urban) to Mixed Open	Cumulative/Acres	Landuse Conversion	N/A	N/A	N/A	Final
Resource BMPs	**Landuse Applied To**	**Reporting Units**	**How Credited**	**TN Efficiency**	**TP Efficiency**	**SED Efficiency**	**Status for Strategy Development**
Forest Harvesting Practices	Forest	Cumulative/Acres	Efficiency	50%	50%	50%	Final
Structural Tidal Shoreline Erosion Control	N/A	linear feet and N, P, and SED Reduction	Water Quality Model	N/A	N/A	N/A	Final
Non-Structural Tidal Shoreline Erosion Control	N/A	linear feet and N, P, and SED Reduction	Water Quality Model	N/A	N/A	N/A	Final
Septic BMPs	**Applied To**	**Reporting Units**	**How Credited**	**TN Efficiency**	**TP Efficiency**	**SED Efficiency**	**Status for Strategy Development**
Septic Connections/Hookups	septic systems	systems	Removal of Systems	N/A	N/A	N/A	Final
Septic Denitrification	septic systems	systems	Efficiency	50%	N/A	N/A	Final
Septic Pumping	septic systems	systems	Efficiency	5%	N/A	N/A	Final

* Note 1: % equals max level of nutrient (n/p) application to crops.
* Note 2: This list does not include municipal or industrial point source BMPs
* Note 3: Cover Crops have two planting windows with associated efficiencies; Early%/Late%
Early: Up to 7 days prior tp published first frost date.
Late: Up to 7 days after published first frost date.
* Note 4: Barn Yard runoff controls for operator where manure storage facilities exist
Barn Yard runoff control for operators where facility is not built (contain daily haul/field storage)
* Note 5: Cumulative – The total acres/linear feet of a BMP installed during an entire period.
Annual – The amount of a BMP installed/implemented for that year only.

Appendix F: Shenandoah Tributary Strategy Team

Much acknowledgement is due to the members of the Virginia Shenandoah Tributary Team who assisted in the production of the Shenandoah Strategy:

Otis Ailsworth	City of Waynesboro
Nora Amos	
Jean Andrews	Augusta County Service Authority
Chris Anderson	Page County
Sharon Angle	City of Staunton
Rob Arner	Southeast Rural Community Assistance Project
Marc Aveni	VA Department of Conservation and Recreation
James Baker	City of Harrisonburg
Hobey Bauhan	Virginia Poultry Federation
Pete Benedetto	Lord Fairfax SWCD
Eric Bendfeldt	Virginia Cooperative Extension – Rockingham County
Gem Bingol	Piedmont Environmental Council
Richard Blackwell, III	Blackwell Engineering
BJ Blessing	Virginia Rural Water Association
Kevin Blythe	VA Department of Forestry
Milton Boyce	Friends of the Shenandoah
Larry Bradford	Town of Woodstock
Robert Brent	VA Department of Environmental Quality
Tim Bristoe	City of Front Royal
Ray Brownfield	Lord Fairfax SWCD
Paul Bugas	VA Department of Game and Inland Fisheries
Jim Burke	Coors Brewing Company
Nancy Carr	North Fork Shenandoah River Nature Programs
Rick Chandler	Town of Dayton
Tom Christoffel	Northern Shenandoah Valley Regional Commission
Dale Cobb	Augusta County
Tim Crider	Town of Grottoes
Megen Dalton	Shenandoah Valley SWCD
James Davis	City of Staunton
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James Didawick	Town of Woodstock
Larry Dovel	Town of Shenandoah
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Becky Earhart	Augusta County
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John Gangwer	Pilgrims Pride
Dale Gardner	Virginia Dairymen's Association
Sandy Greene	Headwaters SWCD
John Gibson	
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Larry Hough	VA Department of Environmental Quality
Julie Jenkins	VA Department of Conservation and Recreation
Hadley Jenner	Rockingham County
Ann Jennings	Chesapeake Bay Foundation
Tedd Jett	Merck
Bill Jones	VA Department of Transportation
Brevetta Jordan	City of Front Royal
John Kaylor	Headwaters SWCD
Tamara Keeler	VA Department of Conservation and Recreation
John Kennedy	VA Department of Environmental Quality
Brenda Kennell	Dupont (Invista)
Stephen Klevickis	Merck
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Eric Lawrence	Frederick County
Jim Lawrence	Lord Fairfax SWCD
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Bruce Lundeen	Shenandoah Pure Water Forum
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Ali McKechie	
Neil McKendry	
Brent Manuel	Town of Woodstock
Brian McReynolds	City of Waynesboro
John Mlinarcik	VA Department of Conservation and Recreation
Jessee Moffett	Frederick-Winchester Service Authority
Charles Moore	Town of Mt. Jackson
Bud Nagelvoort	Lord Fairfax SWCD
Charles Newton	Page County Water Quality Advisory Committee
David Nichols	Town of Bridgewater
Kyle O'Brien	Town of Broadway
Mike Ouderkirck	Coors Brewing Company
Kenneth Owens	Friends of the North Fork
Cathy Perry	Headwaters SWCD
Curtis Poe	Harrisonburg-Rockingham Regional Sanitation Authority
Carol Quay	Canaan Valley Institute
Rich Rau	Town of Berryville
John Reeves	Rockingham County Citizen
Heather Richards	Potomac Conservancy
Jeff Rinker	Coors Brewing Company
Michael Ritchie	Town of New Market
John Ross	
Dia Russell	VA Department of Forestry
Orville Ryman	Town of New Market
Steve Saari	Intrastate Commission on the Potomac River Basin
Frank Sanders	City of Winchester
Diana Scharf	Town of New Market
Lyle Schertz	Lord Fairfax SWCD

