Pennsylvania's

Chesapeake Bay

Tributary Strategy

Prepared by the
Pennsylvania Department of Environmental Protection

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Commonwealth of Pennsylvania

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Department of Environmental Protection

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Pennsylvania's

Chesapeake Bay Tributary Strategy

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For more information, visit DEP's website at www.dep.state.pa.us,
Keyword: "DEP Chesapeake Bay."

Notice of Public Meetings

Pennsylvania's Chesapeake Bay Tributary Strategy

The Department of Environmental Protection (DEP) will host five public meetings on Pennsylvania's Chesapeake Bay Tributary Strategy. The meetings will be held as follows:

- March 17, 2005 at 2:00 p.m. and 7:00 p.m. in the DEP Northeast Regional Office, Susquehanna Room, 2 Public Square, Wilkes-Barre
- March 22, 2005 at 7:00 p.m. in the Lebanon County Conservation District, Penn State Extension Meeting Room, 2120 Cornwall Road, Lebanon
- March 23, 2005 at 7:00 p.m. in the Adams County Conservation District, Penn State Extension Meeting Room, 670 Old Harrisburg Road, Gettysburg
- March 30, 2005 at 7:00 p.m. in the DEP Northcentral Regional Office, Goddard Conference Room, 208 West Third Street, Williamsport

At the meetings, DEP staff will review the recently published Pennsylvania Chesapeake Bay Tributary Strategy, answer questions on the development of the Strategy, and seek public input on Strategy implementation. The Strategy identifies a suite of nonpoint source Best Management Practices (BMPs) and point source management approaches that would be necessary to meet new Chesapeake Bay water quality goals adopted in 2004. The Strategy calls for reducing nutrient and sediment loads to Pennsylvania streams and the Chesapeake Bay from a variety of sources such as agriculture, wastewater treatment plants, urban stormwater and septic systems. For the first time, Pennsylvania's Tributary Strategy is built upon 13 individual strategies for watersheds in the Susquehanna and Potomac basins. The strategy identifies the full range of activities needed, regardless of their cost, so planning can begin for the new initiatives that will be needed to support Tributary Strategy implementation.

With the signing of the Chesapeake 2000 Agreement, Pennsylvania made a commitment to help remove the Chesapeake Bay from the federal Clean Water Act's list of impaired waters by 2010. Pennsylvania is critical to this effort as 50 percent of the fresh water to the Chesapeake Bay flows from the Susquehanna River. The formation of watershed restoration partnerships that benefit Pennsylvania local waters and the Bay is the foundation upon which Pennsylvania will build support for Strategy implementation. Key partners include Conservation Districts, Agricultural organizations, Watershed organizations, Engineers, Municipalities, and Industrial and municipal point source facilities.

Copies of Pennsylvania's Chesapeake Bay Nutrient Reduction Strategy may be obtained by calling Denise Caudill at 717-787-5267, sending email to dcaudill@state.pa.us, or on the Internet at www.dep.state.pa.us , Keyword "Chesapeake Bay." Copies may also be obtained by writing:

Water Planning Office -- Attention: Tributary Strategy
Department of Environmental Protection
10th Floor, Rachel Carson State Office Building
P.O. Box 8555
Harrisburg, PA 17105-8555

EXECUTIVE SUMMARY

Pennsylvania's Chesapeake Bay Tributary Strategy

Pennsylvania's Chesapeake Bay Program

The Chesapeake Bay is a national treasure. Pennsylvania doesn't share a single mile of Bay waterfront, but we are proudly and actively engaged in helping to save the Bay since work that we do to help the Bay also immediately helps Pennsylvania by cleaning our streams, enhancing the health of our families and preserving the rural character and farming economy of our beautiful state.

Pennsylvania takes seriously its role as steward of the Chesapeake Bay. More than half of our Commonwealth is within the Chesapeake Bay Watershed, with the Susquehanna River, the Bay's largest tributary, providing roughly half of the total freshwater flow. The Potomac River, with a sizeable portion of its watershed within our border, adds another 20 percent.

A partner of the original Chesapeake Bay Agreement in 1983, Pennsylvania has been a leader in adopting award-winning programs and working with partners to improve water quality. Now, as that hard work is recognized by Bay partners in having Governor Edward G. Rendell become the first chief executive in the Commonwealth to serve as chairman of the Chesapeake Executive Council, Pennsylvania's commitment grows.

We in Pennsylvania are particularly proud of the innovation we have contributed to Bay restoration efforts. Pennsylvania was the first state in the Bay watershed to enact nutrient management laws for farms, initiate phosphorus limits on major wastewater dischargers and secure an EPA-approved permit program for large-scale farming operations. Between 1985 and 2002, the Commonwealth implemented measures to reduce phosphorus going to the Bay by 858,000 pounds per year, cut nitrogen by more than 10.9 million pounds per year and reduce sediment by 130,000 tons per year. Today, all six water quality monitoring stations measuring nutrients in the Susquehanna River show a declining trend in nitrogen loadings.

Pennsylvania also is the first among the states to meet the goal of the Chesapeake 2000 Agreement to preserve permanently from development 20 percent of the land area in our Bay watershed. More than 2.9 million acres have been set aside. In addition, the state has achieved a net gain of some 6,000 acres of wetland resources over the last two decades. Our Commonwealth already has restored 1,297 miles of riparian forest buffers-substantially more than the 600 miles that the state initially committed to restoring by 2010.

With these accomplishments in hand, Pennsylvania is now ready for the next phase of this historic effort. To meet new water quality goals established by the agreement, our state will need to reduce nitrogen by an additional 37 million pounds per year, phosphorus by an additional 1.1 million pounds per year and sediment by an additional 116,000 tons per year. Pennsylvania's Chesapeake Bay Tributary Strategy that we present today shows how we will meet these challenges and build on the gains we already have made to provide cleaner water resources at home and deliver cleaner water downstream to help restore the world’s most productive estuary.

Pennsylvania is bringing new effort and vigor to the table to usher in the next generation of watershed protection and environmental improvements. Among some of the initiatives that the Commonwealth is putting in place:

- **Limiting Wastewater & Industrial Discharges:** Stringent new regulations will require some 150 significant sewage and industrial dischargers in Pennsylvania to reduce significantly their nutrient loads. The new regulations are among the toughest in the Bay watershed because they use actual flows rather than design flows to determine loads and ensure real results. Specifically, Pennsylvania's 8 mg/L requirement for 2010 flows for nitrogen compares favorably to a 4.5 mg/L requirement at design flows as calculated by other Bay states. These requirements will be implemented and enforced through the permitting process.

- **Upgrading Sewer & Water Infrastructure:** Governor Rendell has worked with the Legislature successfully to secure $250 million in new grants and loans to upgrade, rehabilitate and expand wastewater and water supply systems. Up to $150 million of these funds support nutrient reduction upgrades at wastewater treatment facilities.

- **Enhancing Stormwater Management:** Pennsylvania is requiring enhanced stormwater management efforts, and in particular infiltration of stormwater, by municipalities, developers and design professionals to reduce pollutant loadings to streams. These new requirements are being implemented and enforced through the permitting process.

- **Preserving Agriculture, Communities and Rural Environments:** This initiative, ACRE, puts in place extensive new farm management regulations and puts in place some of the most comprehensive farm-based water quality protections in the nation. In addition to new regulatory requirements that will be effective in April 2005, the plan includes a new effort to analyze and take action on water quality problems in all "agriculturally impaired" waterways-the first time any such effort has been undertaken. The initiative is backed by as much as $13 million in new and existing resources to achieve real results.

- **Accelerating Dam Removals & Building Fish Passageways:** Pennsylvania has removed more dams than any other state, eliminating 50 structures and supporting construction of nearly a dozen fish passages in the Susquehanna River Basin since 1994. The work has restored 384 miles of free-flowing rivers and streams. An additional 270 miles will open in 2006, enabling Pennsylvania to meet its first fish passage goal and restoring habitat critical for the spawning of American shad.

- **Expanding the Conservation Reserve Enhancement Program (CREP):** In the last year Pennsylvania has become the leading participant in the nation in the important CREP program. With 265,000 acres in 59 of the state's 67 counties enrolled, CREP will be among the state's most effective tools for preventing polluted farm runoff from fouling streams.

- **Increasing Forested Buffers & Wetlands:** Pennsylvania is increasing substantially its commitment to forested buffers and wetlands restoration. Specifically, the Commonwealth will dedicate the state's CREP incentives to these investments, since they deliver the greatest water quality benefits.

- **Supporting CBF's Riparian Forest Buffer Program:** Pennsylvania is announcing a new $1 million grant to the Chesapeake Bay Foundation to improve the quality of Pennsylvania's waterways through significant and targeted restoration of riparian forest buffers and wetlands. CBF will work to maximize farmers' participation in the expanded Conservation Reserve Enhancement Program and pilot a new Stream Stewardship Program for the permanent protection of forested buffers.

- **Promoting Manure-to-Energy Programs:** Pennsylvania has launched several major new programs to help finance projects that use manure as a clean energy resource and thereby substantially reduce runoff into streams. The new Pennsylvania Energy Harvest Grant Program, Alternative Energy Portfolio Standard and First Industries Farm Investment Fund have enabled a doubling of the number of methane biodigesters in the state in the last year and a half, with many similar investments planned. The state also has joined our poultry industry in a regional investment in promising new manure gasification technology.

- **Leading the Way in Nutrient Trading:** Pennsylvania recently concluded the first-ever successful nutrient trade. The state is investing in a unique partnership between Wall Street and Pennsylvania farm and conservation groups to build a market-based program that will accelerate nutrient reduction and reduce compliance costs.

- **Securing Conservation Easements for Riparian Buffers:** Pennsylvania has invested millions of dollars into fencing livestock out of streams, planting riparian buffers and installing livestock crossings to improve water quality. These initiatives are of varying duration, however, usually no more than 15 years. To protect these investments and increase their effectiveness, Pennsylvania is launching a new initiative to provide the resources and tools to preserve permanently these buffers and other natural streamside greenways with conservation easements.

- **Supporting Growing Greener II:** Building on the state's award-winning watershed work, the Governor has proposed a substantial expansion of the Growing Greener program. To date, $52 million has been invested in 467 projects in Pennsylvania's portion of the Chesapeake Bay watershed, an investment that substantially will be increased with this new initiative.

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FIGURE 1

Chesapeake Bay Watershed

Chapter One
Chesapeake Bay Program Overview

1. Introduction

The purpose of Pennsylvania's Chesapeake Bay Tributary Strategy is two-fold. The first is to provide a strategy for Pennsylvania to meet its nutrient and sediment reduction goals for the Chesapeake Bay. Tributary Strategies are watershed restoration plans developed by the Chesapeake watershed jurisdictions to correct the nutrient and sediment problems in the tributary watersheds and Chesapeake Bay.

Pennsylvania's Tributary Strategy identifies a suite of nonpoint source Best Management Practices (BMPs) and point source management approaches that would be necessary to meet Bay water quality goals. The Strategy calls for reducing nutrient and sediment loads to Pennsylvania streams and the Chesapeake Bay from a variety of sources such as agriculture, wastewater treatment plants, urban stormwater and septic systems. For the first time, Pennsylvania's Tributary Strategy is built upon 13 individual strategies for watersheds in the Susquehanna and Potomac basins. The strategy identifies the full range of activities needed, regardless of their cost, so we can begin to plan for the new initiatives that will be needed to support Tributary Strategy implementation.

The Strategy lays out one of many different combinations of efforts that would meet Pennsylvania's nutrient and sediment reduction goals. Pennsylvania will take an adaptive management approach to implementing its Tributary Strategy. As we work with conservation districts and other partners to implement BMP's, we will learn that some BMP's in the Strategy are more favorable than others. Through an adaptive management approach, our partners can select those BMP's that they feel are most beneficial to their communities, local landowners, local waters and the Chesapeake Bay.

The second purpose of the Strategy document is to provide the framework to work with our Chesapeake Bay partners in Pennsylvania and across the watershed to develop new program initiatives and the funding that will be necessary to meet our goals. Pennsylvania and its Bay watershed partners recognize that this will be no easy task.

Costs to implement Tributary Strategies across the entire Chesapeake watershed are estimated to be $28 billion. Seven jurisdictions are developing Tributary Strategies, including Pennsylvania, Maryland, Virginia, District of Columbia, Delaware, West Virginia and New York. In Pennsylvania alone, capital costs are estimated at $8.2 billion. Estimates for annualized costs for capital and operation and maintenance are over $1 billion per year. This is roughly equivalent to twice our entire annual budget for all environmental protection programs in the Commonwealth. And it exceeds, by several orders of magnitude, the funds we currently have available, a fact that is acknowledged in the recently published Chesapeake Bay Watershed Blue Ribbon Finance Panel report. The Chesapeake Executive Council established the Panel in 2003 to make recommendations for innovative solutions to finance the Bay restoration effort. Pennsylvania will work closely with the Chesapeake Executive Council over the coming year to determine how best to implement the Panel's recommendations to generate additional federal, state and local funds.

Recognizing that available resources and funds are far short of what is needed, we are making the most of what money we do have by changing the way we make funding decisions. Our primary focus is to fund activities that, based on our current knowledge and capacity, have the greatest potential to support our Tributary Strategy goals. Governor Rendell's Growing Greener II initiative will be essential to help Pennsylvania meet its Tributary Strategy goals. The $800 million bond would, over a four year period, fund $80 million to improve the health of Pennsylvania's 83,161 miles of rivers and streams. The Chesapeake Bay Watershed Blue Ribbon Finance Panel report cites the Governor's Growing Greener II proposal as an example of programs that should be developed in the jurisdictions. Under the Governor's leadership, Pennsylvania has expanded its CREP program which pays farmers for practices which enhance environmental stewardship to be the largest in the nation. In 2005, Pennsylvania will target the practices most beneficial to our watersheds, forested riparian buffers, wetland and stream restoration, for state cost sharing incentives.

In Pennsylvania, agricultural areas are the largest contributors of nonpoint source pollution. Agriculture is the second-largest industry in the Commonwealth of Pennsylvania, and we are absolutely committed to preserving and supporting this sector of our economy. At the same time, we recognize that traditional farming practices need to be modified to protect the waters of the state and preserve our natural resources for future generations.

Education, voluntary measures, and incentives for participation are the foundation of our strategy for reducing agricultural runoff. In addition, we are currently increasing the scope and extent of our regulations aimed at sediment and nutrient management, and we are expanding our efforts to assure compliance and enforce existing regulations in agricultural areas. Through Governor Rendell's plan to protect Agricultural Communities and the Rural Environment (ACRE), the total number of farming operations that will be required to apply nutrient management for nitrogen and phosphorous will increase over six-fold, from 810 to approximately 5,210. At the same time, we will be placing more stringent nutrient limits in permits for wastewater discharges in a balanced approach to meet our Bay goals.

We are also pursuing new technologies and innovative approaches to leverage resources and water quality results. This includes developing a nutrient and sediment-trading program for point and nonpoint sources. Although agriculture is a significant source of nutrients and sediment, population growth will play an ever-increasing role in the contribution of nutrients to our waterways. We are addressing this with a point source strategy that limits nutrient loads from publicly owned treatment works (POTW's). The Governor's Growing Greener II proposal would provide grants for installing nutrient reduction technology at the POTW's. Act 218 of 2004, recently signed by Governor Rendell provides over $250 million in bond financing for water and wastewater infrastructure, which specifically includes funding for the Pennsylvania Infrastructure Investment Authority (PENNVEST) to finance the installation of nutrient reduction technology. In addition to setting maximum nutrient loads for treatment plants, we are setting up a nutrient trading program that will reduce loadings even further. This trading program will generate some of the funding needed to implement these reductions.

The remainder of this Chapter provides an overview of the Chesapeake Bay Program and the development of the new Bay nutrient and sediment reduction goals. Chapters 2 and 3 describe Pennsylvania's Tributary Strategy goals and the new watershed approach to address those goals. A summary of the proposed nonpoint source BMP's and point source facility nutrient reductions to reach Pennsylvania's goals is also provided. Chapter 4 reviews new nonpoint source and nutrient trading initiatives that will advance us towards meeting the goals. The point source strategy is reviewed in Chapter 5. Water quality monitoring programs are addressed in Chapter 6. The Appendices include: Detailed Nonpoint Source Strategies for the 13 Watershed Areas; Ongoing Nonpoint Source Programs; Best Management Practice Matrix; Chesapeake Basin Significant Point Source Facilities; Tributary Strategy Cost Table.

2. Chesapeake Bay Agreement History

In 1983, Pennsylvania entered into an Agreement with Maryland, Virginia, the District of Columbia, the U.S. Environmental Protection Agency (EPA) and the Chesapeake Bay Commission to restore the Chesapeake Bay. For several decades the Bay ecosystem declined because of excess nutrients and sediment, toxic pollutant releases, loss of aquatic habitat and over-harvesting. Of these, excess nutrients - particularly nitrogen and phosphorus - became the major area of focus for achieving improvements to the Bay ecosystem. The 1983 Chesapeake Bay Agreement established the Chesapeake Executive Council to oversee coordinated implementation plans to improve and protect the water quality and living resources of the Chesapeake Bay.

The second Chesapeake Bay Agreement was signed in 1987. This agreement established new leadership in the Chesapeake Executive Council, including the governors of Pennsylvania, Maryland, and Virginia; the mayor of the District of Columbia; the administrator of the U.S. Environmental Protection Agency; and the chair of the Chesapeake Bay Commission. In the 1987 Agreement, the Bay partners mutually agreed to a goal of reducing controllable nutrient loads to the Bay by 40 percent by the year 2000. Pennsylvania developed its first Chesapeake Bay Nutrient Reduction Strategy in 1988, and has updated that document periodically.

3. Chesapeake 2000 Agreement

The Chesapeake Executive Council provided further direction for restoring the Bay when it signed the Chesapeake 2000 Agreement on June 28, 2000. The Agreement established new and far-reaching commitments to guide the Bay partners in their combined efforts to restore and protect the Chesapeake Bay. It outlines 93 commitments detailing protection and restoration goals critical to the health of the Bay watershed. From pledges to increase riparian forest buffers, to preserving additional tracts of land and protect wetlands, the Agreement strives to improve water quality as it is the most critical element in the overall protection and restoration of the Bay and its tributaries.

At the same time Bay partners were developing the new Agreement, the Chesapeake Bay and many of its tidal tributaries were placed on the "impaired waters" list, thus requiring the development of a "total daily maximum load" (TMDL) to comply with the federal Clean Water Act. This action is normally followed by the development of a TMDL through a regulatory process. The Chesapeake 2000 Agreement sought to avoid regulatory

approaches by achieving water quality improvements prior to 2011 when a baywide TMDL would need to be established. The Agreement calls for: "by 2010, correct the nutrient and sediment-related impairments in the Chesapeake Bay and its tidal tributaries sufficiently to remove the Bay and the tidal portions of it tributaries from the list of impaired waters under the Clean Water Act." It sets an ambitious schedule to develop new nutrient and sediment reduction goals.

To work toward this, the Chesapeake Bay Program partners signed a Memorandum of Understanding with the Chesapeake watershed states that are not signatories to the Agreement, including Delaware, New York and West Virginia. They agreed to cooperatively set and achieve nutrient and sediment reduction goals for major tributaries. Figure 1 represents the Chesapeake Bay watershed and state boundaries.

4. Development of New Chesapeake Bay Water Quality Goals

Chesapeake Bay Program partners worked together to develop a process to establish new nutrient and sediment load reductions needed to restore the Bay. Whereas previous water quality goals were based on improving dissolved oxygen in deep waters, the new goal is related to the actual habitat requirements of the Bay's living resources. This process was a departure from the uniform 40 percent nutrient reduction goal established by the 1987 Agreement. Also, a sediment reduction goal was set for the first time. In anticipation of the TMDL deadline in 2011, the Bay Program partners worked to develop new federal and state water quality standards, and nutrient and sediment load allocations.

The new Bay water quality standards are based on three criteria: dissolved oxygen, chlorophyll-a and water clarity. These three criteria are considered the most important improvements needed to restore Bay water quality and living resources. Because of natural variety within the Bay, these criteria were developed for five habitat areas. These include shallow water, open water, deep water, deep channel and migratory and spawning areas. Also, for each habitat area, a "designated use" was established. This use defines what function the habitat area will meet. These uses take into consideration such things as recreational, agricultural, industrial and navigation purposes, as well as the protection of fish, shellfish and wildlife. The final water quality criteria were published by EPA Region III in April 2003. The criteria and other technical information can be found on the EPA Chesapeake Bay Program website at: www.chesapeakebay.net/baycriteria.htm.

5. New Nutrient and Sediment Reduction Goals

Once the water quality criteria and designated uses were established, the nutrient and sediment load reductions needed to attain the uses and criteria were developed using the Chesapeake Bay Watershed and Estuary Models and actual monitoring data. In April 2003, the regional Bay restoration leaders agreed to steep cuts in the amount of nutrients flowing into the Bay and its rivers. The new goals commit the six Bay watershed states and the District of Columbia to reduce nutrient pollution by more than twice as much as was accomplished since coordinated Bay restoration efforts began nearly twenty years ago.

Pennsylvania has made a good start on these ambitious goals. Monitors on our Potomac and Susquehanna Watersheds have recently begun to register a significant downward trend for both phosphorus and nitrogen in virtually every monitoring station which has been

assessing the data since 1985. Real, measurable reductions in our watersheds is our ultimate goal, and this data confirms that efforts made thus far have been successful in reversing the trend and making a good start. Much work remains to be done, and the strategy is a tool that helps us to measure further progress.

Cap loads are the maximum pollutant load of nutrients and sediments that can be allowed and still meet Chesapeake Bay water quality criteria. The new nutrient reduction goals, or cap loads, call for Bay watershed states to reduce the amount of nitrogen from the current 285 million pounds to no more than 175 million pounds per year, and phosphorus from 19.1 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**.** When achieved, the new allocations will reduce annual nitrogen loads by 110 million pounds and phosphorus by 6.3 million pounds from 2000 levels and will provide the water quality necessary for the Bay's plants and animals to thrive.

Also, for the first time, the Bay partners agreed to reduce Baywide sediment loads to provide water clarity necessary for underwater grasses to thrive. Bay states and the District of Columbia agreed to reduce land-based sediment runoff entering the Bay and its rivers from the current 5.04 million tons per year to no more than 4.15 million tons per year.

The new reductions were equitably distributed between Pennsylvania and the other Bay states with each state receiving new cap load allocations. Based on each tributary's nutrient and sediment input to the Bay, the total Chesapeake Bay load was 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. Pennsylvania's cap load allocations for the Susquehanna and Potomac watersheds are described in Chapter 2. Additional information on the process for setting and achieving nutrient and sediment load reductions can be found on the EPA Chesapeake Bay Program website at www.chesapeakebay.net/wqcriteriatech.htm .

6. Water Quality Standards

Following the publication of the federal water quality criteria, the states with Bay and tidal tributary waters began efforts to modify their current state water quality standards. The standards combine water quality criteria and designated uses to produce a target numeric value that, if achieved, will maintain healthy water quality. Delaware has completed the promulgation of their state standards and is awaiting EPA approval. Maryland and the District of Columbia are scheduled to adopt their standards by the spring of 2005, and Virginia is scheduled to complete its process by the fall of 2005.