Jerry Schiro	Town of Luray
Tom Shields	
Trent Small	City of Harrisonburg
Doug Stanley	Warren County
Liz Stoffel	Potomac Conservancy
George Sylvester	Shenandoah County Water Resources
Steve Talley	Canaan Valley Institute
James Tewalt	
Guy Tudor	VA Department of Transportation
Stacy Turner	City of Harrisonburg
Billy Vaughn	Rockingham County
Bobby Whitescarver	USDA- Natural Resources Conservation Service
Jonathan Winsten	
Doug Wolfe	Augusta County
Robert Wolfe	Georges Chicken
Evan Wyatt	Frederick County
Tim Youmans	City of Winchester
YB Yount	City of Waynesboro

Shenandoah Tributary Team Considerations

The initial attempt to develop a mix of practices that would result in reductions to meet the allocation was carried out at the Team level. The Team strategy identified what measures could be implemented in the Shenandoah watershed to meet the reduction goals, assuming that necessary resources would be available. The state agency Team members developed the initial strategy for the urban source category with guidance from the Urban Working Group. The level of effort is a calculated average of the Chesapeake Bay Program Tier 3 and Tier 4, as applied to the Chesapeake Bay Program's projection of urban land uses in 2010.

In keeping with the necessary emphasis on reductions on urban land, the initial strategy for the Shenandoah proposed that urban nutrient management be applied to all urban land by the year 2020. Urban nutrient management involves the reduction of fertilizer to turf grass areas including home lawns, business, and public lands, such as parks, playing fields, school campuses, and rights of ways.

In addition, the initial strategy proposed that stormwater management practices be applied to sixty percent of all urban land by the year 2020. Stormwater management involves the installation of ponds, infiltration swales, and rain gardens (bioretention areas) to capture and temporarily store runoff from developed areas to filter out nutrients, sediment, and other pollutants. Other practices proposed for reducing nutrients and sediment from urban land include the creation of forested and grass buffers along streams, the installation of erosion and sediment control practices on newly developed land, and regular septic system pumpouts. Additional opportunities for nutrient reductions exist through the connection of septic systems to wastewater treatment facilities, and the installation of septic denitrification systems.

While the strategy does place a significant new focus on urban land, continued efforts on agricultural land promises to yield substantial nutrient and sediment reductions as well, especially in light of the Shenandoah watershed's significant agricultural land base. The Agricultural/Forestry Working Group utilized past implementation trends and forecasted potential future implementation as applied to local land use knowledge and the CBPO projection of agriculture and forestry land uses in 2010.

The initial strategy placed emphasis on the installation of animal waste management systems and the implementation of nutrient and farm plans for both nutrient and sediment reduction. Animal waste management systems provide facilities for the storage and handling of livestock and poultry waste and the control of surface runoff water. The proposed strategy places an additional emphasis on liquid systems, such as dairies. Nutrient management plan implementation provides optimum use of nutrients to maintain yield while minimizing nutrient loss. Farm plan implementation focuses on the reduction of sediment loss from cropland. Other practices proposed for reducing nutrients and sediments from agricultural and forest land include conservation tillage, retirement of highly erodible land, the creation of forest and grass buffers along streams, the exclusion of livestock from streams, rotational grazing, and the use of cover crops.

Some of the members of the group expressed concern over the calculated levels of implementation for forested and grass buffers, and indicated that conflict between best management practice requirements and local high grass ordinances may pose problems for implementation. It was recommended that funds be made available through grant assistance for on-site pumpouts and connection of on-site systems to public sewers, and these methods be given serious consideration as components in the strategy. A specific recommendation was offered that maintenance contracts be required for on-site denitrification systems through the mortgage process, because these types of BMPs are maintenance-dependent.

Some members of the group recommended that state government must initiate specific components of the strategy. This would lessen the challenges faced by localities when attempting to make major policy changes. Specifically, it was recommended that the Commonwealth initiate statewide nutrient management planning through public education and a ban on the sale of fertilizer to the everyday consumer. Instead, it was recommended that the Commonwealth create a program that would allow citizens to apply fertilizer to their property through a certification program. A recommendation was also offered regarding the installation of on-site denitrification systems through a state-level initiative.