In many cases when there is a proposed change in water quality standards, an assessment is done of the ability to attain the designated uses and underlying criteria. This assessment is called a Use Attainability Analysis (UAA). The UAA is used to justify changes to state water quality standards by assessing the physical, chemical, biological, economic, or other factors affecting attainment of the designated use. The UAA describes the scientific attributes of the waterbody, both natural and human-caused conditions. If the waterbody attributes make attaining the use impossible, or if there are economic reasons why the use

cannot be attained, the UAA documents these reasons. Finally, the UAA describes how the proposed standards will protect existing uses. The UAA for the Chesapeake Bay watershed is under development and will be completed prior to the adoption the state water quality standards.

The headwater states of Pennsylvania, New York and West Virginia are not required to adopt state water quality standards designed to address the Bay federal water quality criteria. However, neither the federal Clean Water Act nor Pennsylvania water quality regulations allow the issuance of an NPDES permit that would cause impairment to downstream waters and violation of Maryland's new water quality standards. Any discharge which causes or contributes to a violation of the standards is prohibited. The tributary strategies will be used as a method to assure that the water quality standards are met, and Pennsylvania will be implementing the new downstream standards in permits issued in Pennsylvania.

7. Chesapeake Bay Tributary Strategies

Following the allocation of nutrient and sediment cap loads to each Bay watershed jurisdiction, the partners began efforts to develop Chesapeake Bay Tributary Strategies. They are developed independently by each Bay watershed partner on a watershed basis. The Tributary Strategies identify nonpoint source Best Management Practices and point source management approaches which will reduce nutrient and sediment loadings to the Bay and meet the jurisdiction cap load allocation.

The Strategies call for reducing nutrient and sediment loads to the Chesapeake Bay from a variety of sources such as agriculture, wastewater treatment plants, urban stormwater, septic systems, and air. to the strategy estimates the full range of activities needed, regardless of their cost, so the partners can plan for the new initiatives that will be needed to support Tributary Strategy implementation. Total capital costs to implement all the Strategies is estimated to be $28 billion and $2.7 billion in annual costs, which include operation and maintenance, incentives and land rentals.

Out of the $28 billion, roughly one-third ($9 billion) of the capital costs and over half ($1.5 billion) of the annual costs, support existing water quality regulations and programs that will help reduce nutrient and sediment to the Chesapeake Bay. Examples include the federal erosion and sediment control regulations on new development, the federal Concentrated Animal Feeding Operation rule, and the District of Columbia's combined-sewer overflow long-term control plan.

The remaining estimated $19 billion in total upfront capital and $1.2 billion in annual costs support new Chesapeake Bay initiatives that go beyond existing regulatory programs. These costs cover activities such as installation of agricultural manure management systems, upgrading wastewater treatment plants, installing denitrifying septic systems, and retrofitting urban development to control stormwater quality as well as quantity.

A brief summary of the status of each of the Tributary Strategies follows.

Pennsylvania's Draft Tributary Strategy meets its nutrient and sediment cap load allocations for both the Potomac and Susquehanna watersheds. To meet the allocations,

the Strategy relies on a wide variety of nonpoint source Best Management Practices for agriculture and developed lands, nitrogen oxide (NOx) and ammonia emission reductions, point source facility permitting and nutrient trading. Total capital costs to implement the Strategy are estimated to be $8.2 billion. Pennsylvania's costs are higher than the other Bay watershed partners as noted below. This is due to the fact that the Susquehanna provides half the freshwater flow to the Bay and Pennsylvania contributes the highest nitrogen loading.

Maryland's Tributary Strategy meets its nutrient and sediment cap load allocations only on a statewide basis. This means the strategy meets the overall state allocations, but does not meet the allocations for individual watersheds. Capital costs are estimated to be $6.1 billion – the majority of which would support efforts to reduce nutrient loadings from septic systems and urban lands.

Virginia's Tributary Strategy also meets its nutrient and sediment cap load allocations on a statewide basis. The Strategy relies heavily on adoption and implementation of nutrient management plans on both agricultural and urban lands. Capital costs are estimated to be $6.8 billion.

The District of Columbia, Delaware and West Virginia Tributary Strategies do not yet meet their cap load allocations. They are working to refine their strategies. The New York Strategy is under development and is scheduled for completion in December 2005. Current estimates for capital costs for their draft strategies are: Delaware - $304 million; New York - $901 million; West Virginia - $354 million; District of Columbia - $4.3 billion.

8. Chesapeake Bay Watershed Blue Ribbon Finance Panel

Recognizing that additional resources would be necessary to implement the Tributary Strategies, in December 2003 the Chesapeake Executive Council called for the establishment of a Chesapeake Bay Watershed Blue Ribbon Finance Panel. The Panel was charged to identify innovative solutions to financing the multi-billion dollar Bay restoration effort.

The Panel's report, "Saving a National Treasure: Financing the Cleanup of the Chesapeake Bay," calls for a six-year, $15 billion investment from Bay states and the federal government and the creation of a new regional Chesapeake Bay Financing Authority. The authority would distribute restoration funds throughout the seven jurisdictions of the Bay watershed. The proposed ratio of federal to matching funds would be 80/20, similar to the current State Revolving Loan Funds. The total federal contribution would be $12 billion over six years. The states' match is recommended to be $3 billion, apportioned among the states and funded by whatever means the states choose.

In addition to the financing authority, the Panel made specific recommendations for financing nutrient and sediment loading reductions from agriculture, municipal and industrial wastewater treatment, development and air deposition. Governor Rendell's Growing Greener II initiative is identified as a model for other states to adopt. The document is available on the Chesapeake Bay Program website at www.chesapeakebay.net/pubs/blueribbon/index.cfm.

The Chesapeake Executive Council will consider the Panel's recommendations at their January 2005 annual meeting, and provide direction to the Chesapeake Bay Program partners. It is anticipated that the Council will charge the Bay partners to prepare a detailed analysis of the actions necessary to establish the Chesapeake Bay Financing Authority and to implement other Panel recommendations, as appropriate for each jurisdiction.

Chapter Two
Pennsylvania's Tributary Strategy Goals

1. The Challenge: Excess Nutrients

Excessive nutrient enrichment is a major factor in the decline of the Chesapeake Bay ecosystem. Nutrients, primarily nitrogen and phosphorus, stimulate excess algae growth, decomposition and recycling that contribute to oxygen depletion in the Bay. Excess nutrients within the Bay create large blooms of algae that cut off light to underwater grasses (submerged aquatic vegetation or SAV). The SAV are an important habitat for many aquatic animals in the Bay. The decrease in light penetration is considered the primary reason for the significant decline in SAV within the Bay. When the algae blooms consume all the available nutrient food, they die and decompose. The decomposition process depletes the water of oxygen, which is essential for fish, shellfish and other aquatic life. The decrease in SAV habitat and areas of oxygen depletion seriously restrict the ability of the Chesapeake Bay ecosystem to rebound to the level of productivity realized in historic times.

Excess nutrients originate from nonpoint source discharges, point source discharges and air deposition. Nonpoint source discharges are a diffuse source of pollution that cannot be attributed to a clearly identifiable, specific physical location, but rather accumulate from a larger area. Examples include runoff from forestland and undeveloped areas, poorly managed farmland, construction sites and stormwater runoff from city streets and suburban communities. Point source discharges are a source of nutrients that can be attributed to a specific physical location such as a wastewater discharge pipe or a waste lagoon outflow. Examples include discharges from sewage treatment plants, industrial facilities and food production and processing facilities. Pennsylvania's efforts to reduce nutrient discharges from nonpoint and point sources are the focus of this strategy.

A third source of nutrients is direct deposition from the air. Nitrogen compounds are released from mobile sources such as cars, trucks, boats and lawn mowers; and from stationary sources like power plants and factories. Once released into the air, pollutants have the potential to travel great distances. The airshed to the Bay is estimated to be about three times the size of the watershed. As a result, the Bay receives air deposition generated from areas far outside of the Bay watershed. Pennsylvania's efforts to reduce nitrogen air deposition are reflected in EPA's modified Regional Acid Deposition Model (RADM) as an input into the Chesapeake Bay Watershed model. This model calculates nitrogen reductions achieved in Pennsylvania under the federal Clean Air Act requirements and state nitrogen oxide emission reduction programs.

2. New Nutrient and Sediment Reductions Goals

As previously described, in April 2003 Pennsylvania agreed to new nutrient and sediment cap load allocations for the Susquehanna and Potomac River basins. Specifically, Pennsylvania has agreed to reduce nitrogen loads to Chesapeake Bay to no more than 71.9 million pounds per year, phosphorus to no more than 2.47 million pounds per year and sediment to no more than 995,000 tons per year. Within the Chesapeake Bay Program these levels are referred to as "cap" loads because Pennsylvania has agreed to lower

nutrients and sediment to these load levels and agreed to maintain, or cap, the loads at these levels once they are attained. To reach these cap loads, Pennsylvania must reduce nitrogen loads by 37 million pounds per year, phosphorus loads by 1.1 million pounds per year and sediment by 116,000 million tons per year from the estimated loads based on what has been accomplished through 2002.

The next step in the strategy development process was to allocate the necessary reductions between point and nonpoint sources within each of the major river basins.

First, nonpoint source allocations were further divided among the 13 Watershed Team areas in Pennsylvania's Chesapeake Bay watershed. The Watershed Team areas were previously created by DEP for the Environmental Futures planning process. These allocations were based on both the portion of anthropogenic (man made) load that is estimated to be coming from each watershed area and on the relative effort in implementing BMP's that has been accomplished within each watershed area through 2002. This provided a measure of accountability for the nutrient and sediment loads generated in each watershed area, while also acknowledging the efforts already completed in each watershed. Initial allocations following these guidelines indicated that nonpoint source loads would meet and exceed the nutrient and sediment load goals with the exception of the Susquehanna basin phosphorus goal. There would be about a 27,000 pounds shortfall for this goal. As described below, this will be made up for by the point sources because POTWs can more cost effectively remove phosphorus.

Point source allocations were not made to the thirteen Watershed Team areas. Rather, the point source allocations were set for the Susquehanna basin and the Potomac basin. This will give maximum flexibility to achieve cost-effective approaches to meet the basin allocations. The capital improvements to wastewater treatment facilities necessary to address point source loadings are significantly more expensive than BMP's designed to address nonpoint source loadings. In addition, the loadings discharged from these facilities can vary significantly throughout the river basins. For these reasons, evaluating point source reductions for each whole basin is a logical approach.

Initially, significant POTWs were collectively set at discharge load limits based upon 2010 flows with concentrations of 8 milligrams per liter (mg/l) for nitrogen and 1 mg/l for phosphorus within both the Susquehanna and Potomac basins. Industrial dischargers were maintained at 2002 discharge concentrations. Because POTWs can more cost effectively remove phosphorus, it was decide that POTWs would make up the nonpoint source phosphorus shortfall in the Susquehanna basin in exchange for assuming a credit for a portion of the excess nitrogen reductions that would be generated by nonpoint efforts. This provided a more cost effective means of reaching the Susquehanna phosphorus cap goal. With this trade, Pennsylvania’s tributary strategy meets the nutrient cap goals in both the Susquehanna and Potomac basins and consequently for all of Pennsylvania's Bay watershed.

The allocations for the 13 Watershed Team areas and for point source dischargers are listed on Table 2.A.

Table 2.A.

Watershed Team Area Cap Load Allocations

	Nitrogen	Phosphorus	Sediment
Susquehanna Basin			
Central Penn	3,851,000	96,700	29,320
Upper West Branch	4,087,000	58,500	20,230
Susquehannock	6,835,000	95,800	45,610
Lower North Branch	3,373,000	107,900	27,120
Big Bend	5,032,000	153,200	49,470
Bradford/Tioga	4,518,000	145,500	37,300
Upper Susquehanna	2,735,000	74,400	20,170
Wyoming Valley	1,813,000	43,000	12,480
Lackawanna	787,000	14,900	4,820
Lower Susquehanna East	9,259,000	367,500	104,770
Lower Susquehanna West	7,264,000	261,200	85,700
Juniata	8,522,000	235,900	84,220
Susquehanna Basin NPS Total	58,076,000	1,654,400	521,210
Point Source dischargers	7,892,000	477,100	0
Susquehanna Basin Total	65,968,000	2,131,500	521,210
Susquehanna Basin Allocation	67,874,000	2,131,500	797,850
Potomac Basin NPS	3,280,000	251,600	127,270
Potomac Basin PS	407,000	24,600	0
Potomac Basin Total	3,687,000	296,800	127,270
Potomac Basin Allocation	4,021,000	329,500	196,800
Pennsylvania Total	69,656,000	2,455,000	648,480
Pennsylvania Total Allocation	71,895,000	2,461,000	995,000

3. Other Chesapeake 2000 Agreement Goals

The Chesapeake 2000 Agreement also includes numerous commitments to address habitat restoration. These goals were allocated to the 13 Watershed Team areas using the Chesapeake Bay Program watershed model land cover data. Habitat restoration allocations to the Watershed Teams are shown in the attached Table 2.B.

The Agreement identifies specific goals for watershed management plans, wetland preservation plans and wetland restoration. It calls for the development and implementation of locally supported watershed management plans in two-thirds of the Bay

watershed. These plans are to address the protection, conservation and restoration of stream corridors, riparian forest buffers and wetlands. Pennsylvania's share of this goal is to have plans developed for two-thirds of our Chesapeake basin, or about 9.6 million acres. The Agreement further calls for these plans to include a wetland preservation component covering 25 percent of each state's Chesapeake basin, or about 3.6 million acres. Pennsylvania's wetlands goal is to restore 4,000 acres of wetlands from the year 2000 to 2010.

The Chesapeake Executive Council adopted a new riparian forest buffer goal in December 2003. They further agreed that the goal would be modified to reflect the amount of riparian forest buffer miles included in the Tributary Strategy to help reach the nutrient and sediment goals. Pennsylvania's Strategy includes 10,000 miles of riparian forest buffers.

The Bay Program partners have met their 2003 goal to open 1,357 miles of river habitat to migratory and resident fishes. In January 2004, the Council adopted a new Fish Passage goal to complete 100 fish passage and/or dam removal projects that will open an additional 1,000 miles of river habitat. Pennsylvania's share of this goal is 500 miles. The Pennsylvania Fish and Boat Commission coordinates with many partners to provide fish passage and has chosen not to allocate this goal among the Watershed Team areas. The Chesapeake Executive Council Directive further calls for these projects to be integrated within locally supported watershed management plans.

Table 2.B.
Pennsylvania Chesapeake Bay Tributary Strategy
Habitat Restoration Goal Allocations by Watershed Area

Watershed Area	Wetland Restoration Goal for 2000-2010 (acres)	Watershed Management Plan (WMP) Goal (acres)	Wetland Preservation Plan Goal (acres)	Riparian Forest Buffer Goal (miles)
Central Penn	220	599,929	224,973	500
Upper West Branch	101	596,511	223,692	500
Susquehannock	158	1,278,327	479,373	800
Lower North Branch Susquehanna	248	448,789	168,296	500
Big Bend	278	779,840	292,440	700
Bradford/Tioga	419	878,925	329,597	700
Upper Susquehanna	145	525,116	196,919	500
Wyoming Valley	80	287,302	107,738	500
Lackawanna	12	152,888	57,333	500
Lower Susquehanna East	750	1,053,250	394,969	1,200
Lower Susquehanna West	722	942,362	353,386	1,200
Juniata	518	1,434,352	537,882	1,400
Potomac	349	670,091	251,284	1,000
TOTAL	4,000	9,647,682	3,617,882	10,000

Chapter 3
Pennsylvania's Chesapeake Bay Tributary Strategy

1. Pennsylvania's Chesapeake Bay Watershed

Pennsylvania's portion of the Chesapeake Bay watershed accounts for 22,612 square miles of the total 64,238 square miles within the Bay watershed. The major tributaries within Pennsylvania draining into the Bay include the Susquehanna and Potomac Rivers. The Susquehanna River accounts for 20,762 square miles (92 percent) and the Potomac River for 1,571 square miles (7 percent) of Pennsylvania's Bay drainage area. A small portion of Elk Creek and Northeast Creek in southern Chester County and Gunpowder River in southern York County account for 279 square miles (1 percent) of additional drainage to the Bay. For this strategy, these three small watersheds are included with the Susquehanna River Basin.

Forest land is the principal land use (62%), followed by agricultural land (22%), mixed open land (9%), developed land (6%) and open water (1%). Table 3.A. lists the acres of each major land use within Pennsylvania's portion of the Susquehanna River and Potomac River Basins.

Table 3.A.
Distribution of Land Use within Pennsylvania's Portion of the Chesapeake Bay Watershed in Square Miles

	Forest	Agriculture	Developed	Mixed Open	Open Water
Susquehanna	13,154	4,530	1,215	1,893	249
Potomac	929	476	65	97	3
Totals	14,083	5,006	1,280	1,990	252

2. Nutrient and Sediment Loads

Using EPA's Chesapeake Bay watershed model, it is possible to project the nutrient and sediment loads that will occur in response to management actions taken within the watershed. Based on those practices implemented between 1985 and 2002, it is estimated that average yearly nitrogen and phosphorus loads from Pennsylvania will be 109 and 3.58 million pounds respectively and the sediment loads will be 1.11 million tons after the practices become fully effective at reducing loads to surface water and groundwater. These computed loads provide an estimate of the progress toward Pennsylvania's nutrient and sediment reduction goals.

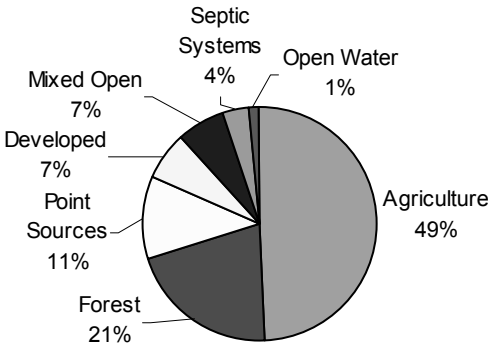
The principal sources of nitrogen loads are estimated to be agriculture (49%), forest land (21%), point source discharges (11%), developed land (7%) and mixed open land (7%). The principal sources of phosphorus within the watershed include agriculture (63%), point source discharges (18%), mixed open land (8%) and developed land (7%). Finally, the sources of sediment loads are estimated to be agriculture (72%), forest land (17%), mixed open land (6%) and developed land (5%). The projected nutrient and sediment loads

delivered to the Chesapeake Bay based on the 2002 implementation and the relative percents of each for all land uses are shown on Table 3.B.

Table 3.B.
Nutrient and Sediment Loads Based on 2002 Implementation

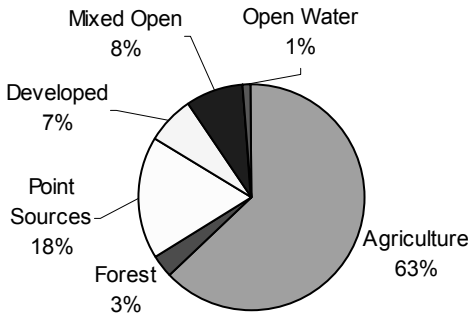
Total Nitrogen in Pounds per Year

Land Use	Delivered Load
Agriculture	53,663,000
Forest	22,659,000
Point Sources	12,487,000
Developed	7,538,000
Mixed Open	7,272,000
Septic Systems	4,023,000
Open Water	1,567,000
Total	109,209,000



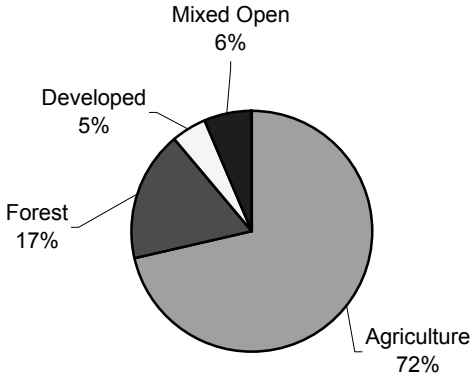
Total Phosphorus in Pounds per Year

Land Use	Delivered Load
Agriculture	2,249,000
Forest	117,200
Point Sources	630,200
Developed	245,100
Mixed Open	298,100
Septic Systems	0
Open Water	40,400
Total	3,580,000



Sediment in Tons per Year

Land Use	Delivered Load
Agriculture	794,200
Forest	193,900
Point Sources	0
Developed	52,500
Mixed Open	71,300
Septic Systems	0
Open Water	0
Total	1,111,900

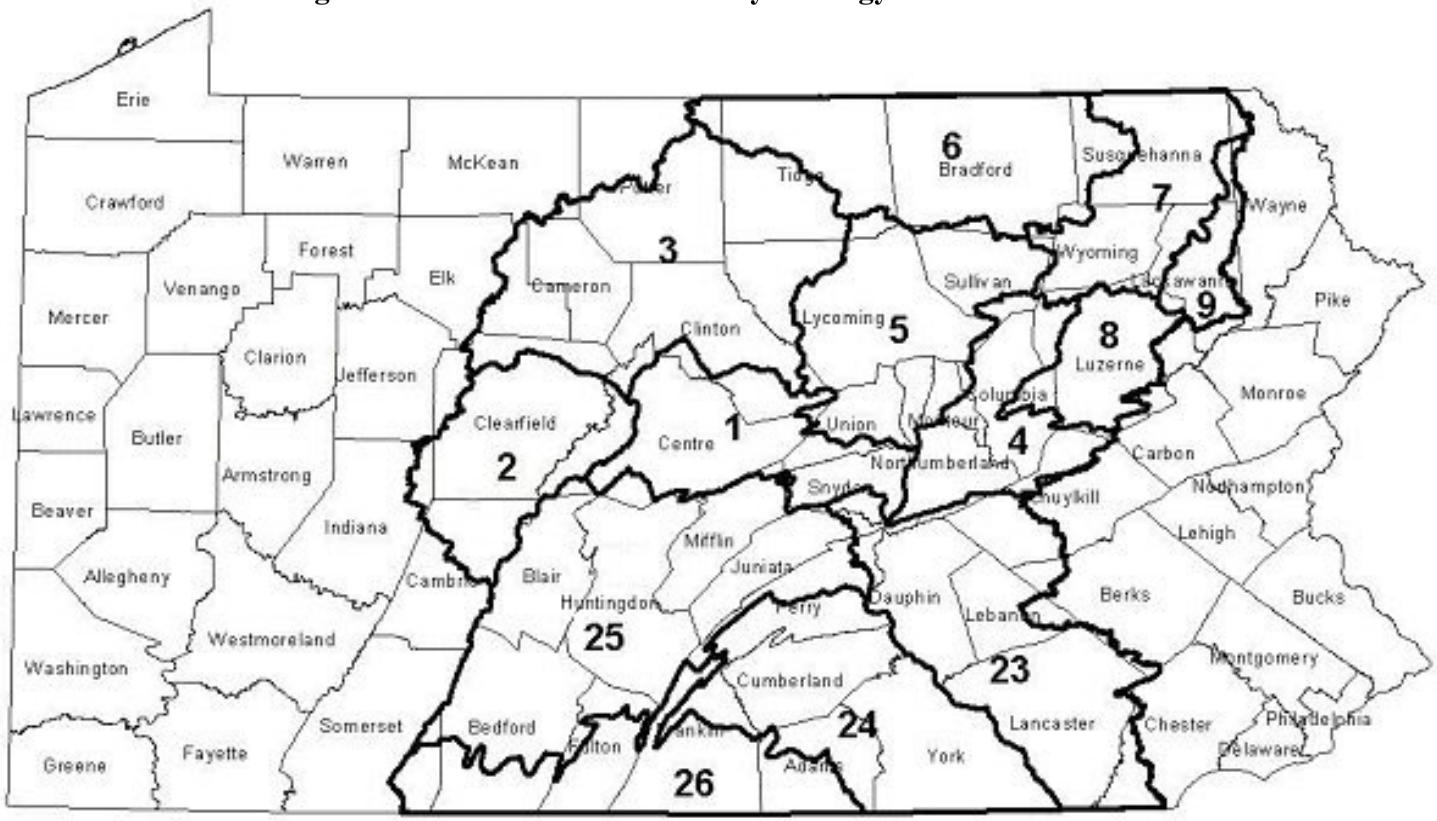


3. Nonpoint Source Tributary Strategy Watersheds

Location and Land Use

To foster more of a regional approach to developing and implementing a nonpoint source strategy, the Tributary Strategy was developed using the 13 Watershed Team areas in Pennsylvania's Chesapeake Bay watershed. The Watershed Team areas were previously created by the DEP for the Environmental Futures planning process. Twelve of the teams are within the Susquehanna basin and one comprises Pennsylvania's portion of the Potomac Basin. The location of the watershed areas is shown on Figure 3.A. and the distribution of land use with the watersheds is listed in Table 3.C.