Also, the Urban Working Group did recognize the link between land use and water quality, and some members requested that consideration be given to how specific components of the strategy may affect local growth management strategies.

Stakeholders voiced additional recommendations throughout the process consistently. Several members offered specific technical advice and guidance, such as the recommendation incorporate soil management techniques to stimulate and increase soil microbial activity to reduce nutrient leaching while providing for crop needs. The concept of the conservation of mass and the lifecycle of nutrients was raised, and the recommendation was offered that nutrients, whether in the form of litter and manure or taken up in a plant, must be removed from the watershed to achieve lasting reductions in nutrients in the Chesapeake Bay.

Throughout this continuous process of developing proposed methods of achieving nutrient and sediment reductions, stakeholders are encouraged to raise substantive concerns and recommendations. The comments range from policy-level issues such as the level of effort that should be reasonably expected from a particular source category, to implementation-level issues such as how the installation of best management practices is tracked. While consensus has not been reached on many issues, the process is successfully allowing the open communication of knowledge, ideas, and problems. Summarized below are the specific points raised by stakeholders involved in the Shenandoah Tributary Strategy development process.

The Point Source Working Group recommended that non-point source best management practices, especially the creation of riparian buffers, are more cost-effective (per pound of nutrient removed per dollar) than installing advanced chemical and biological nutrient removal technologies at significant point sources. This group also indicated that streams with impaired water quality due to fecal coliform or benthic issues often require the same or similar best management practices as those used for reducing nutrients. The group draws the conclusion that by implementing non-point source BMPs, multiple water quality objectives may be reached.

Regarding this topic, the Agriculture/Forestry Workgroup indicated that limited physical opportunities exist for the creation of riparian buffers throughout the watershed. This would in turn limit the extent to which that particular BMPs could be proposed. Also, the group believed that by relying on individual landowners to pay a portion of the cost of the installation of agricultural BMPs, a greater cost is imposed on the families of the nonpoint source category, in contrast to the opportunity for a point source facility to pass the cost of nutrient removal to the many users of the facility.

There was a point raised by some stakeholders that point source facilities discharging less than 0.5 million gallons per day are not considered "significant discharges" and nutrient reductions are not specifically proposed for them. Some stakeholders contended that no one subgroup, even if their source load contribution is small, should be singled out as exempt from the challenge of improving water quality. Several stakeholders stated that the "non-significant "discharges may create substantial local water quality problems as a major contributor in a small subwatershed, even if that facility were less than significant in the overall Shenandoah-Potomac watershed.

Regarding this topic, the Point Source Working Group reported that the "significant dischargers" account for 16 percent and treat 83 percent of the total nitrogen load for the Shenandoah watershed. The group did not believe it would be cost effective to require advanced nutrient removal technologies at the "non-significant dischargers" since they represent only a fraction of the total nitrogen load. The group did support the proposal for operator training at these non-significant dischargers for operational changes to increase nutrient removal. Also, the group supported a proposal that point sources greater than 0.30 million gallons per day sample and test effluent quarterly for total nitrogen concentrations and semi-annually for total phosphorus concentrations, while those less than 0.30 million gallons per day test semi-annually and annually for total nitrogen and total phosphorus, respectively. The Point Source Working Group did recognize that most dischargers will receive some sort of nutrient limits in the future, and supported the concept of nutrient control goals for all point source dischargers.

The Point Source Working Group also made several specific recommendations regarding the establishment of nutrient limits, requesting that the method of determining compliance with nutrient loads allow room for periodic effluent quality variation, provided compliance with annual average total nitrogen and total phosphorus loads is maintained. The group also expressed concern over the potential of nutrient limits appearing in discharge permits within the next two years and requested that the implementation schedules be allowed to extend beyond the five-year terms of the discharge permit that would initiate the limits. This extension is based on the assumption that state and federal monies would be available to assist with upgrades, and would allow for grant acquisition and other financing, public procurement of engineering services, and project completion.

Appendix G: Potomac Tributary Strategy Team

Much acknowledgement is due to the members of the Virginia Potomac Tributary Team who assisted in the production of the Potomac Strategy, special thanks especially to the individuals who provided leadership to the three subcommittees:

Tara Ajello	CH2M Hill
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John Bell	Tri-County/City SWCD
Stephen Bennett	Prince William County Service Authority
Matt Berres	Potomac Conservancy
Alex Blackburn	Loudoun County Soil Scientist
Stacey Blersch	US Army Corps of Engineers – Baltimore District
Kevin Blythe	VA Department of Forestry
Jim Boland	Loudoun SWCD
Tom Broderick	Loudoun County Sanitation Authority
Will Bullard	US Department of Defense - Navy
Anne Burgess	Prince William SWCD
Ron Burgess	Prince William SWCD
Bob Canham	Prince William County Service Authority
Keshia Cheeks	VA Department of Conservation and Recreation
Deirdre Clark	Fauquier County Building and Development
Jeff Corbin	Chesapeake Bay Foundation – Richmond Office
Debbie Cross (*Agriculture co-Lead*)	VA Department of Conservation and Recreation
Keith Dickinson	Virginia Cooperative Extension – Fauquier
Roger Diedrich	Sierra Club – Fairfax Chapter
Thomas Faha	VA Department of Environmental Quality
Adrian Fremont	City of Fairfax Public Works and Engineering
Normand Goulet	Northern Virginia Regional Commission
Tom Grizzard	VA Tech-Occoquan Watershed Monitoring Lab
Barry Harris	USDA- Natural Resources Conservation Service
Art Hart	Tri City/County SWCD
Glenn Harvey (*Point Source Lead*)	Alexandria Sanitation Authority
Carlton Haywood	Interstate Commission Potomac River Basin
Shelby Hertzler	VA Department of Conservation and Recreation
Diane Hoffman	Northern Virginia SWCD
Kim Hosen	Prince William Conservation Alliance
Steven Hubble	Stafford County Planning and Development
Wade Hugh	Prince William County Public Works
Sam Johnson (*Agriculture co-Lead*)	Virginia Cooperative Extension - Westmoreland
Robert Jordan	Potomac River Greenways Coalition
Traci Kammer-Goldberg	Fairfax County Water Authority
Tamara Keeler	VA Department of Conservation and Recreation
John Kennedy	VA Department of Environmental Quality
Dipmani Kumar	Fairfax County Public Works
Patricia Kurpiel	Stafford County Citizen
Jim Lawrence	Lord Fairfax SWCD
Phillip A. Lewis	Dale City Service Corporation
Martha Lyons-Holland	Prince William County Citizen
Heather Mackey	VA Department of Conservation and Recreation

Evelyn Mahieu	Upper Occoquan Sewage Authority
Mike McGrath	Fairfax County
Terry Miller	Dale City Service Corporation
Jesse Moffett	Winchester Service Authority
Madan Mohan	Prince William County Public Works
Shahram Mohsenin	Fairfax County Public Works
Katherine Mull	Northern Virginia Regional Commission
Kate Norris	Prince William SWCD
Judy Okay	VA Department of Forestry
Jason Papacosma	Arlington County Environmental Services
Ryan Pacquet	Lake Jackson Homeowners Association
Greg Prelewicz	Fairfax County Water Authority
Mark Remsberg	King George County Planning and Zoning
Fred Rose	Fairfax County Public Works
Brian Rustia (*Urban Lead*)	Metro Washington Council of Governments
Daniel Schwartz	Northern Virginia SWCD
Kelly Shenk	US EPA – Chesapeake Bay Program Office
Lyle Shertz	Lord Fairfax SWCD
Robert Shoemaker	VA Department of Conservation and Recreation
Angela Sowers	US Army of Corps Engineers – Baltimore District
Gary Switzer	VA Department of Conservation and Recreation
Alison Thompson	VA Department of Environmental Quality
Tom Turner	John Marshall SWCD
David Ward	Loudoun County Stormwater Management
Chuck Weber	Prince William County Service Authority
Aileen Winquist	Arlington County Environmental Services

Potomac Tributary Team Considerations

The development of the Potomac Tributary Strategy has been an open and accessible process. Nine announced meetings were held throughout the basin as often as twice a month during the September 2003 through March 2004 timeframe. Meetings provided diverse participants with information on how the reduction allocations were made, laid out a framework for what needed to be accomplished, and solicited input on how to do it. Stakeholders were divided into three subcommittees: Point Source, Non-Point Source Urban, Non-Point Source Agriculture, with a lead person identified for each committee. Staff from the Department of Conservation and Recreation and the Department of Environmental Quality worked closely with stakeholders to explore and evaluate a wide variety of point and nonpoint source pollution control measures. Analysis provided by the CBPO that showed implementation levels at various levels or "tiers" of effort was used as a starting point for discussion with stakeholders. It was noted repeatedly that The Potomac Tributary Team worked so well together that continuation as an "Implementation team" is recommended.

The Potomac Team, working through the 3 sub-committees, presented an ambitious Tributary Strategy I to the CBPO in February 2004 that represented for the most part a voluntary approach on the part of the localities and treatment plants to develop an equitable and "do-able" scenario to meet an ambitious allocation levels. Unfortunately, this initial strategy did not meet the reduction allocation by approximately 1.6 million pounds. State agency staff was then directed to build upon this initial work to develop a strategy that met the basin's allocations.