Figure 3.A. - Location of Tributary Strategy Watershed Areas



Team 1 – Central Penn
Team 2 – Upper West Branch
Team 3 – Susquehannock
Team 4 – Lower North Branch
Team 5 – Big Bend
Team 6 – Bradford/Tioga
Team 7 – Upper Susquehanna
Team 8 – Wyoming Valley
Team 9 – Lackawanna
Team 23 – Lower Susquehanna East
Team 24 – Lower Susquehanna West
Team 25 -- Juniata
Team 26 -- Potomac

Table 3.C. - Distribution of Land Use with Watershed Areas in Square Miles

Watershed	Agriculture	Forest	Developed	Mixed Open	Open Water	Total
Central Penn	263	918	48	127	10	1,366
Upper West Branch	99	1,152	107	30	10	1,398
Susquehannock	199	2,603	52	125	17	2,996
Lower North Branch	256	580	86	133	18	1,073
Big Bend	307	1,224	57	216	17	1,822
Bradford/Tioga	536	1,210	55	234	22	2,057
Upper Susquehanna	198	777	96	142	20	1,233
Wyoming Valley	77	425	86	69	9	666
Lackawanna	27	224	77	25	5	358
Lower Susquehanna East	1,013	892	276	249	76	2,505
Lower Susquehanna West	846	852	181	290	16	2,164
Juniata	709	2,317	95	253	29	3,402
Potomac	476	929	65	97	3	1,571
					Grand Total	22,611

Developing strategies at the watershed level provides the opportunity for stakeholders to review the strategies and enhance their further development with local on-the-ground knowledge. This approach will help identify pollution sources at the local level, and open up more responsible avenues from citizens to the federal government to address pollution sources. With local resident and government commitment, there is opportunity for more funding sources and management options to achieve reductions. Identifiable results beyond current state and federal programs can be more accurately quantified.

Nutrient and Sediment Loads

The distribution of nutrient and sediment loads within the watersheds is consistent with the distribution of agriculture. The southern portion of the Susquehanna Basin and the Potomac Basin have the highest percent of agriculture within the watershed. This portion of the watershed contributes a large portion of the nutrient and sediments loads delivered to the Chesapeake Bay. Based on 2002 implementation levels, it is estimated that the Lower Susquehanna East, Lower Susquehanna West, Juniata and Potomac watersheds contribute about 52% of the nitrogen, 63% of the phosphorus and 70% of the sediment delivered to the Bay from Pennsylvania. These four watersheds comprise about 42% of the Susquehanna and Potomac Basins but contain about 61% of the land dedicated to agriculture. This is why in previous nutrient reductions strategies, Pennsylvania focused on agricultural lands for nutrient reductions, particularly those in the southern portion of the watershed.

When looking at the distribution of nutrient and sediment loads within the Bay watershed it is useful to look at not only loads delivered to the Bay from the watersheds, but also the loads to local waters. These locally delivered loads are referred to as edge-of-stream loads. These loads impact local water quality and can be the cause of impairments as described in Chapter 3. Edge-of-stream loads are almost always higher than delivered loads. Biological activity, mineralization and trapping in sediments are a few of the processes that reduce the level of nutrients in water during transport to the Bay. Deposition of sediment in floodplains, stream channels and reservoirs, such as at the three reservoirs in the lower Susquehanna River, reduce sediment loads delivered to the Bay. In contrast, high river flows can result in channel scour, bank erosion and scour of sediment out of reservoirs, resulting in yearly delivered loads being higher than edge-of-stream loads.

The Chesapeake Bay Program watershed model provides an estimate of both edge-of-stream and delivered loads. The projected edge-of-stream and delivered nutrient and sediment loads for the watershed areas based on 2002 implementation levels are listed in Table 3.D. More detailed information on the land uses and nutrient loads for the watershed areas are included in Appendix 1.

Table 3.D. -- Nutrient and Sediment Loads Within the Watershed Areas Based on 2002 Implementation

	Edge-Of Stream Loads			Delivered Loads		
Watershed	Nitrogen 1000 lb/yr	Phosphorus 1000 lb/yr	Sediment 1000 tons/yr	Nitrogen 1000 lb/yr	Phosphorus 1000 lb/yr	Sediment 1000 tons/yr
Central Penn	6,360	324.5	106.9	5,960	141	44.4
Upper West Branch	5,070	182.2	55.4	4,210	79	23.0
Susquehannock	9,040	292.7	122.2	8,370	127	50.7
Lower North Branch	5,990	301.7	96.8	5,310	131	40.2
Big Bend	8,350	393.6	180.6	7,840	171	75.0
Bradford/Tioga	10,220	549.2	114.1	6,390	239	47.4
Upper Susquehanna	5,790	268.9	62.0	3,960	117	25.8
Wyoming Valley	3,110	130.5	41.3	2,670	57	17.1
Lackawanna	1,630	66.3	16.4	1,210	29	7.0
Lower Susquehanna East	20,480	1418.7	567.1	19,260	711	278.0
Lower Susquehanna West	13,720	837.0	369.5	13,190	374	159.0
Juniata	14,090	813.4	282.8	12,290	354	117.0
Potomac	8,830	637.5	152.6	6,050	421	227.0
Total	112,680	6,216	2,168	96,710	2,951	1,112

4. Nonpoint Source Strategy Summary

Past Tributary Strategies focused almost exclusively on agricultural practices and upgrades to wastewater treatment plants. While these practices will remain key, the new Strategy includes a host of additional practices including urban stormwater management and air emission reductions. Not only will this mean developing new best management practices, but developing new tracking mechanisms to estimate their reductions as well. A complete listing and descriptions of the best management practices are included in Appendix 3.

Analysis of the nutrient sources within Pennsylvania's portion of the Chesapeake Bay watershed indicates that about 89 percent of nitrogen loads originate from nonpoint sources and about 11 percent are discharged from point sources. Similarly, about 82 percent of the phosphorus originates from nonpoint sources and about 18 percent are discharged from point sources. All of the sediment loads originate from nonpoint sources. Consequently, the major focus of Pennsylvania's tributary strategy is towards reductions in nonpoint source nutrient loads.

The strategy outlines management practices for both the Susquehanna and Potomac Basins needed to achieve the necessary nutrient and sediment reductions. These practices encompass reductions from all sources including agriculture, urban, forestland, open land, and wastewater treatment plants. Nutrient reductions are also shown for septic systems and for air reductions associated with implementation of the Clean Air Act amendments.

Table 3.E. lists a summary of the nonpoint source management practices that are included in the Tributary Strategy and compares the level of implementation to the reported practices implemented through 2002. A summary of anticipated nutrient and sediment reductions are included in Tables 3.F. and 3.G. Table 3.F. lists the estimated nonpoint source edge-of-stream loads for the 1985, 2002, and the 2010 reduction goals, as well as the remaining reductions needed to reach the 2010 goals from what has been accomplished through 2002. Edge-of-stream loads are presented because these loads represent estimates of the improvements to local waters within the watershed areas. This information has more meaning and is more useful to local watershed groups and organizations working within the watersheds.

Table 3.G. lists the estimated non-point source loads delivered to the Chesapeake Bay in the same format as Table 3.F. This table provides an estimate of what portion of the edge-of-stream loads from the watersheds are reaching the Bay. More detailed information for the strategy management practices and projected nutrient and sediment reductions for the watershed areas are included in Appendix A.

Table 3.E.
Pennsylvania Tributary Strategy Best Management Practices

MANAGEMENT PRACTICE	UNITS	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	805,330	496,915	308,415
Carbon Sequestration	Acres	288,442	T	288,442
Conservation (Farm) Plans	Acres	2,385,876	1,206,254	1,179,622
Conservation Tillage	Acres	1,052,763	607,047	445,716
Cover Crops (early)	Acres	951,577	T	951,577
Forest Buffers	Acres	106,484	4,226	102,258
Grass Buffers	Acres	35,320	471	34,849
Land Retirement	Acres	260,907	76,880	184,027
Managed Precision Agriculture	Acres	1,186,303	T	1,186,303
Mortality Composters	Systems	36	T	36
Non-Urban Stream Restoration	Feet	33,400	T	33,400
No-Till	Acres	480,592	0	480,592
Nutrient Management	Acres	403,246	1,164,192	-760,946
Off Stream Watering w/Fencing	Acres	199,755	14,101	185,654
Off Stream Watering w/o Fencing	Acres	119,853	2,130	117,723
Precision Rotational Grazing	Acres	47,197	0	47,197
Rotational grazing	Acres	32,333	11,996	20,337
Horse Pasture Management	Acres	226,128	0	226,128
Tree Planting	Acres	2,596	2,599	-3
Yield Reserve	Acres	401,966	0	401,966
Ammonia Emission Reductions - Poultry	AEUs	121,988	0	121,988
Ammonia Emission Reductions - Swine	AEUs	119,584	0	119,584
Ammonia Emission Reductions - Dairy	AEUs	162,562	0	162,562
Precision Feeding - Dairy	AEUs	487,687	0	487,687
Phytase Feed additive - Swine	AEUs	234,384	0	234,384
Phytase Feed additive - Poultry	AEUs	143,514	0	143,514
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	14,562	7,489	7,073
Dirt & Gravel Road Practices	Feet	2,857,822	0	2,857,822
Forest Buffers	Acres	10,434	46	10,388
Non-Urban Stream Restoration	Feet	367,070	0	367,070
Nutrient Management	Acres	1,248,943	0	1,248,943
Tree Planting	Acres	26,575	26,577	-2
URBAN				
Erosion & Sediment Controls	Acres	17,715	19,349	N/A
Forest Buffers	Acres	4,295	0	4,295
Grass Buffers	Acres	8,395	0	8,395
Septic Denitrification	Systems	288,513	24,937	263,576
Street Sweeping	Acres	29,957	0	29,957
Stormwater Management - Filtration	Acres	250,639	0	250,639
Stormwater Management - Infiltration Practices	Acres	250,891	0	250,891
Stormwater Management - Wet Ponds & Wetlands	Acres	250,891	0	250,891
Urban Stream Restoration	Feet	4,000	0	4,000
Urban Sprawl Reduction	Acres	7,118	0	7,118
Urban Nutrient Management	Acres	442,410	0	442,410
FOREST				
Dirt & Gravel Road Practices	Feet	2,483,036	0	2,483,036
Forest Harvesting Practices	Acres	515	0	515
Non-Urban Stream Restoration	Feet	11,780	0	11,780
MULTIPLE LAND USE				
Wetland Restoration	Acres	4,000	1,068	2,932
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight T = Indicates that practice is being implemented, but tracking has not been completed				

Table 3.F. Nonpoint Source Edge-of-Stream Loads delivered to Local Waters by Watershed Area (Nitrogen and Phosphorus in thousand of pounds/year, Sediment in thousand of tons/year)

	Nitrogen				Phosphorus				Sediment			
Watershed Area	**1985 Load**	**2002 Progress**	**2010 Goal**	**Needed Reduction**	**1995 Load**	**2002 Progress**	**2010 Goal**	**Needed Reduction**	**1985 Load**	**2002 Progress**	**2010 Goal**	**Needed Reduction**
Central Penn	6,897	6180	4,095	2,085	342	315	176	139	119	103	64	39
Upper West Branch	5,699	5,066	4,079	987	234	182	106	76	60	55	44	11
Susquehannock	9,731	9,039	7,333	1,706	343	292	174	119	135	122	99	23
Lower North Branch Susquehanna	7,278	6,092	3,695	2,396	372	307	196	111	130	99	59	40
Big Bend	9,381	8,328	5,360	2,968	451	392	278	114	210	180	108	72
Bradford/Tioga	12,596	10,203	6,927	3,276	730	548	264	284	136	114	81	33
Upper Susquehanna	6,845	5,802	3,843	1,960	367	270	135	135	70	62	44	18
Wyoming Valley	3,547	3,075	2,037	1,039	164	129	78	51	51	41	27	14
Lackawanna	2,069	1,639	1,017	622	103	67	27	39	19	16	10	6
Lower Susquehanna East	25,820	20,639	9,810	10,830	1,696	1,427	617	811	587	571	203	368
Lower Susquehanna West	16,675	13,523	7,564	5,959	899	825	468	358	370	365	182	182
Juniata	15,671	14,264	9,205	5,059	874	823	428	395	327	287	183	103
Potomac	9,920	8,827	4,778	4,049	625	637	323	314	185	153	85	68
TOTAL	132,127	112,676	69,742	42,934	7,200	6,215	3,269	2,946	2,400	2,168	1,190	978

Table 3.G. Nonpoint Source Delivered Loads to Chesapeake Bay by Watershed Area
(Nitrogen and Phosphorus in thousand of pounds/year, Sediment in thousand of tons/year)

	Nitrogen				Phosphorus				Sediment			
Watershed Team	1985 Load	2002 Progress	2010 Goal	Needed Reduction	1995 Load	2002 Progress	2010 Goal	Needed Reduction	1985 Load	2002 Progress	2010 Goal	Needed Reduction
Central Penn	6,150	5,798	3,851	1,947	136.1	136.7	96.7	40.0	49.8	42.8	29.32	13.5
Upper West Branch	4,139	4,210	4,087	123	93.0	79.2	58.5	20.7	25.3	23.0	20.23	2.8
Susquehannock	8,103	8,371	6,835	1,536	136.5	127.1	95.8	31.3	56.5	50.7	45.61	5.1
Lower North Branch Susquehanna	6,176	5,407	3,373	2,034	148.1	133.6	107.9	25.7	54.7	41.2	27.12	14.1
Big Bend	8,538	7,810	5,032	2,778	179.3	170.5	153.2	17.4	88.1	74.6	49.47	25.2
Bradford/Tioga	7,510	6,376	4,518	1,858	290.6	238.4	145.5	92.9	57.3	47.3	37.30	10.0
Upper Susquehanna	4,443	3,967	2,735	1,232	146.2	117.2	74.4	42.9	29.6	25.8	20.17	5.6
Wyoming Valley	2,887	2,643	1,813	830	65.2	56.0	43.0	13.1	21.2	16.9	12.48	4.4
Lackawanna	1,445	1,212	787	425	40.8	28.9	14.9	14.0	8.2	6.9	4.82	2.0
Lower Susquehanna East	23,746	19,407	9,259	10,148	794.7	714.7	367.5	347.2	284.1	279.7	104.77	174.9
Lower Susquehanna West	16,030	13,003	7,264	5,738	369.9	368.9	261.2	107.8	160.3	156.9	85.70	71.2
Juniata	12,933	12,462	8,522	3,940	347.7	357.9	235.9	122.0	137.4	119.1	84.22	34.9
Potomac	6,590	6,055	3,280	2,775	394.5	420.5	251.6	168.9	271.6	227.0	127.27	99.8
TOTAL	108,692	96,721	61,356	35,365	3,142.5	2,949.8	1,906.1	1,043.8	1,244.0	1,111.9	648.5	463.4

The nutrient and sediment reduction strategy will be dynamic in nature. The level of management practices shown in Table 3.E. may vary over time as the strategy is implemented. Existing practices may be improved and new more effective and cost efficient practices may be developed which will replace existing practices shown in the current strategy.

Agriculture Strategy

The agriculture strategy utilizes a complement of existing and newly developed BMPs to achieve significant nutrient and sediment reductions. These BMPs focus on nutrient management and an array of conservation practices to improve water quality, while protecting the soil and natural resources. Working cooperatively with the agricultural community to achieve these reductions is an important part of Pennsylvania's overall strategy.

Based on progress reporting, it is estimated that agriculture has implemented sufficient management practices between 1985 and 2002 to realize nitrogen, phosphorus and sediment reductions of 18.8 million pounds, 811,000 pounds and 247,000 tons, respectively per year. After accounting for this level of BMP implementation, agriculture contributes about 49% of the nitrogen, 63% of the phosphorus and 72% of sediment delivered to the Bay from Pennsylvania.

With full implementation of the agricultural strategy, the edge-of-stream average yearly loads of nitrogen, phosphorus and sediment loads will decrease by an estimated 53.7 million pounds, 2.95 million pounds, and 834,000 tons, respectively.

Examples of practices within the agriculture strategy include:

- 84% of farm acres have an implemented nutrient management plan, a portion will include precision agriculture and yield reserve based practices
- 96% of the tilled land utilize conservation-till practices, with 30% utilizing no-till practices
- 399,138 acres of pasture with implemented pasture management practices
- 95% of the animal waste controlled through comprehensive animal waste management systems
- 951,577 acres of cover crops
- 288,442 acres of land utilizing carbon sequestration practices
- 1,186,303 acres of managed precision agriculture
- 2,385,876 acres of implemented conservation plans
- 106,484 acres of new forest buffers
- 33,400 feet of stream restoration
- 226,128 acres of horse pasture with implemented management plans
- Ammonia emission controls for 85% the poultry, 50% of the swine and 25% of the dairy livestock
- Controlled feed programs

Urban Strategy

The urban strategy utilizes a combination of stormwater management, septic system controls, and land use management to reduce nutrient and sediment loading from urban areas.

Based on progress reporting, it is estimated that sufficient urban management practices were implemented between 1985 and 2002 to realize edge-of-stream nitrogen, and phosphorus and sediment load reductions of 1.13 million pounds, 140,000 pounds and 56 tons, respectively per year. After accounting for this level of BMP implementation, it is estimated that urban land contributes about 7% of the nitrogen, 7% of the phosphorus and 5% of the sediment delivered to the Bay from Pennsylvania. Additionally, septic system discharges are estimated to contribute about 4% of the nitrogen loads. With full implementation of the urban strategy, it is estimated that nitrogen, phosphorus and sediment loads will decrease by an estimated 4.1 million pounds, 177,300 pounds and 37,600 tons, respectively.

Examples of practices within the urban strategy include:

- 752,421 acres of urban land with stormwater management practices
- 17,715 acres of erosion and sediment controls associated with construction activities
- 288,513 septic systems with denitrification controls or that are hooked up to existing treatment facilities
- 4000 feet of urban stream restoration
- 4295 acres of additional forest buffers
- 8395 acres of additional grass buffers
- Development of a program to implement nutrient management on 442,410 acres of urban land receiving commercial or homeowner applications of fertilizer
- Development of a program to track the nutrient and sediment reductions associated with urban street sweeping

Additional Nonpoint Source Strategies

An important component of Pennsylvania's Strategy includes those practices that can be applied to a wide range of land use. These practices are not particular to one sector or land use within the watershed. For example, riparian forest buffers can be planted on agricultural land, urban land, recreation areas and open areas commonly referred to as mixed open land. The majority of the reductions for these practices are included in the agriculture and urban strategies.

Example of additional nonpoint source practices:

- 10,434 acres of forest buffers on mixed open land
- 4,000 acres of new wetlands
- 5.3 million feet of improvements to dirt and gravel roads adjacent to streams
- 378,850 feet of stream restoration in non-urban areas
- 14,605 acres of abandoned mined land reclaimed
- Nutrient management planning on 1.25 million acres of recreational and other mixed open land
- 26,577 acres of tree plantings and reforestation
- 515 acres of forest harvesting practices

Air Reduction Strategy

Pennsylvania's air emission reduction strategy is consistent with the federal Clean Air Act (CAA). Reductions in air emissions specified by the CAA will result in a reduction in nitrogen deposition within Pennsylvania, with subsequent improvements in water quality. With full

implementation of the Clean Air Act, EPA has estimated that nitrogen loads to the Chesapeake Bay from Pennsylvania will be reduced by about 3.7 million pounds per year.

Key components of the strategy include reduced air emission of nitrogen oxides (NOx) from:

- Implementation of seasonal controls during the summer ozone season under the Chapter 145 NOx regulations;
- Enhanced NOx emission standards for new gasoline and diesel powered motor vehicles including cleaner burning fuels;
- Enhanced NOx emission standards for non-road diesel engines such as construction vehicles and farm equipment including cleaner burning fuels; and
- Non-utility NOx source emission reductions from cement plants, stationary internal combustion engines, combustion units and turbines by May of 2005 from recently adopted revisions to Chapters 129 and 145.

In addition, reductions of NOx emissions will be achieved by:

- The adoption and implementation of proposed federal Clean Air Interstate regulations or national multi-pollutant legislation; and
- Strategies necessary to attain new ozone and fine particulate air quality standards and reduce nitrogen deposition to the Bay.

In summary, through 2002, the majority of local nonpoint source reductions have occurred through implementation of agricultural management practices: followed by air deposition reductions and urban management practices. Table 3.H. lists a summary of local edge-of -stream loads for 1985 and 2002 compared to the 2010 reduction goals. Nitrogen reductions from reduced air deposition are not listed separately in Table 3.H. These reductions occur throughout all land uses, and are incorporated into the reductions listed for the land uses. Table 3.I. lists the equivalent loads delivered to the Bay for 1985 and 2002 compared to the 2010 reduction goal.

In both these tables, there are land uses that show that an increase in loads (shown as a negative load) is needed to reach the 2010 goals. This occurs for selective portions of the forest and mixed open land uses. There are nonpoint management practices that reduce nutrient loads by converting one land use into another. Two examples include forest buffers, which convert agricultural and urban land into forested land; and retirement of highly erodible agricultural land that converts plowed land into either pasture land or mixed open land. These types of practices generate nutrient and sediment reductions by converting a land use with relatively higher loading rates into a land use with a lower loading rate. The loads resulting from increased acres of forestland and mixed open land is more than offset by the load reductions generated by the land use conversion.

Table 3.H. Non-Point Source Edge-of-Stream loads delivered to Local Waters by Land Use (Nitrogen and Phosphorus in thousands of pounds/year, Sediment in thousands of tons per/year)

	Land Use					
Nitrogen	**Forest**	**Agriculture**	**Urban**	**Mixed Open**	**Septic Systems**	**Totals**
1985	27,366	81,597	10,007	8,702	4,456	132,127
2002	27,895	62,738	8,876	8,614	4,553	112,676
2002 Progress	-529	18,858	1,131	88	-97	19,452
2010 Goal	25,985	27,859	4,560	8,024	3,313	69,742
Needed Reductions	1,909	34,879	4,316	590	1,239	42,934

Phosphorus	**Forest**	**Agriculture**	**Urban**	**Mixed Open**	**Septic Systems**	**Totals**
1985	315	5,507	725	653	0	7,200
2002	318	4,696	545	656	0	6,215
2002 Progress	-4	811	140	-3	0	944
2010 Goal	276	2,141	221	631	0	3,269
Needed Reductions	43	2,554	364	25	0	2,986

Sediment	**Forest**	**Agriculture**	**Urban**	**Mixed Open**	**Septic Systems**	**Totals**
1985	404	1,744	103	148	0	2,400
2002	415	1,497	108	148	0	2,168
2002 Progress	-10	247	-5	0	0	232
2010 Goal	411	587	23	168	0	1,190
Needed Reductions	4	910	84	-20	0	978

Table 3.I. Nonpoint Source Delivered Loads to Chesapeake Bay by Land Use
(Nitrogen and Phosphorus in thousands of pounds/year, Sediment in thousands of tons/year)

	Land Use					
Nitrogen	**Forest**	**Agriculture**	**Urban**	**Mixed Open**	**Septic Systems**	**Totals**
1985	21,799	67,707	8,181	7,230	3,775	108,692
2002	23,645	54,014	7,628	7,412	4,023	96,721
2002 Progress	-1,846	13,693	554	-182	-248	11,970
2010 Goal	22,843	24,383	4,058	7,075	2,996	61,356
Needed Reductions	802	29,631	3,569	337	1,026	35,366

Phosphorus	**Forest**	**Agriculture**	**Urban**	**Mixed Open**	**Septic Systems**	**Totals**
1985	129	2,434	302	277	0	3,142
2002	143	2,258	247	302	0	2,950
2002 Progress	-13	176	55	-25	0	193
2010 Goal	155	1,261	126	364	0	1,906
Needed Reductions	-13	997	122	-63	0	1,044

Sediment	**Forest**	**Agriculture**	**Urban**	**Mixed Open**	**Septic Systems**	**Totals**
1985	190	932	50	72	0	1,244
2002	194	794	52	71	0	1,112
2002 Progress	-4	138	-2	0	0	132
2010 Goal	210	337	12	89	0	648
Needed Reductions	-16	457	40	-18	0	463

5. Point Source Control Program Summary

Point source discharges contribute about 11% of the total nitrogen and about 18% of the total phosphorus to the Chesapeake Bay from Pennsylvania waters based on 2002 estimates. Full implementation of the point source control program will achieve an estimated reduction of 3.1 million pounds of nitrogen and 745,000 pounds of phosphorus per year.

Under Pennsylvania's Point Source Control Program for protecting the Bay, point source dischargers in the watershed will be allocated annual nutrient cap loads. The cap loads for significant domestic wastewater dischargers will be based on year 2010 projected flows. The 20 significant industrial waste (IW) facilities will be allocated loads based upon their current loadings with an additional margin for growth since only 4 plants have more than 10% of their design flow remaining.

To discharge above 2010 projected flows, dischargers will be required to evaluate wastewater reuse and recycle options, install more advanced nutrient reduction technology, or otherwise provide offsets through trading or other mechanisms approved by the Department. Any increase in the discharge volume will necessarily result in a commensurate reduction in the nutrient

concentration in order to stay below the annual load allocation. National Pollution Discharge Elimination System (NPDES) permits will be the vehicle for enforcing the allocated loads.

Pennsylvania's Chesapeake Bay Program defines as significant any discharge at or above 0.4 million gallons per day (mgd). The approximately 142 significant dischargers currently tracked under Pennsylvania's program account for over 95% of the total annual point source nutrient loads in the Bay watershed. Other Bay jurisdictions control nutrient loads from plants discharging 0.5 mgd or greater.

The Growing Greener II bond initiative proposed by Governor Rendell will make available $20 million per year over a 4-year period to build point source nutrient reduction projects. Act 218 recently signed by Governor Rendell will also enable PENNVEST to finance the installation of nutrient reduction technology.

6. Pennsylvania Tributary Strategy Costs and Estimated Resources

Pennsylvania's Tributary Strategy costs were developed by Scientific Applications International Corporation (SAIC), an independent contractor to the Chesapeake Bay Program. This approach was taken to provide consistency in the development of costs for implementation of Tributary Strategies for the Chesapeake Bay Watershed Blue Ribbon Finance Panel report. SAIC sought to develop average costs for individual BMP's, and utilized information from the jurisdictions for POTW nutrient reduction upgrades.

The Tributary Strategy demonstrates that it will require more than existing water quality regulations and programs to restore the Chesapeake Bay. Through a combination of existing water quality regulatory programs and new initiatives, total capital costs to implement Pennsylvania's Tributary Strategy are estimated to be $8.2 billion. On an annualized basis, capital costs are estimated to be $735 million. Total annualized costs, not including capital costs, are estimated to be $703 million. Estimated available resources from a variety of local, state and federal programs are almost $1 billion per year.

Pennsylvania's Tributary Strategy strives to achieve the majority of its nutrient reductions from the most cost effective sources. Agricultural BMP's account for 75% of the nitrogen reductions in the Strategy, but only account for about 7.2% of the costs at $592 million. POTW's and industrial dischargers are estimated to generate about 11% of Strategy nitrogen reductions, and account for about 4.6% of the costs at $376 million. Pennsylvania's nutrient trading program for point and nonpoint sources is anticipated to generate additional nutrient reductions at reduced costs. Urban BMP’s account for 9% of the nitrogen reductions, and account for 68.5% of the Strategy costs at $5.6 billion. Septic system denitrification accounts for 2.6% of the nitrogen reductions, and 19.5% of Strategy costs at $1.6 billion.

A summary of the costs by individual BMP and for point sources are provided in Appendix E.

Chapter 4
Nonpoint Source Initiatives

No single program can supply the nutrient reductions necessary to achieve the ambitious non-point source goals required by this strategy. Multiple existing programs are being revised to augment the efforts in the agricultural and stormwater sectors, where the greatest opportunities for reductions are found. Enhanced enforcement of existing programs is expected to yield considerable nutrient reductions. However, new programs will undoubtedly be needed to finish the task.

To the greatest degree possible, Pennsylvania intends to rely upon currently proposed and existing regulations, and a combination of voluntary programs and incentives to achieve these nutrient reductions. Emphasis on trading programs and other market based mechanisms to provide the most cost effective solutions will continue to be at the heart of these strategies. Cost sharing and financial incentives will continue to play a central role in ensuring on the ground improvements to our watersheds.

However, as watersheds are identified as impaired, mandatory federal programs under the Clean Water Act to establish Total Maximum Daily Loads (TMDLs) are triggered and mandatory restoration plans will be developed and enforced. National instream standards for nutrients, and new nutrient standards in our downstream Bay partners will also create mandatory regulatory programs in the foreseeable future. Pennsylvania will also need to consider additional instream or groundwater standards to ensure implementation of the non-point source strategies. Further, as we go forward and measure progress, we will be reassessing our current programs and proposing regulatory initiatives as necessary, to ensure the commitments in this strategy are met. Key non-point source programs that will be the engine for this strategy are discussed in this chapter. [1]

1. Pennsylvania's Watershed Approach

Pennsylvania's watershed approach is a "bottom up," citizen based structure to address environmental issues locally. Since most environmental problems originate as local land use issues, determining ways to control pollution could be addressed best by the people within the watershed. This is why the DEP supports a locally developed and implemented watershed management planning effort. Development of these detailed restoration and/or protection plans, along with monitoring the success of implementing the plans, will ultimately result in locally supported water quality improvements. They also will be a key component in Pennsylvania's effort to reach the cap goals toward restoring the Chesapeake Bay.

Pennsylvania's Department of Environmental Protection promotes a watershed management process that contains the following six steps:

- Watershed Organization Development & Sustainability;
- Securing Financial and Human Resources;
- Watershed Assessment;

[1]Recently developed nonpoint source initiatives to address Pennsylvania's nutrient and sediment reduction goals are included in this chapter. A comprehensive summary of Pennsylvania's traditional programs is included in Appendix B.

- Developing a Watershed Management Plan;
- Implementation; and
- Monitoring for Success.

In order to educate the citizenry of the Commonwealth, DEP is developing a "Watershed Stewardship Guide" based upon the six steps. The six steps and other pertinent information are arranged as toolboxes enabling someone to use one or more of these steps depending upon their needs.

DEP is developing the guide with help from many of our watershed stewards. The guide will be available in the spring 2005 with training provided through the DEP Watershed Academy. The watershed managers in the DEP regional offices and the conservation district watershed specialists will provide support for the local efforts.

DEP has also developed a series of Watershed Academies at different technical levels targeting a diversified audience. Academy content is delivered through a diverse cadre of instructors which focuses on watershed approach/impact based topics and targets a wide audience. Core agenda topics combine classroom and/or field exercise in stream ecology and watershed processes, watershed stewardship, watershed impacts, nonpoint and point source pollution, stream restoration, best management practices, protection and expansion of buffer zones, native plant protection, invasive species and other biodiversity issues as they become necessary.

In October 2004, DEP received a $10,000 grant from the EPA Chesapeake Bay Program Office to plan and conduct Watershed Academies on the Watershed Stewardship Guide and associated toolboxes. Two to four workshops in the Chesapeake Bay basin are being planned for late winter and early spring of 2005. Partners assisting in presenting these academies include: Western Pennsylvania Conservancy; Canaan Valley Institute; and the National Park Service Rivers and Trails Program.

2. Growing Greener: Environmental Stewardship and Watershed Protection Act

Growing Greener is the largest single investment of state funds in Pennsylvania's history - $1.2 billion to address Pennsylvania's critical environmental concerns of the 21st century. Recommended by the Governor's 21st Century Environment Commission, Growing Greener funds programs in four state agencies: the Departments of Agriculture (farmland preservation); Conservation and Natural Resources (state park and local recreation projects); and the Pennsylvania Infrastructure Investment Authority (wastewater and drinking water improvements). The Department of Environmental Protection's (DEP) portion of Growing Greener supports the largest watershed restoration program in the country awarding more than $150 million in watershed grants since 1999 and leveraging an additional $325 million in funding from local project sponsors. The program is directed to control pollution from agricultural and urban storm water runoff, abandoned mine lands and oil and gas wells that are the cause of 96 percent of the water quality impairment in the Commonwealth. DEP's watershed restoration program won the 2001 Council of State Governments National Innovation Award.

DEP is authorized to allocate nearly $500 million in grants for watershed restoration and protection; abandoned mine reclamation; and abandoned oil and gas well plugging projects. Of the $500 million, about $100 million is anticipated to be targeted to address critical agricultural

needs within Pennsylvania's portion of the Chesapeake Bay watershed. It is clear, however, that all Growing Greener projects will enhance Pennsylvania's watershed restoration effort.

A wide variety of organizations are eligible for Growing Greener grants. Counties, local governments, authorities, conservation districts, watershed associations and other non-profit groups involved in watershed restoration and protection may apply. DEP has designated several categories of watershed projects that can be funded through Growing Greener, including:

- Watershed group organization/support
- Develop plan for watershed restoration and/or protection
- Education/outreach
- Design for large, multiphase construction
- Construction, small or large
- Operation, maintenance and replacement
- Technical assistance to support one or more of the project types above

In Pennsylvania's Chesapeake Bay watershed alone, 467 Growing Greener projects totaling over $52 million dollars have been funded. Even with this large investment, there is still a substantial unmet demand. In 2004, DEP received 577 applications worth $120 million from volunteers and local conservation groups across the Commonwealth for their work of revitalizing communities, improving watersheds and protecting the environment. Governor Rendell has recognized this demand and the value of such grassroots investment and has proposed an initiative to strengthen Growing Greener. This initiative, known as Growing Greener II, will enhance the Environmental Stewardship Fund with an additional $21 million per year for investment in watershed groups and county conservation districts that have achieved such astounding success in cleaning up the environment and revitalizing their communities. It will also make available $20 million per year over a four-year period to install nutrient reduction technology in wastewater treatment plants.

Growing Greener Grant to the Chesapeake Bay Foundation supports Riparian Forest Buffers

To further support Pennsylvania's Tributary Strategy implementation, in January 2005 DEP will provide an additional $1 million in Growing Greener funds to the Chesapeake Bay Foundation (CBF) for their Pennsylvania Watershed Restoration Program. Though this program, CBF works to improve the water quality of Pennsylvania's waterways through significant and targeted restoration of riparian forest buffers and wetlands. CBF's strategic approach will maximize agriculture landowner participation in the Conservation Reserve Enhancement Program (CREP), and pilot a new Stream Stewardship Program for the restoration and permanent protection of forested buffers in developing areas.

3. The Role of Nutrient Trading and Other Market-Based Initiatives

Given the magnitude of the estimated resources needed to reach Chesapeake Bay goals, innovative strategies with the potential to reduce costs must be developed and aligned with core water programs. Nutrient trading is an example of an innovative approach that offers greater efficiency in achieving water quality goals on a watershed basis – reducing costs even while achieving more for the environment.

Nutrient trading uses concepts that have been successfully applied in air quality trading programs, which have demonstrated that market-based initiatives have the ability to make significant contributions to improving the environment. In a 2003 Air Emissions Progress Report, EPA recognized the innovative, market-based acid rain cap-and-trade program enacted in 1990 as a major reason for the nation's progress in improving air quality. The Acid Rain Progress Report, released in September 2004, showed annual SO_2 and NO_x emissions have declined 5.1 million tons (32 percent) and 2.5 million tons (37 percent), respectively, since 1990.

Support for the development and application of nutrient trading programs continues to grow. In their 2003 Annual Report, the Citizens' Advisory Committee to the Chesapeake Executive Council (EC) recommended that the EC should endorse nutrient trading as a tool for nutrient reductions and aggressively move forward to develop and implement a Bay-wide trading program.

While it can take many different forms, the foundations of trading are that a water quality goal is established and that sources within the watershed have significantly different costs to achieve comparable levels of pollution control. The potential for significant environmental improvement is created as the cost differentials result in incentives for entities to create credits by going beyond statutory, regulatory or voluntary obligations and goals. These programs provide a structure where environmental improvement credits can be traded to others to help them more cost effectively meet their obligations or goals. Studies have estimated that trading and other market-based approaches could save anywhere from 10% to over 50% compared to approaches without incentive-based features. An important component of Pennsylvania's market-based trading program is to ensure that generated credits are above and beyond those reductions needed to reach the nutrient cap goals.

Pennsylvania – A Leader in Market-Based Initiatives

Pennsylvania has been a leader in moving the trading concept forward, focusing initial efforts in the Conestoga Watershed. The Conestoga River Nutrient Trading Pilot is a cooperative effort among Pennsylvania Environmental Council (PEC), DEP, the U.S. Environmental Protection Agency, the Conservation Fund, Environmental Defense, Chesapeake Bay Foundation, LandStudies Inc., and Pennsylvania State University. The program is among the first to apply trading as an incentive to assist farmers, communities and industry to meet and exceed state and federal water quality goals by working to establish a voluntary pollution credit-trading program on the Conestoga River watershed in Pennsylvania.

This unique partnership among environmental, business and government leaders has resulted in successes such as the initiation of the first successful nutrient trade. The Pennsylvania Environmental Council, Lititz Borough and Pfizer Inc. completed the first trade as part of the Conestoga Pilot, putting together a natural stream restoration project to reshape a portion of the tributary Santo Domingo Creek. DEP awarded $250,000 to support PEC's continued efforts to develop a nutrient trading program and assist the Department in developing coordinated policies and tools for water quality trading markets that may be expanded to address additional environmental media. Pennsylvania has also taken a leadership position by calling for the development of a nutrient credit registry as a critical step in continuing to build a trading program. Pennsylvania has been working with Wall Street entities and other partners in this effort.

Other successes have occurred outside of the Conestoga Pilot Program. To showcase how harnessing market forces can be an effective means of achieving environmental regulatory goals at less expense than traditional command and control regulations, DEP approved the transfer of nitrogen oxide air emission reduction credits from Hershey Foods Corp. to the Chesapeake Bay Foundation, which will permanently retire all the transferred credits for the restoration and protection of the Chesapeake Bay and its watershed. By retiring these credits, 189 tons per year of nitrogen oxide emissions have been permanently removed from the atmosphere, thus reducing the amount of nitrogen that could reach the Chesapeake Bay.

DEP will continue to support and help develop other market-based programs. Recently, PEC was awarded a Conservation Innovation Grant from the U.S. Department of Agriculture's Natural Resources Conservation Service to design and implement a "reverse auction," which allows the lowest bidder to receive funding for one or more best management practices that reduce nitrogen, phosphorus and sediment runoff on farms. The practice will stretch limited conservation dollars by allowing the market to set a price, as opposed to grant administrators setting a fixed price for BMPs in a watershed.

Building the framework and infrastructure for trading and other market-based initiatives will play a critical role in Pennsylvania's strategy to meet Chesapeake Bay goals. Because harnessing market forces is an effective way to achieve environmental regulatory goals at less expense, the Department will continue to work with regulated entities, the general public and other stakeholders to develop and build these types of programs.

4. ACRE Initiative

Pennsylvania is a national leader in agriculture and environmental protection. We were the first state to enact nutrient management laws for farms. Nearly 2,000 farms have developed nutrient management plans and more than 460 farmers voluntarily have taken courses to do their part to conserve, enhance and protect the environment. Pennsylvania is one of the first states with phosphorous indexing--an approach that is more protective of water quality than the alternative nitrogen indexing--and also one of the first to have an EPA-approved permit program for large-scale farming operations.

The ACRE initiative aims to build on this strong foundation, proposing extensive new improvements to farm management regulations. These changes are substantially broader than federal regulations and encompass more farms and farm types, strengthening key water quality requirements. Moreover, they aim to bring rural communities together again by taking on the issue of farm odors and by fostering negotiation and dialogue rather than litigation. The ACRE Initiative includes:

- **Create an Agriculture Review Board:** Farmers, residents and municipalities will have a forum where they can identify disagreements over existing or planned farming operations in a community. The five-member review board will encourage and support dialogue among differing parties to resolve disputes. The board also will conduct administrative hearings and rule on the legality of certain local ordinances affecting agriculture, if dialogue should fail to resolve issues.

- **Regulate a Greater Number and Broader Variety of Farms:** Proposed regulatory changes published in the *Pennsylvania Bulletin* on August 7, 2004 increase the number of

farming operations considered to be Concentrated Animal Operations (CAOs) by over 60% by incorporating nonproduction animals, such as horses. The proposed regulations also more than double the number of farming operations considered to be Concentrated Animal Feeding Operations (CAFOs) by incorporating poultry operations and adopting EPA animal threshold numbers. These proposed regulatory changes are discussed in more detail later in this document.

- **Enhance Enforcement:** One million dollars in additional funding will be provided for enhanced technical assistance programs and increased staff for monitoring and enforcement. DEP will initiate a focused effort to ensure compliance with existing prohibitions against unpermitted discharges to Pennsylvania waters under the state's Clean Streams Law.

- **Require Best Management Practices for Odor:** New and expanding CAFOs and CAOs will be required to put in place best management practices related to construction and operation of farm operations to avoid or mitigate odor problems. Other farm operations will be encouraged to put the practices into play as well.

- **Address Federal Air Quality Mandates:** An Agricultural Air Quality Task Force will examine data, review the specific causes of air emission problems related to agriculture and suggest further measures to reduce this potential concern. The task force will provide technical assistance to help farmers address federal air quality requirements. This initiative promotes an open, science-based discussion of air quality issues.

- **Close the Manure "Export Loophole":** Farms importing manure from CAFOs and CAOs must have signed agreements, nutrient balance sheets documenting allowable application rates, required record keeping, and the same manure application setbacks and buffers to protect water resources as the farm that produced the manure.

- **Ensure Minimum Buffers to Streams:** Nutrient management plan changes will require either a 100-foot setback or a 35-foot permanent vegetative buffer from waterbodies for manure application for CAFOs, CAOs and importing farms.

- **Improve Agriculture Impaired Streams:** The state is launching the first-ever exercise to analyze and take action on water quality problems in all "agriculturally impaired" waterways. Water quality assessments document that almost 4,000 miles of streams do not meet designated standards as a result of nutrient and sediment releases from agricultural operations. Farm organizations have offered to assist in outreach so farmers can understand better the linkages between farm operations and water quality challenges, so stream assessment methodologies can be reviewed and improved.

- **Use of Antibiotics:** DEP and the Department of Agriculture are monitoring research and development related to agricultural antibiotics to identify the impact of specific types and the extent of residuals in the environment. The information will be used to guide future policy related to the use of antibiotics in the food system and the potential public health risks.

- **Appropriate Funding for Efforts:** Overall, as much as $13 million in new and existing resources will be available for enhanced environmental protection on farms.

5. CAFO and Manure and Nutrient Management Regulation Revisions

The regulation revisions for CAFO and all agricultural operations that manage or land apply manure are being finalized as part of the ACRE Initiative. They include a description of DEP's authority to establish additional requirements or require permits for manure management or land application practices in watersheds with agricultural impaired waterbodies. These regulations will be used to require actions beyond standard practices where necessary to restore waterbodies impaired by sediment and nutrient runoff from agricultural operations. These enhanced requirements will be included in our manual of acceptable agricultural practices or defined in approved plans for restoring agricultural impaired waterbodies. The regulatory revisions also increase the number of farming operations considered to be CAOs from 810 to 1,310 and the number of CAFOs from 160 to 350 therefore requiring more operations to complete nutrient management plans.

The revised regulations will require that manure exported from CAOs and CAFOs is properly managed. Importing sites will be required to develop and implement phosphorus-based nutrient management plans for this imported manure or develop and implement a nutrient balance sheet that documents proper nitrogen-based application rates with a minimum 150' manure application setback from waterbodies. Signed agreements are required with manure haulers and brokers, and manure application records must be maintained. These requirements are expected to apply to 3900 CAO and CAFO manure import sites. In addition, haulers and brokers who transport this manure will have to be certified under the Pennsylvania Commercial Manure Hauler and Broker Certification Act. These agents are responsible for maintaining records and complying with the Nutrient Management Act. Through the revisions to the Manure Management regulations, the total number of farming operations that will be required to apply nutrient management for nitrogen and phosphorus will increase from 810 to approximately 5210, a six-fold increase.

In combination with the Nutrient Management Program regulation update, a number of additional improvements in how nutrients are managed on agricultural operations will be accomplished with these regulation revisions. These include:

- Phosphorus-based nutrient management (also required as the result of a recent Environmental Quality Board decision)
- Enhanced conservation planning requirements
- Strict limits on winter application and field stacking of manure
- Additional controls on barnyard and feedlot areas
- Consolidation and clarification of basic manure management requirements for all agricultural operations
- Expanded coverage of Clean Streams Law permits for manure storage systems

Nutrient Management Program History

Under the state Clean Streams Law, requirements were first adopted in 1977 covering the storage, handling and application of animal manure (25 Pa. Code Chapter 91). This regulation requires that all agricultural operations store, handle and apply animal manure in accordance with the Manure Management Manual or obtain approval or permits from the Department. The Manure Management Manual is based on U. S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) technical standards for soil conservation and nutrient management contained in the Pennsylvania Technical Guide. This manual also requires that all

manure storage systems be designed, construction overseen and certified to meeting applicable standards by a professional engineer.