Both the Urban and Agricultural Subcommittes brought up important issues. For agriculture, concern was raised about past and present BMP tracking in terms of both BMP numbers and acres submitted from the local level versus what was credited by the CBPO. Also noted was that a large segment of the agricultural community is believed to be implementing best management practices on a voluntary basis. If the practices are in accordance with standard specifications, then they should be recognized and accounted for through the state's tracking system. The recommendation for the CBPO to consider horse pasture management and horse manure management as eligible for nutrient reductions was also heard. For the urban community, a critical need for a simple, easy to use, urban best management practice tracking system at the state level to keep accurate records of both existing and new storm water management and other urban practices was repeatedly brought up. Similar to agriculture, the urban subcommittee repeatedly voiced concerns that in the absence of a tracking system, many practices already in place are simply not being accounted for. Maintenance concerns for BMPs as they age or change ownership over time was also a concern of this subcommittee.

The Point Source Subcommittee of the Potomac Tributary Team focused issues affecting wastewater treatment plants operating in the northern Virginia region. Facility representatives on this subcommittee expressed their opinions on the achievement and maintenance of point source nutrient load "caps", endorsing positions advocated by the Virginia Association of Municipal Wastewater Agencies (VAMWA). They cited three important local conditions that need to be considered in the Potomac Tributary Strategy:

Blue Plains is a major facility (370 MGD design capacity) owned and operated by the DC Water and Sewer Authority (WASA). It treats flows from several Virginia jurisdictions and that portion of the flow from Virginia is counted toward the Virginia point source cap loads. However, the Virginia jurisdictions do not have control of the treatment levels at Blue Plains. DC WASA is facing several daunting capital demands including significant Combined Sewer Overflow work, construction of a new digester complex and ongoing plant upgrades. Blue Plains is currently required to remove nitrogen to an annual average level of 7.5 mg/l. When, and to what extent, improvements for nitrogen removal are implemented is unknown at this time. A capital program to increase nitrogen removal (estimated at $820 million of which the Virginia share could be $103 million at Blue Plains may involve a complex negotiation between the Virginia and Maryland jurisdictions served by Blue Plains, the District of Columbia, and the EPA. The Washington Area Council of Governments may take the lead in these negotiations.

The Upper Occoquan Sewage Authority (UOSA) treats flows from portions of Fairfax County, Prince William County, and the Cities of Manassas and Manassas Park. The facility discharges to an unnamed tributary of Bull Run, about 19 stream miles above the Fairfax County Water Authority (FCWA) intake located in the high dam of the Occoquan Reservoir. The reservoir provides drinking water to about 1.2 million residents of Northern Virginia (750,000 in Fairfax County and about 450,000 through wholesale customers). UOSA has one of the most stringent discharge permits in the world. The UOSA permit is unique in that it details operational requirements for the plant dependent on the nitrate level at the FCWA water intake. If nitrate levels approach 5 mg/l, UOSA is required to remove nitrate from its effluent using a denitrification system. Prior to the 5 mg/l drinking water threshold, nitrate is considered beneficial to the overall water quality in the reservoir by helping to trap phosphorus in the sediments. UOSA will continue to be operated primarily to protect the water supply for FCWA customers.

Finally, regional growth in northern Virginia is expected to continue among the highest rates in the Bay watershed. However, growth will not be evenly distributed across the area. In general, the western suburbs are growing at a faster rate than the more developed areas inside the Beltway. The Potomac Tributary Strategy must find a way to accommodate equity in the handling of divergent growth rates.