Pennsylvania's Nutrient Management Act (Act 6) became law in the spring of 1993 and became fully effective on October 1, 1997. Act 6 requires regulatory oversight of nutrient management plans on farms classified as CAOs and this is contained in regulations (25 Pa. Code Chapter 83). Program administration is a cooperative effort of the State Conservation Commission, DEP, the Department of Agriculture and the Cooperative Extension Service of the Pennsylvania State University. Implementation has focused on the following:

- Establishing criteria, planning requirements and implementation schedules for nutrient management measures on CAOs;
- Developing educational programs on nutrient management to prevent pollution of surface and groundwater; and
- Providing technical and financial assistance for nutrient management and alternate uses of animal manure.

Regulations (25 Pa. Code Chapter 92) and an initial strategy for permitting large animal feeding operations were developed in February 1999 to describe methods to be used to control water quality impacts of animal manures and for the state to comply with CAFO requirements of the Clean Water Act. Under the state's current CAFO program, new or modified farming operations with more than 1000 AEUs, a CAO with more than 300 AEUs located in a special protection watershed and any farming operation with a direct discharge to surface waters are required to obtain an individual NPDES permit. All existing CAOs with more than 300 animal equivalent units (AEUs), all existing farming operations with more than 1,000 AEUs and all new CAOs between 301 and 1,000 AEUs are required to obtain coverage under a general NPDES permit. The requirements in each category are designed to take both size and potential to have an adverse impact on water quality into account. Revisions to the Federal CAFO program were signed by the EPA Administrator December 15, 2002, published in the Federal Register on February 12, 2003, and took effect on April 13, 2003. States have two years to revise state-specific CAFO programs incorporating the new regulation changes.

6. Poultry Litter-to-Energy Project

Pennsylvania will participate in an innovative public-private partnership to demonstrate the use of poultry litter to generate usable energy and a valuable residual product. This project will retrofit and operate an industrial power plant in Amelia Court House, Virginia to provide a pilot demonstration of a poultry litter gasification system for industrial power production. Testing and analysis of emissions and residuals to determine the environmental impact of the energy production process are included in the project. The partnership includes the state governments of Pennsylvania and Virginia, USDA, Chesapeake Bay Foundation, and the agriculture industry.

Pennsylvania DEP has joined PennAg Industries and Wenger Feeds to support this project. DEP has offered a grant of $25,000 to PennAg Industries to support the testing of stack emissions, ash and fuel/poultry litter at this facility. Wenger Feed has also made available $5,000 to PennAg Industries for this project in exchange for the opportunity to process Pennsylvania poultry litter through the pilot system. Wenger Feeds and other Pennsylvania agricultural producers are interested in this project to demonstrate an energy production alternative to land

application of poultry litter. By participating in the Virginia project, Pennsylvania can proceed directly to full scale facility development if the pilot results are successful.

7. Chesapeake Bay Implementation Grant Program

The DEP is the state agency responsible for implementing Pennsylvania's Chesapeake Bay Implementation Grant Program. The program is supported by EPA and matching state funds. The Chesapeake Bay Program provides technical assistance to agricultural landowners to implement best management practices for the reduction of erosion and proper application of nutrients. It provides funds to conservation districts to employ technical personnel to accomplish these activities. This funding supports 43 Bay technicians, seven engineers and three engineering assistants within the conservation districts. DEP personnel assist conservation technicians with training and oversight.

The program also provides cost-share funds to landowners to correct nutrient management problems and associated erosion and water control problems on their farms. To participate, landowners agree to implement a comprehensive nutrient program to address critical problems. Thirty-eight counties participate in the program. Cost-share funds are limited to 80 percent of the cost, up to $30,000, of BMPs approved by the State Conservation Commission. In addition, the funding supports central office staff and six nutrient management specialists in the regional offices.

To better direct limited funds and resources to maximize water quality benefits, DEP is proposing to change the process for allocating funds to conservation districts under the Chesapeake Bay Program. County conservation districts have been asked to work with DEP regional office staff and other local partners to develop County Implementation Plans that emphasize water quality results. As part of these County Plans, the districts may propose alternative priorities, action plans and outputs that they believe are consistent with the Tributary Strategy and may be more effective in meeting the new Bay Program objectives. The regions will be making the recommendations on the distribution of Bay BMP funds based on their assessment of the quality of county plans and watershed priorities.

DEP is proposing that the available BMP implementation budget will be distributed to the regions based on edge-of-stream nonpoint source loads as calculated by the Bay Watershed model. In addition, the Bay Stream Bank Fencing Program traditionally budgets $50,000 per Bay Field Representatives for fencing projects. The regions will be able to apply some, or all, of these funds to supplement their district BMP implementation budgets. The regions will then allocate their budgets to their districts based on the quality of the plans and watershed priorities. The County Implementation Plans are valuable management tools for directing available resources to accomplish environmental results and help farmers.

8. Conservation Reserve Enhancement Program (CREP)

CREP is a supplemental program to the Conservation Reserve Program (CRP), administered by the USDA Farm Service Agency. With the expansion of CREP into the Ohio River basin last year, Pennsylvania now has the largest program in the nation, covering 265,000 acres in 59 of the state's 67 counties. The entire Chesapeake Bay Watershed is covered under CREP. Governor Rendell also dedicated an additional $5 million in Growing Greener funds to Pennsylvania farmers statewide for eligible costs of conservation practices. With this funding,

the state has contributed $14 million for the installation of agricultural best management practices on more than 3,500 farms and 94,000 acres through CREP. In addition, Pennsylvania has shifted the focus of the program, targeting resources more efficiently by authorizing state money only for projects, such as riparian forest buffers, wetland restoration, and natural revegetative riparian buffers that demonstrate actual water quality benefits. This is a significant shift that will magnify limited resources to achieve the greatest benefits and improve water quality.

9. Conservation Easements For Riparian Buffers

Restoring riparian buffers is an important activity in helping to restore the Chesapeake Bay. Pennsylvania has invested millions of dollars into fencing livestock out of streams, planting riparian buffers, and installing livestock crossings yet these investments are not protected over the long term. In other words, there is no program in place that protects the integrity of these practices after initial relatively short-term grant contracts expire. In addition, many properties change ownership and new owners may not understand or agree with the former owners intention to install riparian buffers. Buffers planted under the CREP program in Pennsylvania are the closest we come to long-term protection, but even these contracts expire after 15 years.

As a result, Pennsylvania has begun developing a Conservation Easement Program specifically designed to protect riparian buffers in perpetuity. The DEP in partnership with DCNR and the Pennsylvania Land Trust Association (PALTA) is developing specific easement language, and evaluating ways to streamline the easement process while keeping costs to a minimum. Education and resource materials will be developed. A pilot program for the new Conservation Easement Program will be implemented in at least two watersheds in the Chesapeake Bay basin.

10. TMDL Program

Excess nutrients also present a challenge for Pennsylvania's streams and rivers. In compliance with the federal Clean Water Act, the Commonwealth developed a plan to complete a statewide assessment of its surface waters. Full-scale fieldwork for the unassessed waters project began in 1997 and the fieldwork should be completed for the Chesapeake Basin by September 2005. The following table shows our progress on assessments and Total Maximum Daily Load (TMDL) development for the Susquehanna River Basin and the Potomac River Basin.

After stream assessments are completed, plans will be developed to restore the water quality in the impaired steams. Each listed waterbody in part five of the integrated stream report (formerly the 303(d) list) will need to have a TMDL developed for it. The plans will establish the TMDL for the pollutant causing the impairment. Pennsylvania is one of the nations leaders in the number of TMDLs developed, and some of these are in the Bay watershed. The tables shown above reflect the number of miles we have completed TMDLs for versus the number of miles impaired by a specific cause.

Table 4.1. Progress of River Assessment and TMDLs Completed

Susquehanna River Assessed Miles - 40,280				
Impairment Causes	Miles Impaired	Percent Impaired	TMDL Miles	% TMDLs Completed
Siltation	2684	7%	539	20%
Nutrients	893	2%	275	31%
Organic Enrichment/ Low Dissolved Oxygen	371	1%	183	49%
Excessive Algal Growth	8	0%	1	14%
Potomac River Assessed Miles - 3,575				
Impairment Causes	Miles Impaired	Percent Impaired	TMDL Miles	% TMDLs Completed
Siltation	176	5%	0	0
Nutrients	102	3%	0	0
Organic Enrichment/ Low Dissolved Oxygen	11	0%	0	0

11. Stormwater Management

More effective management of stormwater runoff from developed areas presents a definite opportunity for nutrient reductions. Development that incorporates best management practices for retaining nutrients on-site rather than concentrating runoff and directing it offsite will result in significant reductions in nutrient loads from developed areas. DEP's Comprehensive Stormwater Management Policy, effective September 28, 2002, integrates water resource management programs in the DEP Water Management Deputate to improve their effectiveness. The policy addresses the need to improve water quality, sustain water quantity (including groundwater recharge and stream baseflow), protect high quality (HQ) and exceptional value (EV) designated streams, and integrate federal NPDES Phase II stormwater management obligations.

DEP's approach to stormwater control requires infiltration of stormwater flows where appropriate. This approach reduces pollutant loadings to streams, recharges groundwater tables, enhances stream base flow during times of drought and reduces the threat of flooding and streambank erosion resulting from storm events. Permit conditions require the use of stormwater BMPs as the means of managing stormwater from construction sites covered by federal National Pollution Discharge Elimination System (NPDES) Phase I and Phase II construction, as well as post construction stormwater flows.

DEP is currently developing a new BMP manual to replace Pennsylvania's Handbook of Best Management Practices for Developing Areas, published in 1998. The Draft Pennsylvania BMP Manual was presented to the Manual Oversight Committee in December, 2004. A series of

focus group meetings will occur in early 2005, followed by a formal public comment period. The final Manual is expected to be published by the fall of 2005. The manual will comprehensively address both structural and non-structural BMPs and provide guidance to municipalities, the development community and design professionals in meeting DEP's Comprehensive Stormwater Management Policy objectives. It will also assist Municipalities with Separate Storm Sewer Systems (MS4s), other permittees and regulated parties in complying with federal NPDES Phase II obligations.

Administratively, DEP has integrated its permitting programs with stormwater management plans developed on a watershed basis under the Stormwater Management Act (Act 167). Act 167 requires counties to prepare watershed stormwater management plans. The policy requires these plans to incorporate a water quality protection component into all stormwater management control plans.

Municipalities implement the Act 167 plans through enactment of local ordinances and regulations. Currently 18 watershed plans with a water quality component, affecting 192 municipalities, are completed in the Chesapeake Bay basin. An additional seven plans with a water quality component will be completed within two to three years, involving 112 municipalities. DEP reimburses municipalities for stormwater plan implementation. To initiate tracking of nutrient reductions achieved through stormwater management, DEP will request municipalities to provide information on the type of BMPs installed through the annual NPDES Phase II reporting requirements.

In addition, DEP will rely on Act 167 plans to meet the new federal National Pollution Discharge Elimination System (NPDES) Phase II stormwater requirements. The NPDES permitting program applies to eight urbanized areas in the basin, including Altoona, Hagerstown area, Harrisburg, Lancaster, Scranton-Wilkes-Barre, State College, Williamsport and York. These areas encompass 161 municipalities. DEP has also integrated post construction stormwater management planning and implementation into its NPDES permit for construction activities to ensure water quality standards continue to be met after construction is completed.

12. Energy Harvest Grant Program

The Pennsylvania Energy Harvest Grant Program provides the last increment of financing for clean and renewable energy projects that are proven to improve air quality, protect watersheds and preserve land. Manure digesters are of particular interest. Water quality suffers from agricultural runoff. However, biodigesters can turn potential pollution into clean energy. The output from Pennsylvania's hogs and dairy cows can produce 631,000 megawatt-hours of electricity. That's enough to power 86,000 homes or reduce the need for 384,459 barrels of oil, which would fill up more than a half-million average-sized cars with gasoline-roughly the number of all passenger cars in Philadelphia. All of this adds a promising dimension to farming. At the same time, air and water quality improve. Since its inception in May 2003, Energy Harvest has awarded $10 million and leveraged another $26.7 million in private funds, helping to make Pennsylvania a national leader in building and deploying advanced energy technology.

13. Pennsylvania’s Alternative Energy Portfolio Standard

With the passage of the Alternative Energy Portfolio Standard, Pennsylvania now proudly boasts one of the most far-reaching and ambitious renewable energy measures in the nation. The

Governor recently enacted a two-tiered clean energy portfolio standard that ensures in 15 years, 18 percent of all of the energy generated in the Commonwealth comes from clean, efficient and renewable resources, including importantly, manure and other biomass sources of energy. This encourages the development of biodigesters and other manure management systems that can reduce farm runoff. Additionally, anticipated statewide rules for net-metering and interconnection will make it easier for small-scale local energy projects and biodigesters that can help to reduce discharges to local waterways when best management practices are implemented. Promoting the development of cleaner advanced energy sources also will help to reduce the atmospheric deposition of nitrogen that ultimately ends up in the Bay. The clean energy portfolio standard annually will avoid 21,398 tons of nitrogen oxide.

14. Air Reduction Strategy

Atmospheric Deposition has been estimated to contribute about 25 – 32% of the anthropogenic nitrogen load delivered to the Chesapeake Bay. A portion of the reductions in nutrient loading due to NOx emission reductions achieved under current Clean Air Act (CAA) or PA Air Pollution Control Act (APCA) requirements have been factored into the allocated nutrient reduction goals. However, at this time more effort is necessary to better define and quantify those emission reductions, their impact on nutrient loads, and additional potential reductions.

Pennsylvania has made tremendous progress in reducing NOx emissions to improve air quality, and a number of programs that will further reduce NOx emissions are in the pipeline. Future control programs slated for mobile sources include controls on light- and heavy-duty engines, motorcycles, miscellaneous engines, aircraft, locomotives and marine vessels. Voluntary reductions are expected from programs to encourage reduction of unnecessary idling of trucks, buses, and trains and from a program encouraging retrofits for diesel engines. For mobile sources, Table B-1 in Appendix B. shows federal strategies in place or to be implemented with their expected emissions reductions.

A number of voluntary measures are also being promoted by the Commonwealth:

WHAT	NOx Impact	Activities
Reduction of unnecessary diesel idling from trucks, buses and trains	About 13 tons of NOx per day statewide is contributed by long-term truck/bus idling	Pursuing truck stop electrification, education of school bus fleet operators. Two local jurisdictions have anti-idling ordinances
Diesel retrofit grants - 2 school districts - 2 private companies - 1 municipality	Most retrofits are for PM; some provide NOx reductions from 5 to 20%	Ongoing, as funding permits. EPA also has initiatives to recognize voluntary efforts

A number of strategies to reduce air emissions of NOx from industrial sources have been implemented in Pennsylvania that continue to limit NOx emissions or will provide greater NOx reductions with full implementation. Additional control strategies for NOx reductions are possible for the future.

The Reasonably Available Control Technology (RACT) program and the NOx State Implementation Plan Interstate requirements (NOx SIP Call) regulations achieved significant

reductions in NOx emissions from point sources. Rules were recently adopted that will yield some additional NOx reductions from cement kilns, large boilers, internal combustion engines and turbines. These programs and the emission reduction benefits include:

- Reasonably Available Control Technology (RACT) – Required economically reasonable controls on existing major stationary sources statewide, year-round, achieving a 35% reduction;
- NOx SIP Call – 75% Reduction in NOx emissions from 1990 levels during the ozone season (May 1 thru September 30) for electric generating units (EGU's); and
- Small Sources of NOx, Cement Kilns, and Engines -- Recently adopted regulation will require additional NOx emission reductions from cement kilns, large boilers, internal combustion engines and turbines. For Southeast PA this extends to smaller boilers, engines and turbines. These NOx limits will apply during the ozone season (May 1 thru September 30) starting May 1, 2005. Estimated reductions are approximately 3-10 tons per day.

Additional NOx reductions are being achieved through a number of other mechanisms including:

- Enforcement Settlements- DEP has negotiated and is continuing to seek year-round NOx controls in new settlement agreements; and
- Application of lowest achievable emission limits and/or stringent permitting requirements for new or modified sources of NOx.

Also, the following emission reduction strategies have been proposed or are being considered:

- Proposed Clean Air Interstate Rule (CAIR) or National Multi-pollutant legislation - Either of these programs is anticipated to result in an approximate 65% reduction in annual NOx for Electric Generating Unit's (EGU's) from 2002 levels. EPA is expected to finalize CAIR proposal in March 2005 if Clear Skies legislation is not enacted. Note: The Ozone Transport Commission (OTC) member states have developed a proposal including more stringent NOx and SOx emission caps for electric generating units. In June 2005, the OTC will consider an implementation strategy.
- Best Available Retrofit Technology (BART) – This program will require control of large NOx emitters built between 1962 and 1977. A SIP revision including regulations is due 3 years after PM 2.5 designations (4/5/2008). Controls will be required to be in place by 2013-2018.
- Eight-Hour Ozone SIP Revision – This new ambient air quality standard will require reasonably available control technology on major stationary sources of NOx not controlled for the 1-hour ozone requirements. EPA's Phase 2 Implementation Final Rule is anticipated in early-Spring 2005. This rulemaking will set new requirements for attainment which will necessitate new ozone season NOx reductions.
- PM 2.5 SIP Revision– Achievement of the PM2.5 ambient air quality standard may require NOx controls to reduce emissions of precursors to nitrate particulates that contribute to PM 2.5 in the atmosphere. EPA's implementation rule is now scheduled for proposal in February 2005. A SIP including regulations will be due 3 years after PM 2.5 designations (4/5/2008) with controls in place by 2013.
- Chesapeake Bay NOx Reduction Initiative - Review of large NOx emitting sources is underway to determine if further reductions are possible from additional source

categories. Certain source categories including glass furnaces, lime kilns and municipal waste combustors could achieve substantial reductions in NOx emissions.

- The use of diesel fired distributed generation is creating increased NOx emissions from numerous new and existing internal combustion engines. The Bureau of Air Quality is planning to issue new general permit requirements covering certain new internal combustion engines.

Pennsylvania's Particulate Matter (PM) 2.5 Program will contribute to measuring air deposition. The DEP operates 13 ambient PM 2.5 samplers located statewide designed for chemical speciation analysis. Filter analysis for the PM 2.5 speciation samplers is being done under a national EPA-funded contract by RTI (Research Triangle Institute) in North Carolina. Ammonium is one of the components determined from these sample analyses. Other major components measured include sulfate, nitrate, organic carbon, elemental carbon, and crustal material. Wet deposition of ammonium is monitored by the Pennsylvania Atmospheric Deposition Monitoring Network that is maintained by DEP under cooperative agreement with The Pennsylvania State University. The purpose of this program is to determine the acidity of precipitation falling in Pennsylvania for environmental assessment purposes. In addition to ammonium, parameters determined include sulfate, nitrate, chloride, calcium, magnesium, potassium, sodium, and specific conductance. Eighteen (18) acid precipitation monitoring sites are currently in operation in Pennsylvania.

15. 2007 Progress Review and Development of New Program Initiatives

Pennsylvania will continue work with stakeholder groups to identify and consider new program initiatives which will help meet its Bay nutrient and sediment reduction goals while addressing local stream impairments. We will also track the success of ongoing initiatives within and outside the state. In 2007, the Chesapeake Bay Program partners have scheduled a re-evaluation of the nutrient and sediment reduction goals with a revised Watershed Model. In conjunction with this effort, Pennsylvania will also undertake an internal strategy progress review. At that time we will identify and expand efforts that are yielding the greatest success. With the groundwork done on new initiatives, we will also select and undertake additional initiatives with the greatest potential for water quality results. The Department will engage stakeholder workgroups to consider initiatives that achieve the following:

- Improve watershed restoration and management by developing and implementing a watershed restoration/protection planning and approval process; local watershed nutrient balance analysis to inventory sources and uses for more comprehensive solutions to nutrient load reductions; and identifying and encouraging opportunities for partnerships to develop innovative approaches to nutrient and sediment load reductions;

- Extend and improve nutrient and sediment loads from agricultural operations through additional funds and working with farmers, energy producers, mining operators, and others;

- Improve management of post-construction stormwater by working with groups including the conservation districts, developers, consultants, farmers, and municipalities;

- Reduce nitrogen releases from on-lot sewage systems by working with sewage enforcement officers, developers, municipalities, and others;

- Reduce groundwater nitrogen levels to protect for potable water supply by working with groups including farmers, sewage enforcement officers, developers and municipalities;

- Improve management of urban, suburban and mixed lands by working with other sectors including the commercial fertilizer industry, landscape service providers, and the golf course industry;

- Increase the use of excess nutrients (manure/biosolids) for mine closures and abandoned mine land reclamation; and

- More effectively address air emissions that contribute nutrient loads to waterbodies by working with various groups including the agriculture community and power generators.

Chapter 5

Point Source Nutrient Control Program

1. Introduction

Pennsylvania's point source nutrient control program's major focus is regulating approximately 142 "significant" point sources in the Chesapeake Bay watershed through nutrient load limits in NPDES permits. For Pennsylvania's Chesapeake Bay Program, a significant point source is defined as a wastewater treatment plant with a design flow of 0.4 million gallons per day (mgd) or greater. Collectively, these significant sources account for 95% of the total point source nutrient load. Those point sources not meeting the definition of a "significant" source constitute less than 0.55% of Pennsylvania's overall nutrient load. Other Bay partner state point source nutrient reduction programs address plants with design flows of 0.5 mgd or greater. Appendix D lists the significant point source discharges located in each watershed area.

2. General Program Elements

The point source strategy will establish annual Total Nitrogen (TN) and Total Phosphorus (TP) load limits for the wastewater dischargers. The specific permitted loads for each of the significant dischargers will be based on achieving 8mg/l TN at flows equal to those projected for the year 2010, which are generally lower than the design flow of the plants. Annual load limits for TP will generally be based upon achieving a 1mg/l discharge concentration at year 2010 flows, except for any facilities causing in-stream, near-field impacts from their TP discharges. These few dischargers will require a specific locally-driven refinement of the annual TP load limit and a concentration limit. Because most facilities are discharging below and often significantly below their design flow, establishing equivalent cap loads using design flow rather than 2010 flows would require the use of much lower effluent concentrations. The approach in this strategy results in cap loads that achieve and maintain the targeted aggregate load cap through a more appropriate resource allocation than would be required using design flow with a lower concentration.

The 20 significant industrial waste (IW) facilities will be allocated loads based upon their current loadings with an additional margin for growth since only 4 plants have more than 10% of their design flow remaining. An option under consideration would establish an aggregate IW load, thereby enabling the facilities to trade with each other or outside the IW group to achieve the aggregate load.

These point source discharge TN and TP cap loads will be enforced through National Pollutant Discharge Elimination System (NPDES) individual or watershed-based permits. The Department is actively investigating options for the development of a general watershed permit to establish and monitor the cap loads, specify the requirements for expanding discharges beyond the year 2010 projected flows, and accelerate overall implementation of the point source nutrient control program.

To discharge above 2010 projected flows, dischargers will be required to evaluate wastewater reuse and recycle options, install more advanced nutrient reduction technology, or otherwise provide offsets through trading or other mechanisms approved by the Department. Any increase

in the discharge volume will necessarily result in a commensurate reduction in the nutrient concentration in order to stay below the annual load allocation.

Point sources that can reliably and consistently treat to below the 2010 cap loads, and are willing to accept those reduced loads as NPDES permit conditions, would be eligible to receive authorized nutrient reduction credits. Those facilities unable to achieve and maintain their established 2010 cap loads may opt to purchase available authorized nutrient credits. These types of trading activities would be administered through a trading program, which is further described in other portions of this document.

Beyond the cap loads established for existing significant point source dischargers, similar cap loads will be established for new systems and existing small systems when flows are projected to grow above 0.4 mgd. These new significant sources will be required to offset their nutrient loads through nutrient reduction treatment technology, the purchase of nutrient credits, documented septic system retirement credits, and wastewater reuse and land application credits. Point sources with flows below the 0.4 mgd will also receive an annual nutrient load cap. These will be based upon design flow and existing performance.

3. Specific Program Elements

All point source dischargers in the Chesapeake Bay basin will have nutrient monitoring and reporting requirements incorporated into their NPDES permits. In addition, nutrients carried in by-passed, blended or partially treated discharges, including combined sewer overflows (CSOs), sanitary sewer overflows (SSOs) and high flow bypasses, must be monitored and accounted for against the discharger's permitted cap load.

To improve overall tracking of cap loads and reliable projection of flows, regulatory modifications to the annual wasteload management requirements will be initiated. Further, the sewage facilities planning program will be strengthened to document the septic system relief credit that must be captured and tracked for the period 1985 thru 2010. This will create a TN reduction pool for those point sources that relieve these systems**.**

The Department will also establish new policy guidance to direct the evaluation of wastewater reuse and land application/ aquifer recharge options as an ultimate method of wastewater disposal. Additional revisions to the Sewage Facilities Update regulatory requirements are under consideration to further strengthen and institutionalize the wastewater reuse and recycle option.

4. Financial Incentives

Currently 10% of the Growing Greener grants (approximately $4 million annually) are set aside for Water and Sewage System infrastructure improvements. In the past two years, applications proposing nutrient reduction modifications have been eligible for these grants. This has resulted in eleven grants to these types of proposals in this two-year period. The Department proposes to maintain this eligibility and encourage additional applications.

The Growing Greener II bond initiative proposed by Governor Rendell will make available $80M over a 4-year period in part to build point source nutrient reduction projects. Eligibility requirements for this bond issue will be designed to encourage the most effective and efficient

use of the monies toward achieving the cap loads established under this point source control strategy.

Act 218 recently signed by Governor Rendell provides $250 million in bond money for sewer and water infrastructure. Of this $250 million in bond money, $200 million will be used to provide grants and loans to upgrade, rehabilitate, and expand wastewater and water supply systems that are connected to economic development projects. Point sources within the Chesapeake Bay watershed meeting the stated criteria could apply for this money. The Act transfers the remaining $50 million of the Water and Sewer Bond authorization to PENNVEST, which would be allowed to issue up to $100 million in new bonds under its existing authority to provide grants and loans for targeted environmental problems. The new fund within PENNVEST will be at least $100 million and at most $150 million. This money can assist point sources in the Chesapeake Bay watershed achieve the cap loads as one of the targeted environmental problems specified for the money is to introduce nutrient reduction technologies into wastewater treatment facilities.

Chapter 6
Water Quality Monitoring

1. Chesapeake Bay Program Monitoring

Water quality monitoring of nutrients and sediment further quantifies the success of Pennsylvania's nutrient reduction strategy. A water-quality monitoring program was initiated in 1984 to provide nutrient and sediment loading data for the main stem Susquehanna River and its major tributaries. In 1989 a station was added on Conococheague Creek, a tributary of the Potomac River. With the support of some limited EPA and USGS funding, 15 additional monitoring stations were added in the Susquehanna and Potomac basins to document nutrient and sediment loading to the Chesapeake Bay in 2004. Many of these stations are located at or near DEP tributary boundaries to facilitate assessment of progress toward achieving nutrient reduction goals. Water quality data derived from these sites are also provided to the Chesapeake Bay Program Office (CBPO) to assist in calibration of the watershed model and SRBC, USGS and EPA staff use this information to evaluate changes in nitrogen, phosphorus and sediment loads and concentrations over time.

For the Susquehanna River, original model calibration stations were established at Towanda to identify loadings from New York State, at Danville for the North Branch Susquehanna Subbasin, at Lewisburg for the West Branch Susquehanna Subbasin, at Newport for the Juniata River, at Marietta for the Middle Susquehanna Subbasin, and at Conestoga for the Conestoga River. The current non-tidal monitoring network includes a total of 20 stations in the Pennsylvania portion of the Susquehanna River basin and two in the Potomac.

To better estimate Pennsylvania point source nutrient loads in the Chesapeake Bay watershed model, voluntary nutrient monitoring was initiated in October 1998. Pennsylvania has 142 significant point dischargers with daily flows of 0.4 MGD or greater in the Chesapeake basin. Currently, 75 facilities engage in quarterly monitoring of total nitrogen and total phosphorus discharges from their facilities.

2. Citizens' Volunteer Monitoring Program

Pennsylvania DEP's Citizens' Volunteer Monitoring Program (CVMP) was initiated in 1996 to provide support and technical assistance to community based water-monitoring efforts. The goals of this program include: fostering stewardship by helping communities find the tools needed to meet their own goals in gathering information about water resources and giving the Department a better understanding of water resources by receiving quality assured data from volunteers. A description of some of the current and future activities of the CVMP that may be useful in the Chesapeake Bay Watershed follows.

Volunteer Environmental Monitoring Panel and Keystone Watershed Monitoring Network

A statewide Volunteer Environmental Monitoring Panel made up of representatives from the volunteer monitoring community, business and industry, the agricultural community, organizations that provide services to volunteer monitoring groups and resource agencies was formed in 1998. The panel, in conjunction with the CVMP, hosted a statewide summit of volunteer water monitors in 1999. As a result, the Pennsylvania Organization for Watersheds

and Rivers (POWR) coordinated development of a statewide network of volunteers. The goals of the network are to: facilitate communication and support to volunteer watershed-monitoring groups; establish and coordinate training protocols and materials that are recognized by a variety of data users; identify solutions for addressing the current and future needs of volunteer watershed monitors; advance the recognition and credibility of volunteer watershed monitors to address local and statewide issues and elevate the effectiveness of volunteer watershed monitoring groups.

Network development has been slow since 2003 due to changing volunteers, and a lack of funding and coordinator. POWR has recently secured funding for the development of a statewide data system and hopes to reinvigorate the Network when the data system is completed in 2005.

Technical Handbook

Community based monitors in Pennsylvania use a variety of methods for sampling and analysis. Instead of attempting to prescribe standardized protocols for all the groups, the CVMP, in collaboration with a variety of partners prepared a technical handbook – *Designing Your Monitoring Program, A Technical Handbook for Community Based Monitoring in Pennsylvania* – that includes a study design process. This process is a logical series of choices about the why, what, when, where and how of monitoring. With a written study design, each group will have a clear game plan to guide them through their monitoring program and lend credibility to their data collection and any actions that result from information gathered. The group also identifies the data user in this process so that clear data quality objectives and quality assurance measures can be set up front before monitoring occurs. Defining a purpose, data use, and data users are clearly the most critical portions of the study design process. Additional chapters are being developed for the handbook, including: lake monitoring, the stream redesignation process, monitoring for potential use in the Integrated Waterbody Listing Process, and monitoring natural stream channel design projects.

Training and Technical Assistance

The program provides "workshops on demand" which are specifically planned and tailored to the goals of a particular group including the study design process, data interpretation and monitoring for streams, lakes and restoration projects. The CVMP also provides technical assistance and mentoring to community based monitoring groups.

Pennsylvania Senior Environment Corps

The CVMP works closely with the Environmental Alliance for Senior Involvement (EASI) in providing guidance to 25 Pennsylvania Senior Environment Corps (PASEC) throughout the state. Thirteen PASECs are in the Chesapeake Bay Watershed. The volunteers use standardized protocols under the guidelines of a statewide Quality Assurance Project Plan (QAPP) to assess physical and chemical indicators of stream health once a month. They also do a habitat assessment and water quality rating using benthic macroinvertebrate communities twice a year. This data can be used as a screening tool to determine where further study is needed and can also show the success or failure of restoration efforts. The data is housed in a database maintained by EASI.

Watershed Snapshot

The CVMP plans and implements an annual statewide *Watershed Snapshot*. During the event, thousands of volunteers and professionals collect water quality data at their routine sampling stations during a 10-day period in April that includes Earthday. No limitations are placed on how to choose the monitoring sites or equipment used. In many cases, streams or lakes are chosen based simply upon their proximity and accessibility to participants. *Watershed Snapshot* includes monitoring options for physical, chemical and biological indictors, a habitat assessment and a buffer assessment. The CVMP compiles the data into a report that can be used as an educational tool. The data is "democratized" – all data is used without regard to the data quality objectives employed – to develop a "picture" of the overall water quality in Pennsylvania and get a better picture of the ranges in results that can be expected, as well as determining trends and effects of physical influences upon water chemistry. Watershed Snapshot will become totally web-based in 2005. Data sheets will be available for download and an online database will be available for volunteers to input their own data.

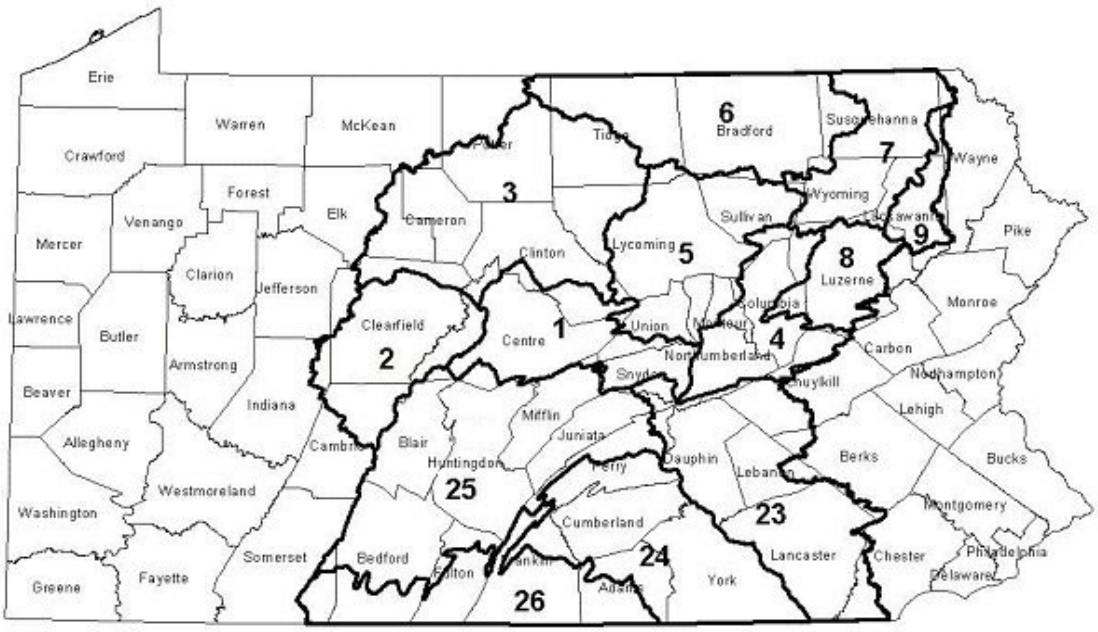
The Role of Community Based Monitoring in State Assessments

Community based monitoring plays a vital role in state assessments. Volunteer monitors in Pennsylvania sample daily, monthly, semi-annually and quarterly at many sampling stations throughout the state. While much of this data is collected for the watershed group's own use, some data is collected for use in the state's water quality assessment program. Data collected for this use must be under a written quality assurance/quality control plan or study design that follows strict criteria concerning age of data, identification of a stream segment, and frequency of sampling. In an effort to get more citizen monitoring data that meets these protocols, the CVMP included a detailed discussion in the handbook – *Designing Your Monitoring Program, A Technical Handbook for Community Based Monitoring in Pennsylvania* – dedicated to educating the public on how a monitoring program must be designed and implemented if the goal is to have data usable in the 305(b) report and listed on 303(d) list of impaired waters. Other special sampling efforts by volunteers include: collecting bacteriological data that can be used in determining recreational use suitability in surface waters that are on the 303(d) list of impaired waters; collecting data on lakes used to determine trophic status; and monitoring BMP implementation sites to determine progress in improving water quality.

Appendix A.
Nonpoint Source Strategies for the Thirteen Watershed Areas

This appendix provides additional information on the non-point sources strategies developed for the 13 watershed areas within Pennsylvania's portion of the Chesapeake Bay watershed. Twelve of the watershed teams are within the Susquehanna River basin and one comprises Pennsylvania's portion of the Potomac River basin. The location of the watershed areas is shown on Figure A-1.

Figure A-1 - Location of Tributary Strategy Watershed Areas



Team 1 – Central Penn
Team 2 – Upper West Branch
Team 3 – Susquehannock
Team 4 – Lower North Branch
Team 5 – Big Bend
Team 6 – Bradford/Tioga
Team 7 – Upper Susquehanna
Team 8 – Wyoming Valley
Team 9 – Lackawanna
Team 23 – Lower Susquehanna East
Team 24 – Lower Susquehanna West
Team 25 -- Juniata
Team 26 -- Potomac

For each watershed area information is provided on land uses, nutrient and sediment loads, and strategy level of management practices.

Central Penn Watershed

The Central Penn watershed is located in central Pennsylvania and includes portions of Centre, Clinton, Mifflin, Snyder and Union Counties. DEP Field operations for the watershed are through the North Central Regional Office.

Major tributaries within the watershed include Bald Eagle, Penns and Middle Creeks. Overall, the Central Penn watershed is about 6 percent of Pennsylvania's Bay watershed. Forestland is the main land use within the watershed: followed by agriculture, mixed open and urban/developed lands. The land use acres are listed in Table A-1.

Table A-1
Central Penn Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	587,632	918	67.2%
Agriculture	168,271	263	19.2%
Mixed Open	81,502	127	9.3%
Urban/Developed	30,475	48	3.5%
Open water	6,279	10	0.7%
Total	874,158	1,366	100%
Portion of Pennsylvania's Bay Watershed			6.0%

The 2010 nutrient and sediment goals for the Central Penn watershed are listed in table A-3. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-2
Central Penn Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	4,094,583	175,580	63,848
Delivered Loads	3,851,000	96,700	29,320

The suite of non-point source management practices to reach these goals is listed in Table A-3. These include principally agricultural and urban management practices: with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-4.

Table A-3: Central Penn Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	419	245	174
Carbon Sequestration	Acres	16,182	T	16,182
Conservation (Farm) Plans	Acres	141,455	78,334	63,122
Conservation Tillage	Acres	57,497	37,906	19,591
Cover Crops (early)	Acres	54,000	T	54,000
Forest Buffers	Acres	5,659	113	5,547
Grass Buffers	Acres	717	41	676
Land Retirement	Acres	12,735	4,908	7,826
Managed Precision Agriculture	Acres	66,610	T	66,610
Mortality Composters	Systems	1	T	1
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	25,550	T	25,550
Nutrient Management	Acres	22,203	60,543	-38,339
Off Stream Watering w/Fencing	Acres	15,405	856	14,549
Off Stream Watering w/o Fencing	Acres	9,243	103	9,140
Precision Rotational Grazing	Acres	3,326	T	3,326
Rotational grazing	Acres	2,465	706	1,758
Horse Pasture Management	Acres	6,000	T	6,000
Tree Planting	Acres	116	0	116
Yield Reserve	Acres	22,203	0	22,203
Ammonia Emission Reductions - Poultry	AEUs	5,284	0	5,284
Ammonia Emission Reductions - Swine	AEUs	11,832	0	11,832
Ammonia Emission Reductions - Dairy	AEUs	8,978	0	8,978
Precision Feeding - Dairy	AEUs	26,934	T	26,934
Phytase Feed additive - Swine	AEUs	23191	T	23,191
Phytase Feed additive - Poultry	AEUs	6,216	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	680	336	344
Dirt & Gravel Road Practices	Feet	25,527	T	25,527
Forest Buffers	Acres	358	2	356
Non-Urban Stream Restoration	Feet	6,000	T	6,000
Nutrient Management	Acres	87,087	0	87,087
Tree Planting	Acres	2,327	2,295	32
URBAN				
Erosion & Sediment Controls	Acres	757	1,014	-257
Forest Buffers	Acres	43	0	43
Grass Buffers	Acres	120	T	120
Septic Denitrification	Systems	15,457	2,166	13,291
Street Sweeping	Acres	1,850	T	1,850
Stormwater Management - Filtration	Acres	9,731	0	9,731
Stormwater Management - Infiltration Practices	Acres	9,984	0	9,984
Stormwater Management - Wet Ponds & Wetlands	Acres	9,984	0	9,984
Urban Stream Restoration	Feet	4,000	T	4,000
Urban Sprawl Reduction	Acres	516	0	516
Urban Nutrient Management	Acres	20,388	0	20,388
FOREST				
Dirt & Gravel Road Practices	Feet	138,473	T	138,473
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	220	84	136
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight T = indicates that the practice is being implemented but tracking has not been completed				

Table A-4: Central Penn Watershed
Summary of Non-point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	3,933,712	1,596,731	-2,336,981	3,270,207	-663,505	-1,673,476
Forest	1,783,018	1,658,205	-124,813	1,788,945	5,927	-130,740
Urban/Developed	344,705	165,648	-179,057	316,447	-28,258	-150,799
Mixed Open	570,839	479,416	-91,423	542,073	-28,766	-62,657
Air Dep. to Water	75,098	58,706	-16,392	73,452	-1,646	-14,746
Septic Systems	189,149	135,877	-53,272	188,665	-484	-52,788
Totals	6,896,521	4,094,583	-2,801,938	6,179,789	-716,732	-2,085,206

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	252,444	111,912	-140,532	232,515	-19,929	-120,603
Forest	17,057	14,051	-3,006	16,973	-84	-2,922
Urban/Developed	25,554	7,939	-17,615	19,668	-5,886	-11,729
Mixed Open	43,551	38,121	-5,430	41,800	-1,751	-3,679
Air Dep. to Water	3,557	3,557	0	3,557	0	0
Septic Systems	0	0	0	0	0	0
Totals	342,163	175,580	-166,583	314,513	-27,650	-138,933

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	77,985	26,377	-51,608	62,149	-15,836	-35,772
Forest	25,953	25,831	-122	26,233	280	-402
Urban/Developed	4,131	887	-3,244	4,437	306	-3,550
Mixed Open	10,629	10,753	124	10,164	-465	589
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	118,698	63,848	-54,850	102,983	-15,715	-39,135

Upper West Branch Watershed

The Upper West Branch watershed is located in central Pennsylvania and includes portions of Cambria, Centre, Clearfield, and Indiana Counties. DEP Field operations for the watershed are through the North Central Regional Office.

Major tributaries within the watershed include the Upper West Branch of the Susquehanna River and Moshannon Creek. Overall, the Central Penn watershed is about 6 percent of Pennsylvania's Bay watershed. Forestland is the main land use within the watershed, followed by urban/developed lands, agriculture, and mixed open. The land use acres are listed in Table A-5.

Table A-5
Upper West Branch Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	737,260	1,152	82.4%
Agriculture	63,659	99	7.1%
Mixed Open	19,074	30	2.1%
Urban/Developed	68,331	107	7.6%
Open water	6,417	10	0.7%
Total	894,742	1,398	100%
Portion of Pennsylvania's Bay Watershed			6.2%

The 2010 nutrient and sediment goals for the Upper West Branch watershed are listed in Table A-6. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-6
Upper West Branch Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	4,079,476	106,208	44,050
Delivered Loads	4,087,000	58,500	20,230

The suite of non-point source management practices to reach these goals is listed in Table A-7. These include principally agricultural and urban management practices: with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-8.

Table A-7: Upper West Branch Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	51	36	15
Carbon Sequestration	Acres	6,123	T	6,123
Conservation (Farm) Plans	Acres	49,627	34,448	15,179
Conservation Tillage	Acres	19,577	7,853	11,724
Cover Crops (early)	Acres	17,669	T	17,669
Forest Buffers	Acres	3,310	8	3,302
Grass Buffers	Acres	106	15	90
Land Retirement	Acres	5,238	1,463	3,774
Managed Precision Agriculture	Acres	28,024	T	28,024
Mortality Composters	Systems	1	T	1
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	9,300	T	9,300
Nutrient Management	Acres	9,341	18,707	-9,365
Off Stream Watering w/Fencing	Acres	1,460	407	1,053
Off Stream Watering w/o Fencing	Acres	876	44	832
Precision Rotational Grazing	Acres	350	T	350
Rotational grazing	Acres	234	541	-307
Horse Pasture Management	Acres	4,000	T	4,000
Tree Planting	Acres	56	0	56
Yield Reserve	Acres	9,341	0	9,341
Ammonia Emission Reductions - Poultry	AEUs	18	0	18
Ammonia Emission Reductions - Swine	AEUs	79	0	79
Ammonia Emission Reductions - Dairy	AEUs	1,968	0	1,968
Precision Feeding - Dairy	AEUs	5,905	T	5,905
Phytase Feed additive - Swine	AEUs	155	T	155
Phytase Feed additive - Poultry	AEUs	21	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	3,000	1,500	1,500
Dirt & Gravel Road Practices	Feet	230,000	T	230,000
Forest Buffers	Acres	1,680	0	1,680
Non-Urban Stream Restoration	Feet	6,000	T	6,000
Nutrient Management	Acres	5,164	0	5,164
Tree Planting	Acres	2,175	2,175	0
URBAN				
Erosion & Sediment Controls	Acres	735	735	0
Forest Buffers	Acres	1,070	0	1,070
Grass Buffers	Acres	135	T	135
Septic Denitrification	Systems	11,329	6,078	5,251
Street Sweeping	Acres	2,530	T	2,530
Stormwater Management - Filtration	Acres	21,175	0	21,175
Stormwater Management - Infiltration Practices	Acres	21,175	0	21,175
Stormwater Management - Wet Ponds & Wetlands	Acres	21,174	0	21,174
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	237	0	237
Urban Nutrient Management	Acres	8,018	0	8,018
FOREST				
Dirt & Gravel Road Practices	Feet	230,000	T	230,000
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	101	71	30
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight T = indicates that the practice is being implemented but tracking has not been completed				

Table A-8: Upper West Branch Watershed
Summary of Non-Point Source Local Edge-0f-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	1,669,575	906,097	-763,478	1,319,424	-350,151	-413,327
Forest	2,609,358	2,409,400	-199,958	2,607,671	-1,687	-198,271
Urban/Developed	949,959	423,082	-526,877	785,611	-164,348	-362,529
Mixed Open	167,081	134,324	-32,757	139,532	-27,549	-5,208
Air Dep. To Water	75,173	59,668	-15,505	73,451	-1,722	-13,783
Septic Systems	227,539	146,902	-80,637	140,609	-86,930	6,293
Totals	5,698,685	4,079,473	-1,619,212	5,066,298	-632,387	-986,825

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	118,483	46,685	-71,798	89,339	-29,144	-42,654
Forest	28,448	22,680	-5,768	28,062	-386	-5,382
Urban/Developed	70,207	21,252	-48,955	49,692	-20,515	-28,440
Mixed Open	12,958	11,957	-1,001	11,441	-1,517	516
Air Dep. to Water	3,634	3,634	0	3,634	0	0
Septic Systems	0	0	0	0	0	0
Totals	233,730	106,208	-127,522	182,168	-51,562	-75,960

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	18,437	6,930	-11,507	13,628	-4,809	-6,698
Forest	35,395	35,270	-125	35,669	274	-399
Urban/Developed	5,119	970	-4,149	5,028	-91	-4,058
Mixed Open	1,264	880	-384	1,079	-185	-199
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	60,215	44,050	-16,165	55,404	-4,811	-11,354

Susquehannock Watershed

The Susquehannock watershed is located in north-central Pennsylvania and includes portions of Cameron, Centre, Clearfield, Clinton, Elk, Lycoming, McKean, Potter and Tioga Counties. DEP Field operations for the watershed are through the North Central Regional Office.