Appendix H: Shenandoah, Potomac Input Decks & Loadings by Land Use 1985-2002

Table H-1: Shenandoah Basin Input Deck	Land Use	Available	2002 BMP	2010 BMP	Remaining
Forestry BMPs		Units	Progress	Goal	BMP Need
Forest Harvesting Practices	Forest	920,094	0	3,705	3,705
Agricultural BMPs					
Buffers Forested	Hay	189,580	259	18,958	18,699
Nutrient Management Plan Implementation	Hay	189,580	99,446	126,071	26,625
Retirement Highly Erodible Land	Hay	189,580	0	0	0
Soil Conservation Water Quality Plans	Hay	189,580	29,572	126,071	96,499
Tree Planting	Hay	189,580	0	18,958	18,958
Wetland Restoration	Hay	189,580	0	18,958	18,958
Yield Reserve	Hay	189,580	0	2,654	2,654
Buffers Forested	Cropland*	106,068	178	0	0
Buffers Grass	Cropland*	106,068	40	26,517	26,477
Cover Crops	Cropland*	106,068	534	73,842	73,308
Continuous No-Till	Cropland*	106,068	0	0	0
Conservation Tillage	Cropland*	106,068	71,576	71,576	0
Nutrient Management Plan Implementation	Cropland*	106,068	67,366	73,842	6,476
Retirement Highly Erodible Land	Cropland*	106,068	3,950	0	0
Soil Conservation Water Quality Plans	Cropland*	106,068	21,167	73,842	52,675
Tree Planting	Cropland*	106,068	0	0	0
Wetland Restoration	Cropland*	106,068	0	0	0
Yield Reserve	Cropland*	106,068	0	1,591	1,591
Animal Waste Management Systems/Barnyard Runoff Control	Manure	427	315	427	112
Poultry Litter Alternative Use/Transported (Dry Tons)	Manure	527,392	0	114,878	114,878
Buffers Forested	Pasture	325,279	0	32,528	32,528
Grazing Land Protection	Pasture	325,279	26,327	24,096	0
Soil Conservation Water Quality Plans	Pasture	325,279	60,863	231,761	170,898
Stream Protection with Fencing	Pasture	325,279	1,555	134,178	132,623
Stream Protection without Fencing	Pasture	325,279	0	73,188	73,188
Stream Stabilization/Restoration (linear feet)	Pasture	na	0	20,000	20,000
Tree Planting	Pasture	325,279	0	32,528	32,528
Urban BMPs					
Buffers Forested	Pervious Urban	139,749	0	5,590	5,590
Erosion Sediment Control	Impervious Urban	40,166	0	8,035	8,035
Erosion Sediment Control	Pervious Urban	139,749	0	24,471	24,471
Nutrient Management Plan Implementation	Pervious Urban	139,749	116	42,483	42,367
Non Structural Shoreline Erosion Control (linear feet)	Pervious Urban	na	0	0	0
Stream Restoration (linear feet)	Impervious Urban	na	0	7,500	7,500
Stream Restoration (linear feet)	Pervious Urban	na	0	15,000	15,000
Structural Shoreline Erosion Control (linear feet)	Pervious Urban	na	0	0	0
Storm Water Management - Filtering Practices	Impervious Urban	40,166	0	5,893	5,893
Storm Water Management - Filtering Practices	Pervious Urban	139,749	0	20,473	20,473
Storm Water Management - Infiltration Practices	Impervious Urban	40,166	0	5,893	5,893
Storm Water Management - Infiltration Practices	Pervious Urban	139,749	0	20,473	20,473
Storm Water Management - Wet Ponds/Wetlands	Pervious Urban	139,749	0	17,307	17,307
Storm Water Management - Wet Ponds/Wetlands	Impervious Urban	40,166	0	5,893	5,893
Tree Planting	Pervious Urban	139,749	0	5,590	5,590
Mixed Open BMPs					
Buffers Forested	Mixed Open	151,773	0	7,634	7,634
Nutrient Management Plan Implementation	Mixed Open	151,773	0	99,929	99,929
Non Structural Shoreline Erosion Control (linear feet)	Mixed Open	na	0	0	0
Structural Shoreline Erosion Control (linear feet)	Mixed Open	na	0	0	0
Tree Planting	Mixed Open	151,773	0	7,634	7,634
Wetland Restoration	Mixed Open	151,773	0	7,634	7,634
Septic BMPs					
Septic Connections (systems)	Septic	52,800	0	2,640	2,640
Septic Pumping (systems)	Septic	52,800	0	37,620	37,620

All implementation units are acres unless otherwise noted.

BMPs in bold letters are conversion practices. Once converted, no additional BMPs can be applied.

BMPs not in bold letters are non-conversion practices and can have multiple BMPs applied per acre.

*Acres available for high-till and low-till are combined in this table, providing one figure for total acres of cropland available.