Major tributaries within the watershed include the Susquehannock Branch of the Susquehanna River and Pine Creek. Overall, the Susquehannock watershed is about 13 percent of Pennsylvania's Bay watershed. Forestland is the main land use within the watershed; followed by agriculture, mixed open and urban/developed lands. The land use acres are listed in Table A-9.

Table A-9
Susquehannock Watershed Land Uses

Distribution of Landuses			
Landuse	Acres	Square Miles	Percent of Area
Forest	1,666,023	2,603	86.9%
Agriculture	127,107	199	6.6%
Mixed Open	79,921	125	4.2%
Urban/Developed	33,510	52	1.7%
Open water	10,783	17	0.6%
Total	1,917,344	2,996	100%
Portion of Pennsylvania's Bay Watershed			13.2%

The 2010 nutrient and sediment goals for the Susquehannock watershed are listed in table A-10. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-10
Central Penn Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	7,333,074	173,902	99,330
Delivered Loads	6,835,000	95,800	45,610

The suite of non-point source management practices to reach these goals is listed in Table A-11. These include principally agricultural and urban management practices: with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-12.

Table A-11 Susquehannock Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	142	78	64
Carbon Sequestration	Acres	7,667	T	7,667
Conservation (Farm) Plans	Acres	95,273	55,055	40,218
Conservation Tillage	Acres	25,499	12,741	12,758
Cover Crops (early)	Acres	23,075	T	23,075
Forest Buffers	Acres	8,943	7	8,936
Grass Buffers	Acres	186	74	112
Land Retirement	Acres	5,129	2,562	2,567
Managed Precision Agriculture	Acres	45,800	T	45,800
Mortality Composters	Systems	1	T	1
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	11,800	T	11,800
Nutrient Management	Acres	15,267	32,871	-17,605
Off Stream Watering w/Fencing	Acres	9,470	673	8,797
Off Stream Watering w/o Fencing	Acres	5,682	150	5,532
Precision Rotational Grazing	Acres	2,273	T	2,273
Rotational grazing	Acres	1,515	1,150	365
Horse Pasture Management	Acres	10,000	T	10,000
Tree Planting	Acres	53	0	53
Yield Reserve	Acres	15,267	0	15,267
Ammonia Emission Reductions - Poultry	AEUs	203	0	203
Ammonia Emission Reductions - Swine	AEUs	973	0	973
Ammonia Emission Reductions - Dairy	AEUs	4,596	0	4,596
Precision Feeding - Dairy	AEUs	13,788	T	13,788
Phytase Feed additive - Swine	AEUs	1907	T	1,907
Phytase Feed additive - Poultry	AEUs	239	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	405	405	0
Dirt & Gravel Road Practices	Feet	600,000	T	600,000
Forest Buffers	Acres	680	4	676
Non-Urban Stream Restoration	Feet	27,250	T	27,250
Nutrient Management	Acres	17,374	0	17,374
Tree Planting	Acres	4,039	4,039	0
URBAN				
Erosion & Sediment Controls	Acres	1,023	1,024	-1
Forest Buffers	Acres	77	0	77
Grass Buffers	Acres	98	T	98
Septic Denitrification	Systems	8,553	1,301	7,252
Street Sweeping	Acres	1,190	T	1,190
Stormwater Management - Filtration	Acres	10,686	0	10,686
Stormwater Management - Infiltration Practices	Acres	10,686	0	10,686
Stormwater Management - Wet Ponds & Wetlands	Acres	10,686	0	10,686
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	428	0	428
Urban Nutrient Management	Acres	4,220	0	4,220
FOREST				
Dirt & Gravel Road Practices	Feet	600,000	T	600,000
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	158	133	25
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight T = indicates that the practice is being implemented but tracking has not been completed				

Table A-12: Susquehannock Watershed
Summary of Non-Point Source Local Edge-0f-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	3,110,313	1,446,033	-1,664,280	2,500,687	-609,626	-1,054,654
Forest	5,425,801	5,095,736	-330,065	5,451,064	25,263	-355,328
Urban/Developed	403,991	179,211	-224,780	343,808	-60,183	-164,597
Mixed Open	541,469	433,858	-107,611	509,403	-32,066	-75,545
Air Dep. to Water	130,578	103,169	-27,409	127,759	-2,819	-24,590
Septic Systems	118,545	75,067	-43,478	105,873	-12,672	-30,806
Totals	9,730,697	7,333,074	-2,397,623	9,038,594	-692,103	-1,705,520

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	209,937	77,917	-132,020	170,220	-39,717	-92,303
Forest	53,655	44,914	-8,741	53,472	-183	-8,558
Urban/Developed	30,095	8,676	-21,419	21,508	-8,587	-12,832
Mixed Open	43,269	36,289	-6,980	41,158	-2,111	-4,869
Air Dep. to Water	6,106	6,106	0	6,106	0	0
Septic Systems	0	0	0	0	0	0
Totals	343,062	173,902	-169,160	292,464	-50,598	-118,562

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	45,926	14,847	-31,079	32,933	-12,993	-18,086
Forest	75,872	76,130	258	76,848	976	-718
Urban/Developed	4,306	800	-3,506	4,298	-8	-3,498
Mixed Open	8,463	7,553	-910	8,007	-456	-454
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	134,567	99,330	-35,237	122,086	-12,481	-22,756

Lower North Branch Watershed

The Lower North Branch watershed is located in central Pennsylvania and includes portions of Columbia, Luzerne, Lycoming, Montour, Northumberland, Schuylkill and Sullivan Counties. DEP Field operations for the watershed are through the North Central Regional Office.

Major tributaries within the watershed include Fishing and Catawissa Creeks. Overall, the Central Penn watershed is about 5 percent of Pennsylvania's Bay watershed. Forestland is the main land use within the watershed; followed by agriculture, mixed open and urban/developed lands. The land use acres are listed in Table A-13.

Table A-13
Lower North Branch Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	371,272	580	54.0%
Agriculture	163,966	256	23.9%
Mixed Open	84,820	133	12.3%
Urban/Developed	55,102	86	8.0%
Open water	11,789	18	1.7%
Total	686,950	1,073	100%
Portion of Pennsylvania's Bay Watershed			4.7%

The 2010 nutrient and sediment goals for the Lower North Branch watershed are listed in Table A-14. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-14
Central Penn Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	3,695,460	195,896	59,062
Delivered Loads	3,373,000	107,900	27,120

The suite of non-point source management practices to reach these goals is listed in Table A-15. These include principally agricultural and urban management practices: with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-16.

Table A-15: Lower North Branch Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	166	114	52
Carbon Sequestration	Acres	23,465	T	23,465
Conservation (Farm) Plans	Acres	127,744	137,016	-9,272
Conservation Tillage	Acres	80,050	48,275	31,775
Cover Crops (early)	Acres	75,810	T	75,810
Forest Buffers	Acres	5,637	475	5,162
Grass Buffers	Acres	475	9	466
Land Retirement	Acres	22,114	14,433	7,681
Managed Precision Agriculture	Acres	71,877	T	71,877
Mortality Composters	Systems	2	T	2
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	36,335	T	36,335
Nutrient Management	Acres	24,478	46,433	-21,955
Off Stream Watering w/Fencing	Acres	5,296	440	4,856
Off Stream Watering w/o Fencing	Acres	3,177	34	3,143
Precision Rotational Grazing	Acres	1,271	T	1,271
Rotational grazing	Acres	847	394	453
Horse Pasture Management	Acres	9,000	T	9,000
Tree Planting	Acres	271	0	271
Yield Reserve	Acres	24,478	0	24,478
Ammonia Emission Reductions - Poultry	AEUs	3,472	0	3,472
Ammonia Emission Reductions - Swine	AEUs	6,835	0	6,835
Ammonia Emission Reductions - Dairy	AEUs	2,078	0	2,078
Precision Feeding - Dairy	AEUs	6,233	T	6,233
Phytase Feed additive - Swine	AEUs	13397	T	13,397
Phytase Feed additive - Poultry	AEUs	4,085	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	1,482	750	732
Dirt & Gravel Road Practices	Feet	100,000	T	100,000
Forest Buffers	Acres	364	0	364
Non-Urban Stream Restoration	Feet	12,000	T	12,000
Nutrient Management	Acres	93,423	0	93,423
Tree Planting	Acres	1,195	1,213	-18
URBAN				
Erosion & Sediment Controls	Acres	983	1,016	-33
Forest Buffers	Acres	59	0	59
Grass Buffers	Acres	107	T	107
Septic Denitrification	Systems	16,717	1,217	15,500
Street Sweeping	Acres	1,850	T	1,850
Stormwater Management - Filtration	Acres	16,905	0	16,905
Stormwater Management - Infiltration Practices	Acres	16,905	0	16,905
Stormwater Management - Wet Ponds & Wetlands	Acres	16,905	0	16,905
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	96	0	96
Urban Nutrient Management	Acres	33,700	0	33,700
FOREST				
Dirt & Gravel Road Practices	Feet	100,000	T	100,000
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	249	52	196
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight T = indicates that the practice is being implemented but tracking has not been completed				

Table A-16: Lower North Branch Watershed
Summary of Non-Point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	4,326,632	1,455,235	-2,871,397	3,288,909	-1,037,723	-1,833,674
Forest	1,153,018	1,066,175	-86,843	1,154,471	1,453	-88,296
Urban/Developed	768,649	326,006	-442,643	654,587	-114,062	-328,581
Mixed Open	679,151	620,441	-58,710	661,450	-17,701	-41,009
Air Dep. to Water	137,022	105,666	-31,356	133,859	-3,163	-28,193
Septic Systems	213,154	121,937	-91,217	198,390	-14,764	-76,453
Totals	7,277,626	3,695,460	-3,582,166	6,091,666	-1,185,960	-2,396,206

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	254,972	121,243	-133,729	205,096	-49,876	-83,853
Forest	10,389	8,444	-1,945	10,303	-86	-1,859
Urban/Developed	52,711	14,351	-38,360	37,960	-14,751	-23,609
Mixed Open	47,530	45,181	-2,349	47,243	-287	-2,062
Air Dep. to Water	6,677	6,677	0	6,677	0	0
Septic Systems	0	0	0	0	0	0
Totals	372,279	195,896	-176,383	307,279	-65,000	-111,383

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	96,690	29,872	-66,818	65,564	-31,126	-35,692
Forest	18,702	18,268	-434	18,829	127	-561
Urban/Developed	6,601	1,331	-5,270	6,643	42	-5,312
Mixed Open	8,258	9,591	1,333	8,137	-121	1,454
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	130,251	59,062	-71,189	99,173	-31,078	-40,111

Big Bend Watershed

The Big Bend watershed is located in central Pennsylvania and includes portions of Bradford, Centre, Clinton, Columbia, Lycoming, Montour, Northumberland, Sullivan, Tioga, Union and Wyoming Counties. DEP Field operations for the watershed are through the North Central Regional Office.

Major tributaries within the watershed include Loyalsock, Muncy, Buffalo and Chillisquoque Creeks. Overall, the Central Penn watershed is about 8 percent of Pennsylvania's Bay watershed. Forestland is the main land use within the watershed; followed by agriculture, mixed open and urban/developed lands. The land use acres are listed in Table A-17.

Table A-17
Big Bend Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	783,599	1,224	67.2%
Agriculture	196,578	307	16.9%
Mixed Open	138,522	216	11.9%
Urban/Developed	36,645	57	3.1%
Open water	10,992	17	0.9%
Total	1,166,337	1,822	100%
		Portion of Pennsylvania's Bay Watershed	8.1%

The 2010 nutrient and sediment goals for the Big Bend watershed are listed in table A-18. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-18
Big Bend Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	5,359,929	278,015	107,735
Delivered Loads	5,032,000	153,200	49,470

The suite of non-point source management practices to reach these goals is listed in Table A-19. These include principally agricultural and urban management practices: with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-20.

Table A-19 Big Bend Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	248	139	109
Carbon Sequestration	Acres	22,607	T	22,607
Conservation (Farm) Plans	Acres	148,431	134,605	13,826
Conservation Tillage	Acres	78,366	31,251	47,115
Cover Crops (early)	Acres	71,484	T	71,484
Forest Buffers	Acres	7,808	114	7,694
Grass Buffers	Acres	421	100	321
Land Retirement	Acres	18,542	8,925	9,617
Managed Precision Agriculture	Acres	80,746	T	80,746
Mortality Composters	Systems	2	T	2
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	34,680	T	34,680
Nutrient Management	Acres	27,054	49,687	-22,633
Off Stream Watering w/Fencing	Acres	6,858	1,257	5,601
Off Stream Watering w/o Fencing	Acres	4,115	231	3,884
Precision Rotational Grazing	Acres	1,646	T	1,646
Rotational grazing	Acres	1,097	546	551
Horse Pasture Management	Acres	12,000	T	12,000
Tree Planting	Acres	159	0	159
Yield Reserve	Acres	26,915	0	26,915
Ammonia Emission Reductions - Poultry	AEUs	2,704	0	2,704
Ammonia Emission Reductions - Swine	AEUs	6,202	0	6,202
Ammonia Emission Reductions - Dairy	AEUs	5,933	0	5,933
Precision Feeding - Dairy	AEUs	17,799	T	17,799
Phytase Feed additive - Swine	AEUs	12155	T	12,155
Phytase Feed additive - Poultry	AEUs	3,181	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	714	356	358
Dirt & Gravel Road Practices	Feet	360,000	T	360,000
Forest Buffers	Acres	631	1	630
Non-Urban Stream Restoration	Feet	72,000	T	72,000
Nutrient Management	Acres	144,931	0	144,931
Tree Planting	Acres	2,639	2,634	5
URBAN				
Erosion & Sediment Controls	Acres	536	534	2
Forest Buffers	Acres	47	0	47
Grass Buffers	Acres	86	T	86
Septic Denitrification	Systems	24,683	761	23,922
Street Sweeping	Acres	1,270	T	1,270
Stormwater Management - Filtration	Acres	11,719	0	11,719
Stormwater Management - Infiltration Practices	Acres	11,719	0	11,719
Stormwater Management - Wet Ponds & Wetlands	Acres	11,719	0	11,719
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	376	0	376
Urban Nutrient Management	Acres	23,407	0	23,407
FOREST				
Dirt & Gravel Road Practices	Feet	360,000	T	360,000
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	278	85	193
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight T = indicates that the practice is being implemented but tracking has not been completed				

Table A-20: Big Bend Watershed
Summary of Non-Point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	5,411,810	1,967,604	-3,444,206	4,334,696	-1,077,114	-2,367,092
Forest	2,295,612	2,193,278	-102,334	2,338,321	42,709	-145,043
Urban/Developed	418,236	183,190	-235,046	366,404	-51,832	-183,214
Mixed Open	838,140	742,284	-95,856	864,800	26,660	-122,516
Air Dep. to Water	126,049	98,374	-27,675	123,034	-3,015	-24,660
Septic Systems	291,291	175,199	-116,092	300,460	9,169	-125,261
Totals	9,381,138	5,359,929	-4,021,209	8,327,715	-1,053,423	-2,967,786

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	324,369	182,966	-141,403	270,943	-53,426	-87,977
Forest	23,516	19,791	-3,725	23,719	203	-3,928
Urban/Developed	31,112	8,891	-22,221	23,015	-8,097	-14,124
Mixed Open	65,450	60,141	-5,309	68,328	2,878	-8,187
Air Dep. to Water	6,226	6,226	0	6,226	0	0
Septic Systems	0	0	0	0	0	0
Totals	450,673	278,015	-172,658	392,231	-58,442	-114,216

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	140,558	40,739	-99,819	107,667	-32,891	-66,928
Forest	36,147	36,862	715	37,099	952	-237
Urban/Developed	8,412	1,742	-6,670	8,846	434	-7,104
Mixed Open	24,780	28,392	3,612	26,061	1,281	2,331
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	209,897	107,735	-102,162	179,673	-30,224	-71,938

Bradford/Tioga Watershed

The Bradford/Tioga watershed is located in north-central Pennsylvania and includes portions of Bradford, Lycoming, Potter, Sullivan, Susquehanna, Tioga and Wyoming Counties. DEP Field operations for the watershed are through the North Central Regional Office.

Major tributaries within the watershed include Towanda, Sugar, Wysox, and Wyalusing Creeks. Overall, the Central Penn watershed is about 9 percent of Pennsylvania's Bay watershed. Forestland is the main land use within the watershed; followed by agriculture, mixed open and urban/developed lands. The land use acres are listed in Table A-21.

Table A-21
Bradford/Tioga Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	774,501	1,210	58.8%
Agriculture	343,140	536	26.1%
Mixed Open	149,774	234	11.4%
Urban/Developed	35,196	55	2.7%
Open water	13,771	22	1.0%
Total	1,316,382	2,057	100%
		Portion of Pennsylvania's Bay Watershed	9.1%

The 2010 nutrient and sediment goals for the Bradford/Tioga watershed are listed in table A-22. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-22
Bradford/Tioga Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	6,926,540	264,106	81,242
Delivered Loads	4,518,000	145,500	37,300

The suite of non-point source management practices to reach these goals is listed in Table A-23. These include principally agricultural and urban management practices: with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-24.

Table A-23: Bradford/Tioga Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	425	301	124
Carbon Sequestration	Acres	15,916	T	15,916
Conservation (Farm) Plans	Acres	248,685	93,319	155,366
Conservation Tillage	Acres	53,160	14,854	38,306
Cover Crops (early)	Acres	48,028	T	48,028
Forest Buffers	Acres	7,924	366	7,557
Grass Buffers	Acres	245	8	237
Land Retirement	Acres	14,373	5,471	8,902
Managed Precision Agriculture	Acres	122,366	T	122,366
Mortality Composters	Systems	4	T	4
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	24,285	T	24,285
Nutrient Management	Acres	40,789	83,894	-43,105
Off Stream Watering w/Fencing	Acres	22,797	507	22,290
Off Stream Watering w/o Fencing	Acres	13,678	317	13,361
Precision Rotational Grazing	Acres	5,471	T	5,471
Rotational grazing	Acres	3,648	1,362	2,286
Horse Pasture Management	Acres	6,000	T	6,000
Tree Planting	Acres	326	0	326
Yield Reserve	Acres	40,789	0	40,789
Ammonia Emission Reductions - Poultry	AEUs	363	0	363
Ammonia Emission Reductions - Swine	AEUs	3,390	0	3,390
Ammonia Emission Reductions - Dairy	AEUs	15,299	0	15,299
Precision Feeding - Dairy	AEUs	45,898	T	45,898
Phytase Feed additive - Swine	AEUs	6645	T	6,645
Phytase Feed additive - Poultry	AEUs	427	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	458	229	229
Dirt & Gravel Road Practices	Feet	160,000	T	160,000
Forest Buffers	Acres	536	0	536
Non-Urban Stream Restoration	Feet	64,000	T	64,000
Nutrient Management	Acres	161,377	0	161,377
Tree Planting	Acres	2,541	2,537	4
URBAN				
Erosion & Sediment Controls	Acres	673	673	0
Forest Buffers	Acres	29	0	29
Grass Buffers	Acres	60	T	60
Septic Denitrification	Systems	12,920	1,443	11,477
Street Sweeping	Acres	1,240	T	1,240
Stormwater Management - Filtration	Acres	11,221	0	11,221
Stormwater Management - Infiltration Practices	Acres	11,221	0	11,221
Stormwater Management - Wet Ponds & Wetlands	Acres	11,221	0	11,221
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	339	0	339
Urban Nutrient Management	Acres	22,318	0	22,318
FOREST				
Dirt & Gravel Road Practices	Feet	160,000	T	160,000
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	419	93	325
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight				
T = indicates that the practice is being implemented but tracking has not been completed				

Table A-24: Bradford/Tioga Watershed
Summary of Non-Point Source Local edge-0f-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	8,636,154	3,266,073	-5,370,081	6,098,354	-2,537,800	-2,832,281
Forest	2,333,937	2,454,692	120,755	2,509,371	175,434	-54,679
Urban/Developed	403,043	175,757	-227,286	344,298	-58,745	-168,541
Mixed Open	897,294	802,396	-94,898	940,973	43,679	-138,577
Air Dep. to Water	158,841	126,979	-31,862	155,739	-3,102	-28,760
Septic Systems	166,484	100,643	-65,841	153,802	-12,682	-53,159
Totals	12,595,753	6,926,540	-5,669,213	10,202,537	-2,393,216	-3,275,997

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	610,480	171,876	-438,604	430,127	-180,353	-258,251
Forest	19,761	18,509	-1,252	21,038	1,277	-2,529
Urban/Developed	28,057	7,553	-20,504	20,373	-7,684	-12,820
Mixed Open	64,246	58,369	-5,877	69,143	4,897	-10,774
Air Dep. to Water	7,799	7,799	0	7,799	0	0
Septic Systems	0	0	0	0	0	0
Totals	730,343	264,106	-466,237	548,480	-181,863	-284,374

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	91,844	34,802	-57,042	65,999	-25,845	-31,197
Forest	31,844	34,923	3,079	34,355	2,511	568
Urban/Developed	3,005	599	-2,406	3,076	71	-2,477
Mixed Open	9,764	10,918	1,154	10,428	664	490
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	136457	81242	-55215	113858	-22599	-32616

Upper Susquehanna Watershed

The Upper Susquehanna watershed is located in northeast Pennsylvania and includes portions of Bradford, Lackawanna, Luzerne, Sullivan, Susquehanna, Wayne and Wyoming Counties. DEP Field operations for the watershed are through the North East Regional Office.

Major tributaries within the watershed include Tuckhannock, Meshoppen and Bowman Creeks. Overall, the Central Penn watershed is about 6 percent of Pennsylvania's Bay watershed. Forestland is the main land use within the watershed; followed by agriculture, mixed open and urban/developed lands. The land use acres are listed in Table A-25.

Table A-25
Upper Susquehanna Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	497,077	777	63.0%
Agriculture	126,961	198	16.1%
Mixed Open	90,973	142	11.5%
Urban/Developed	61,532	96	7.8%
Open water	12,755	20	1.6%
Total	789,297	1,233	100%
Portion of Pennsylvania's Bay Watershed			5.5%

The 2010 nutrient and sediment goals for the Upper Susquehanna watershed are listed in Table A-26. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-26
Upper Susquehanna Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	3,842,537	135,022	43,925
Delivered Loads	2,735,000	74,400	20,170

The suite of non-point source management practices to reach these goals is listed in Table A-27. These include principally agricultural and urban management practices: with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-28.