Table H-2: Potomac Basin Input Deck	Land Use	Available	2002 BMP	2010 BMP	Remaining
Forestry BMPs		Units	Progress	Goal	BMP Need
Forest Harvesting Practices	Forest	667,404	0	4,743	4,743
Agricultural BMPs					
Buffers Forested	Hay	125,287	299	12,528	12,229
Nutrient Management Plan Implementation	Hay	125,287	50,166	82,121	31,955
Retirement Highly Erodible Land	Hay	125,287	0	1,253	1,253
Soil Conservation Water Quality Plans	Hay	125,287	31,383	82,121	50,738
Tree Planting	Hay	125,287	0	12,528	12,528
Wetland Restoration	Hay	125,287	93	12,528	12,435
Yield Reserve	Hay	125,287	0	1,728	1,728
Buffers Forested	Cropland*	87,646	589	4,382	3,794
Buffers Grass	Cropland*	87,646	139	13,148	13,009
Cover Crops	Cropland*	87,646	2,092	59,468	57,376
Continuous No-Till	Cropland*	87,646	0	0	0
Conservation Tillage	Cropland*	87,646	57,025	57,025	0
Nutrient Management Plan Implementation	Cropland*	87,646	69,038	59,468	0
Retirement Highly Erodible Land	Cropland*	87,646	7,369	0	0
Soil Conservation Water Quality Plans	Cropland*	87,646	56,898	59,468	2,570
Tree Planting	Cropland*	87,646	0	877	877
Wetland Restoration	Cropland*	87,646	152	877	725
Yield Reserve	Cropland*	87,646	0	683	683
Animal Waste Management Systems/Barnyard Runoff Control	Manure	48	28	48	20
Poultry Litter Alternative Use/Transported (Dry Tons)	Manure	2,392	0	0	0
Buffers Forested	Pasture	204,281	0	20,428	20,428
Grazing Land Protection	Pasture	204,281	16,904	16,439	0
Soil Conservation Water Quality Plans	Pasture	204,281	51,126	155,250	104,124
Stream Protection with Fencing	Pasture	204,281	787	81,712	80,925
Stream Protection without Fencing	Pasture	204,281	0	32,684	32,684
Stream Stabilization/Restoration (linear feet)	Pasture	na	0	33,500	33,500
Tree Planting	Pasture	204,281	0	20,428	20,428
Urban BMPs					
Buffers Forested	Pervious Urban	324,190	0	12,923	12,923
Erosion Sediment Control	Impervious Urban	154,158	0	30,974	30,974
Erosion Sediment Control	Pervious Urban	324,190	0	52,262	52,262
Nutrient Management Plan Implementation	Pervious Urban	324,190	20,967	98,206	77,239
Non Structural Shoreline Erosion Control (linear feet)	Pervious Urban	na	0	46,000	46,000
Stream Restoration (linear feet)	Impervious Urban	na	0	26,500	26,500
Stream Restoration (linear feet)	Pervious Urban	na	0	33,750	33,750
Structural Shoreline Erosion Control (linear feet)	Pervious Urban	na	0	4,600	4,600
Storm Water Management - Filtering Practices	Impervious Urban	154,158	4	21,904	21,900
Storm Water Management - Filtering Practices	Pervious Urban	324,190	10	45,971	45,962
Storm Water Management - Infiltration Practices	Impervious Urban	154,158	1	21,904	21,903
Storm Water Management - Infiltration Practices	Pervious Urban	324,190	3	45,971	45,968
Storm Water Management - Wet Ponds/Wetlands	Pervious Urban	324,190	1,811	45,971	44,161
Storm Water Management - Wet Ponds/Wetlands	Impervious Urban	154,158	868	21,904	21,036
Tree Planting	Pervious Urban	324,190	0	12,923	12,923
Mixed Open BMPs					
Buffers Forested	Mixed Open	155,752	0	7,788	7,788
Nutrient Management Plan Implementation	Mixed Open	155,752	0	103,573	103,573
Non Structural Shoreline Erosion Control (linear feet)	Mixed Open	na	0	26,000	26,000
Structural Shoreline Erosion Control (linear feet)	Mixed Open	na	0	2,600	2,600
Tree Planting	Mixed Open	155,752	0	7,788	7,788
Wetland Restoration	Mixed Open	155,752	0	7,788	7,788
Septic BMPs					
Septic Connections (systems)	Septic	78,388	0	11,291	11,291
Septic Pumping (systems)	Septic	78,388	0	47,429	47,429

All implementation units are acres unless otherwise noted.

BMPs in bold letters are conversion practices. Once converted, no additional BMPs can be applied.

BMPs not in bold letters are non-conversion practices and can have multiple BMPs applied per acre.

*Acres available for high-till and low-till are combined in this table, providing one figure for total acres of cropland available.

Figure H-1: Shenandoah 1985 Percent Nitrogen Loads by Land Use. Total Load = 7,294,810 lbs.

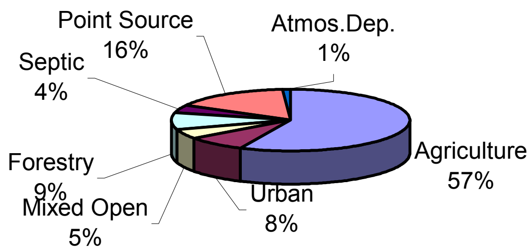

Figure H-2: Shenandoah 2002 Percent Nitrogen Loads by Land Use. Total Load = 7,071,784 lbs.

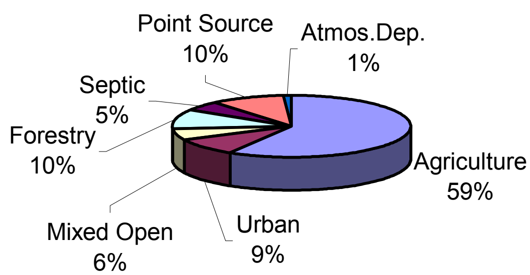

Figure H-3: Shenandoah 1985 Percent Phosphorus Loads by Land Use. Total Load = 1,348,625 lbs.

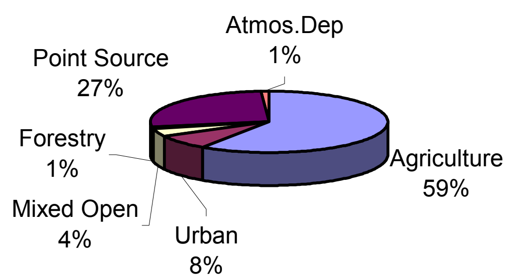

Figure H-4: Shenandoah 2002 Percent Phosphorus Loads by Land Use. Total Load = 1,200,453 lbs.

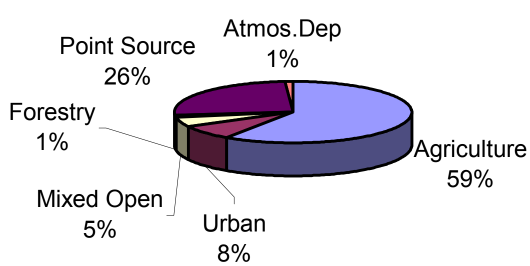

Figure H-5: Shenandoah 1985 Percent Sediment Loads by Land Use. Total Load = 561,170 tons

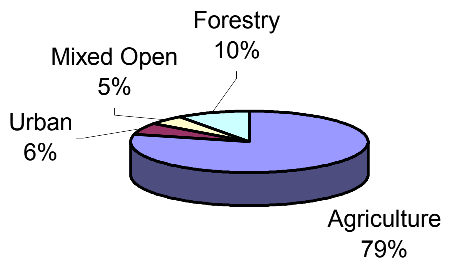

Figure H-6: Shenandoah 2002 Percent Sediment Loads by Land Use. Total Load = 513,481 tons

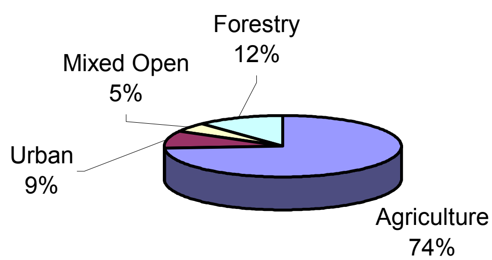

Figure H-7: Potomac 1985 Percent Nitrogen Loads by Land Use. Total Load = 16,141,316 lbs.

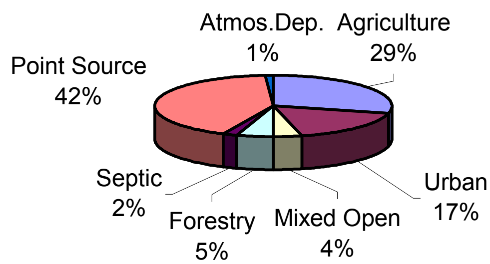

Figure H-8: Potomac 2002 Percent Nitrogen Loads by Land Use. Total Load = 14,992,237 lbs.

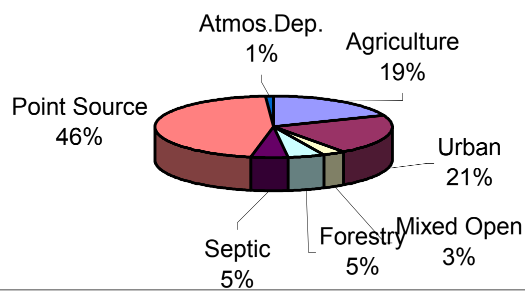

Figure H-9: Potomac 1985 Percent Phosphorus Loads by Land Use. Total Load = 957,20 lbs.

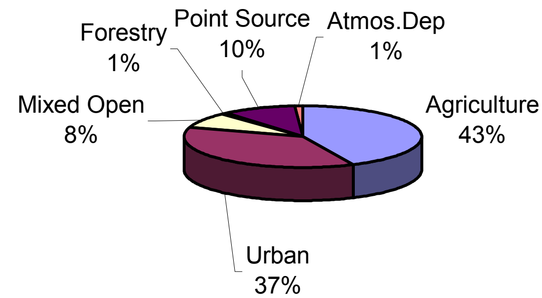

Figure H-10: Potomac 2002 Percent Phosphorus Loads by Land Use. Total Load = 741,608 lbs.

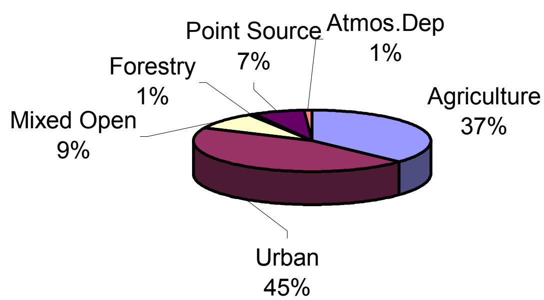

Figure H-11: Potomac 1985 Percent Sediment Loads by Land Use. Total Load = 266,46 tons

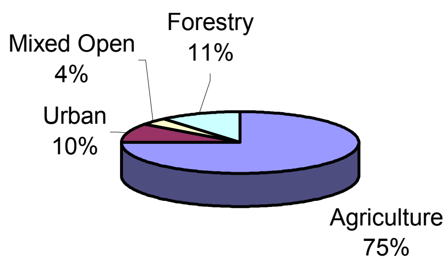

Figure H-12: Potomac 2002 Percent Sediment Loads by Land Use. Total Load = 206,979 tons