Table A-27: Upper Susquehanna Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	147	131	16
Carbon Sequestration	Acres	6,694	T	6,694
Conservation (Farm) Plans	Acres	84,611	33,148	51,463
Conservation Tillage	Acres	22,296	9,780	12,517
Cover Crops (early)	Acres	20,090	T	20,090
Forest Buffers	Acres	5,511	254	5,257
Grass Buffers	Acres	115	3	113
Land Retirement	Acres	5,720	1,825	3,895
Managed Precision Agriculture	Acres	42,168	T	42,168
Mortality Composters	Systems	2	T	2
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	10,248	T	10,248
Nutrient Management	Acres	14,074	21,547	-7,473
Off Stream Watering w/Fencing	Acres	7,157	235	6,921
Off Stream Watering w/o Fencing	Acres	4,294	15	4,279
Precision Rotational Grazing	Acres	1,431	T	1,431
Rotational grazing	Acres	1,431	456	975
Horse Pasture Management	Acres	2,925	T	2,925
Tree Planting	Acres	110	0	110
Yield Reserve	Acres	14,056	0	14,056
Ammonia Emission Reductions - Poultry	AEUs	24	0	24
Ammonia Emission Reductions - Swine	AEUs	666	0	666
Ammonia Emission Reductions - Dairy	AEUs	5,910	0	5,910
Precision Feeding - Dairy	AEUs	17,730	T	17,730
Phytase Feed additive - Swine	AEUs	1306	T	1,306
Phytase Feed additive - Poultry	AEUs	29	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	1,628	819	809
Dirt & Gravel Road Practices	Feet	400,000	T	400,000
Forest Buffers	Acres	451	0	451
Non-Urban Stream Restoration	Feet	50,000	T	50,000
Nutrient Management	Acres	95,165	0	95,165
Tree Planting	Acres	1,398	1,398	0
URBAN				
Erosion & Sediment Controls	Acres	359	361	-2
Forest Buffers	Acres	96	0	96
Grass Buffers	Acres	143	T	143
Septic Denitrification	Systems	14,159	708	13,451
Street Sweeping	Acres	1,808	T	1,808
Stormwater Management - Filtration	Acres	19,469	0	19,469
Stormwater Management - Infiltration Practices	Acres	19,469	0	19,469
Stormwater Management - Wet Ponds & Wetlands	Acres	19,469	0	19,469
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	770	0	770
Urban Nutrient Management	Acres	41,973	0	41,973
FOREST				
Dirt & Gravel Road Practices	Feet	400,000	T	400,000
Forest Harvesting Practices	Acres	515	0	515
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	145	41	103
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight				
T = indicates that the practice is being implemented but tracking has not been completed				

Table A-28: Upper Susquehanna Watershed
Summary of Non-Point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	3,462,143	1,018,491	-2,443,652	2,401,520	-1,060,623	-1,383,029
Forest	1,707,364	1,771,105	63,741	1,825,872	118,508	-54,767
Urban/Developed	777,211	334,637	-442,574	659,929	-117,282	-325,292
Mixed Open	571,266	495,760	-75,506	599,608	28,342	-103,848
Air Dep. to Water	153,804	123,494	-30,310	150,618	-3,186	-27,124
Septic Systems	173,695	99,050	-74,645	164,512	-9,183	-65,462
Totals	6,845,483	3,842,537	-3,002,946	5,802,059	-1,043,424	-1,959,522

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	250,699	63,385	-187,314	163,698	-87,001	-100,313
Forest	14,497	13,161	-1,336	15,365	868	-2,204
Urban/Developed	53,936	14,712	-39,224	39,043	-14,893	-24,331
Mixed Open	41,090	36,541	-4,549	44,345	3,255	-7,804
Air Dep. to Water	7,223	7,223	0	7,223	0	0
Septic Systems	0	0	0	0	0	0
Totals	367,445	135,022	-232,423	269,674	-97,771	-134,652

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	35,982	12,213	-23,769	25,377	-10,605	-13,164
Forest	21,652	23,444	1,792	23,292	1,640	152
Urban/Developed	6,386	1,324	-5,062	6,533	147	-5,209
Mixed Open	6,458	6,944	486	6,904	446	40
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	70,478	43,925	-26,553	62,106	-8,372	-18,181

Wyoming Valley Watershed

The Wyoming Valley watershed is located in northeast Pennsylvania and includes portions of Columbia and Luzerne Counties. DEP Field operations for the watershed are through the North East Regional Office.

Major tributaries within the watershed include Nescopeck and Wapwallopen Creeks. Overall, the Wyoming Valley is about 3 percent of Pennsylvania's Bay watershed. Forestland is the main land use within the watershed followed by urban/developed, agriculture, and mixed open lands. The land use acres are listed in Table A-29.

Table A-29
Wyoming Valley Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	272,214	425	63.8%
Agriculture	49,163	77	11.5%
Mixed Open	44,059	69	10.3%
Urban/Developed	55,018	86	12.9%
Open water	6,039	9	1.4%
Total	426,493	666	100%
Portion of Pennsylvania's Bay Watershed			2.9%

The 2010 nutrient and sediment goals for the Wyoming Valley watershed are listed in Table A 30. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-30
Wyoming Valley Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	2,036,591	77,980	21,173
Delivered Loads	1,813,000	43,000	12,480

The suite of non-point source management practices to reach these goals is listed in Table A-31. These include principally agricultural and urban management practices: with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-32.

Table A-31 Wyoming Valley Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	36	25	11
Carbon Sequestration	Acres	6,448	T	6,448
Conservation (Farm) Plans	Acres	39,939	42,581	-2,641
Conservation Tillage	Acres	19,882	10,704	9,178
Cover Crops (early)	Acres	18,457	T	18,457
Forest Buffers	Acres	5,151	143	5,008
Grass Buffers	Acres	87	2	84
Land Retirement	Acres	6,171	4,133	2,038
Managed Precision Agriculture	Acres	21,818	T	21,818
Mortality Composters	Systems	1	T	1
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	9,883	T	9,883
Nutrient Management	Acres	7,273	9,848	-2,575
Off Stream Watering w/Fencing	Acres	1,596	128	1,467
Off Stream Watering w/o Fencing	Acres	958	10	948
Precision Rotational Grazing	Acres	317	T	317
Rotational grazing	Acres	319	140	179
Horse Pasture Management	Acres	1,758	T	1,758
Tree Planting	Acres	85	0	85
Yield Reserve	Acres	7,273	0	7,273
Ammonia Emission Reductions - Poultry	AEUs	280	0	280
Ammonia Emission Reductions - Swine	AEUs	864	0	864
Ammonia Emission Reductions - Dairy	AEUs	912	0	912
Precision Feeding - Dairy	AEUs	2,736	T	2,736
Phytase Feed additive - Swine	AEUs	1694	T	1,694
Phytase Feed additive - Poultry	AEUs	329	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	3,224	797	2,427
Dirt & Gravel Road Practices	Feet	100,000	T	100,000
Forest Buffers	Acres	581	0	581
Non-Urban Stream Restoration	Feet	50,000	T	50,000
Nutrient Management	Acres	43,744	0	43,744
Tree Planting	Acres	648	643	5
URBAN				
Erosion & Sediment Controls	Acres	708	702	6
Forest Buffers	Acres	327	0	327
Grass Buffers	Acres	86	T	86
Septic Denitrification	Systems	18,966	1,203	17,763
Street Sweeping	Acres	2,244	T	2,244
Stormwater Management - Filtration	Acres	17,309	0	17,309
Stormwater Management - Infiltration Practices	Acres	17,309	0	17,309
Stormwater Management - Wet Ponds & Wetlands	Acres	17,309	0	17,309
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	8	0	8
Urban Nutrient Management	Acres	31,130	0	31,130
FOREST				
Dirt & Gravel Road Practices	Feet	100,000	T	100,000
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	80	19	61
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight				
T = indicates that the practice is being implemented but tracking has not been completed				

Table A-32: Wyoming Valley Watershed
Summary of Non-Point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	1,234,074	429,822	-804,252	927,658	-306,416	-497,836
Forest	882,612	821,658	-60,954	877,686	-4,926	-56,028
Urban/Developed	757,875	311,694	-446,181	631,953	-125,922	-320,259
Mixed Open	364,868	294,190	-70,678	349,192	-15,676	-55,002
Air Dep. to Water	70,231	54,777	-15,454	68,608	-1,623	-13,831
Septic Systems	237,026	124,450	-112,576	220,200	-16,826	-95,750
Totals	3,546,686	2,036,591	-1,510,095	3,075,297	-471,389	-1,038,706

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	75,440	32,886	-42,554	56,267	-19,173	-23,381
Forest	7,952	6,522	-1,430	7,833	-119	-1,311
Urban/Developed	51,652	13,908	-37,744	36,627	-15,025	-22,719
Mixed Open	25,311	21,243	-4,068	24,769	-542	-3,526
Air Dep. to Water	3,421	3,421	0	3,421	0	0
Septic Systems	0	0	0	0	0	0
Totals	163,776	77,980	-85,796	128,917	-34,859	-50,937

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	26,937	8,203	-18,734	17,349	-9,588	-9,146
Forest	14,166	13,895	-271	14,163	-3	-268
Urban/Developed	5,505	1,061	-4,444	5,464	-41	-4,403
Mixed Open	3,893	4,014	121	3,768	-125	246
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	50,501	27,173	-23,328	40,744	-9,757	-13,571

Lackawanna Watershed

The Lackawanna watershed is located in northeast Pennsylvania and includes portions of Lackawanna, Luzerne, Susquehanna and Wayne Counties. DEP Field operations for the watershed are through the North East Regional Office.

The watershed includes the Lackawanna River. Overall, the Lackawanna watershed is about 2 percent of Pennsylvania's Bay watershed. Forestland is the main land use within the watershed followed by urban/developed, agriculture, and mixed open lands. The land use acres are listed in Table A-33.

Table A-33
Lackawanna Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	143,116	224	62.5%
Agriculture	17,433	27	7.6%
Mixed Open	16,049	25	7.0%
Urban/Developed	49,176	77	21.5%
Open water	3,388	5	1.5%
Total	229,162	358	100%
Portion of Pennsylvania's Bay Watershed			1.6%

The 2010 nutrient and sediment goals for the Lackawanna watershed are listed in table A-34. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-34
Lackawanna Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	1,016,676	27,016	10,488
Delivered Loads	787,000	14,900	4,820

The suite of non-point source management practices to reach these goals is listed in Table A-35. These include principally agricultural and urban management practices with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-36.

Table A-35 Lackawanna Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	23	20	3
Carbon Sequestration	Acres	391	T	391
Conservation (Farm) Plans	Acres	6,049	4,629	1,420
Conservation Tillage	Acres	1,128	1,716	-587
Cover Crops (early)	Acres	903	T	903
Forest Buffers	Acres	1,457	46	1,411
Grass Buffers	Acres	7	0	7
Land Retirement	Acres	323	206	117
Managed Precision Agriculture	Acres	2,980	T	2,980
Mortality Composters	Systems	1	T	1
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	600	T	600
Nutrient Management	Acres	993	2,198	-1,204
Off Stream Watering w/Fencing	Acres	541	25	516
Off Stream Watering w/o Fencing	Acres	324	3	322
Precision Rotational Grazing	Acres	108	T	108
Rotational grazing	Acres	108	53	55
Horse Pasture Management	Acres	1,755	T	1,755
Tree Planting	Acres	19	0	19
Yield Reserve	Acres	993	0	993
Ammonia Emission Reductions - Poultry	AEUs	6	0	6
Ammonia Emission Reductions - Swine	AEUs	46	0	46
Ammonia Emission Reductions - Dairy	AEUs	895	0	895
Precision Feeding - Dairy	AEUs	2,685	T	2,685
Phytase Feed additive - Swine	AEUs	91	T	91
Phytase Feed additive - Poultry	AEUs	7	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	1,434	718	716
Dirt & Gravel Road Practices	Feet	80,000	T	80,000
Forest Buffers	Acres	2,461	0	2,461
Non-Urban Stream Restoration	Feet	25,000	T	25,000
Nutrient Management	Acres	11,640	0	11,640
Tree Planting	Acres	247	248	-1
URBAN				
Erosion & Sediment Controls	Acres	279	279	0
Forest Buffers	Acres	2,142	0	2,142
Grass Buffers	Acres	107	T	107
Septic Denitrification	Systems	12,043	682	11,361
Street Sweeping	Acres	1,667	T	1,667
Stormwater Management - Filtration	Acres	14,733	0	14,733
Stormwater Management - Infiltration Practices	Acres	14,733	0	14,733
Stormwater Management - Wet Ponds & Wetlands	Acres	14,733	0	14,733
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	3	0	3
Urban Nutrient Management	Acres	28,805	0	28,805
FOREST				
Dirt & Gravel Road Practices	Feet	80,000	T	80,000
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	12	6	6

AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight
T = indicates that the practice is being implemented but tracking has not been completed

Table A-36: Lackawanna Watershed
Summary of Non-Point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	693,580	76,170	-617,410	326,944	-366,636	-250,774
Forest	453,109	504,573	51,464	497,972	44,863	6,601
Urban/Developed	622,162	246,976	-375,186	522,626	-99,536	-275,650
Mixed Open	100,007	74,305	-25,702	107,418	7,411	-33,113
Air Dep. to Water	39,757	31,830	-7,927	38,908	-849	-7,078
Septic Systems	159,967	82,822	-77,145	144,816	-15,151	-61,994
Totals	2,068,582	1,016,676	-1,051,906	1,638,684	-429,898	-622,008

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	46,547	4,447	-42,100	21,439	-25,108	-16,992
Forest	4,067	4,015	-52	4,429	362	-414
Urban/Developed	42,988	11,102	-31,886	30,849	-12,139	-19,747
Mixed Open	7,115	5,533	-1,582	7,877	762	-2,344
Air Dep. to Water	1,919	1,919	0	1,919	0	0
Septic Systems	0	0	0	0	0	0
Totals	102,636	27,016	-75,620	66,513	-36,123	-39,497

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	7,112	937	-6,175	3,286	-3,826	-2,349
Forest	6,508	7,652	1,144	7,193	685	459
Urban/Developed	4,771	891	-3,880	4,826	55	-3,935
Mixed Open	1,085	1,008	-77	1,188	103	-180
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	19,476	10,488	-8,988	16,493	-2,983	-6,005

Lower Susquehanna East Watershed

The Lower Susquehanna East watershed is located in south central Pennsylvania and includes portions of Berks, Chester, Dauphin, Juniata, Lancaster, Lebanon, Northumberland, Perry, Schuylkill, and Snyder Counties. DEP Field operations for the watershed are through the South Central Regional Office.

The major tributaries with the watershed include Swatara, Chickies, Pequea and Octararo Creeks and the Conestoga River. Overall, the Lower Susquehanna East watershed is about 11 percent of Pennsylvania's Bay watershed. Agriculture is the main land use within the watershed followed by forest, urban/developed and mixed open lands. The land use acres are listed in Table A-37.

Table A-37
Lower Susquehanna East Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	570,596	892	35.6%
Agriculture	648,067	1,013	40.4%
Mixed Open	159,394	249	9.9%
Urban/Developed	176,486	276	11.0%
Open water	48,483	76	3.0%
Total	1,603,025	2,505	100%
Portion of Pennsylvania's Bay Watershed			11.1%

The 2010 nutrient and sediment goals for the Lower Susquehanna East watershed are listed in table A-38. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-38
Lower Susquehanna East 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	9,809,802	616,687	202,541
Delivered Loads	9,259,000	367,500	104,770

The suite of non-point source management practices to reach these goals is listed in Table A-39. These include principally agricultural and urban management practices with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-40.

Table A-39 Lower Susquehanna East Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	1,842	1,332	509
Carbon Sequestration	Acres	67,380	T	67,380
Conservation (Farm) Plans	Acres	476,206	214,542	261,663
Conservation Tillage	Acres	264,971	96,219	168,752
Cover Crops (early)	Acres	245,727	T	245,727
Forest Buffers	Acres	13,747	779	12,968
Grass Buffers	Acres	12,712	74	12,638
Land Retirement	Acres	66,308	7,542	58,766
Managed Precision Agriculture	Acres	235,523	T	235,523
Mortality Composters	Systems	8	T	8
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	115,860	T	115,860
Nutrient Management	Acres	80,951	334,953	-254,002
Off Stream Watering w/Fencing	Acres	39,390	1,899	37,491
Off Stream Watering w/o Fencing	Acres	23,634	225	23,409
Precision Rotational Grazing	Acres	9,454	T	9,454
Rotational grazing	Acres	6,302	1,690	4,612
Horse Pasture Management	Acres	50,000	T	50,000
Tree Planting	Acres	544	0	544
Yield Reserve	Acres	80,951	0	80,951
Ammonia Emission Reductions - Poultry	AEUs	81,209	0	81,209
Ammonia Emission Reductions - Swine	AEUs	45,708	0	45,708
Ammonia Emission Reductions - Dairy	AEUs	54,290	0	54,290
Precision Feeding - Dairy	AEUs	162,870	T	162,870
Phytase Feed additive - Swine	AEUs	89589	T	89,589
Phytase Feed additive - Poultry	AEUs	95,540	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	282	281	1
Dirt & Gravel Road Practices	Feet	202,606	T	202,606
Forest Buffers	Acres	651	18	633
Non-Urban Stream Restoration	Feet	27,200	T	27,200
Nutrient Management	Acres	188,419	0	188,419
Tree Planting	Acres	1,512	1,546	-34
URBAN				
Erosion & Sediment Controls	Acres	5,408	6,304	-896
Forest Buffers	Acres	149	0	149
Grass Buffers	Acres	3,243	T	3,243
Septic Denitrification	Systems	55,361	2,311	53,050
Street Sweeping	Acres	6,799	T	6,799
Stormwater Management - Filtration	Acres	52,929	0	52,929
Stormwater Management - Infiltration Practices	Acres	52,929	0	52,929
Stormwater Management - Wet Ponds & Wetlands	Acres	52,929	0	52,929
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	2,063	0	2,063
Urban Nutrient Management	Acres	99,158	0	99,158
FOREST				
Dirt & Gravel Road Practices	Feet	145,627	T	145,627
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	0	0	0
MULTIPLE LANDUSE				
Wetland Restoration	Acres	750	80	670
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight				
T = indicates that the practice is being implemented but tracking has not been completed				

Table A-40: Lower Susquehanna East Watershed
Summary of Non-Point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	19,618,067	4,878,156	-14,739,911	14,414,063	-5,204,004	-9,535,907
Forest	1,374,904	1,291,425	-83,479	1,406,278	31,374	-114,853
Urban/Developed	2,068,217	999,573	-1,068,644	1,938,180	-130,037	-938,607
Mixed Open	1,138,025	1,263,060	125,035	1,128,481	-9,544	134,579
Air Dep. to Water	534,567	408,758	-125,809	526,469	-8,098	-117,711
Septic Systems	1,086,217	968,830	-117,387	1,225,993	139,776	-257,163
Totals	25,819,997	9,809,802	-16,010,195	20,639,464	-5,180,533	-10,829,662

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	1,414,552	424,995	-989,557	1,178,859	-235,693	-753,864
Forest	13,255	10,667	-2,588	13,444	189	-2,777
Urban/Developed	152,316	50,154	-102,162	119,761	-32,555	-69,607
Mixed Open	87,950	103,412	15,462	87,957	7	15,455
Air Dep. to Water	27,459	27,459	0	27,459	0	0
Septic Systems	0	0	0	0	0	0
Totals	1,695,532	616,687	-1,078,845	1,427,480	-268,052	-810,793

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	523,183	148,617	-374,566	505,241	-17,942	-356,624
Forest	23,719	23,761	42	24,317	598	-556
Urban/Developed	21,202	5,324	-15,878	22,517	1,315	-17,193
Mixed Open	18,587	24,839	6,252	18,598	11	6,241
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	586,691	202,541	-384,150	570,673	-16,018	-368,132

Lower Susquehanna West Watershed

The Lower Susquehanna West watershed is located in south central Pennsylvania and includes portions of Adams, Cumberland, Franklin, Perry and York Counties. DEP Field operations for the watershed are through the South-Central Regional Office.

The major tributaries with the watershed include Sherman, Conodoguinet, Yellow Breeches, Conewago, and Codorus Creeks. Overall, the Lower Susquehanna West watershed is about 10 percent of Pennsylvania's Bay watershed. Agriculture is the main land use within the watershed; followed by forest, mixed open and urban/developed lands. The land use acres are listed in Table A-41.

Table A-41
Lower Susquehanna West Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	532,515	832	38.4%
Agriculture	541,319	846	39.1%
Mixed Open	185,518	290	13.4%
Urban/Developed	115,756	181	8.4%
Open water	10,150	16	0.7%
Total	1,385,258	2,164	100%
		Portion of Pennsylvania's Bay Watershed	9.6%

The 2010 nutrient and sediment goals for the Lower Susquehanna West watershed are listed in table A-42. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-42
Lower Susquehanna West Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	7,563,878	467,504	182,465
Delivered Loads	7,264,000	261,200	85,700

The suite of non-point source management practices to reach these goals is listed in Table A-43. These include principally agricultural and urban management practices with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-44.

Table A-43: Lower Susquehanna West Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	510	409	101
Carbon Sequestration	Acres	57,999	T	57,999
Conservation (Farm) Plans	Acres	416,215	146,256	269,958
Conservation Tillage	Acres	209,625	167,828	41,797
Cover Crops (early)	Acres	188,408	T	188,408
Forest Buffers	Acres	13,749	418	13,331
Grass Buffers	Acres	7,827	30	7,797
Land Retirement	Acres	54,034	8,535	45,499
Managed Precision Agriculture	Acres	211,135	T	211,135
Mortality Composters	Systems	5	T	5
Non-Urban Stream Restoration	Feet	26,400	T	26,400
No-Till	Acres	100,408	T	100,408
Nutrient Management	Acres	72,094	245,526	-173,431
Off Stream Watering w/Fencing	Acres	30,446	1,791	28,655
Off Stream Watering w/o Fencing	Acres	18,267	268	17,999
Precision Rotational Grazing	Acres	7,307	T	7,307
Rotational grazing	Acres	4,871	1,015	3,857
Horse Pasture Management	Acres	43,260	T	43,260
Tree Planting	Acres	410	0	410
Yield Reserve	Acres	72,094	0	72,094
Ammonia Emission Reductions - Poultry	AEUs	13,451	0	13,451
Ammonia Emission Reductions - Swine	AEUs	8,294	0	8,294
Ammonia Emission Reductions - Dairy	AEUs	14,542	0	14,542
Precision Feeding - Dairy	AEUs	43,626	T	43,626
Phytase Feed additive - Swine	AEUs	16256	T	16,256
Phytase Feed additive - Poultry	AEUs	15,825	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	369	365	4
Dirt & Gravel Road Practices	Feet	376,813	T	376,813
Forest Buffers	Acres	689	21	667
Non-Urban Stream Restoration	Feet	21,120	T	21,120
Nutrient Management	Acres	195,774	0	195,774
Tree Planting	Acres	1,763	1,726	37
URBAN				
Erosion & Sediment Controls	Acres	3,795	4,213	-417
Forest Buffers	Acres	109	0	109
Grass Buffers	Acres	1,779	T	1,779
Septic Denitrification	Systems	54,227	3,109	51,118
Street Sweeping	Acres	4,377	T	4,377
Stormwater Management - Filtration	Acres	34,625	0	34,625
Stormwater Management - Infiltration Practices	Acres	34,625	0	34,625
Stormwater Management - Wet Ponds & Wetlands	Acres	34,625	0	34,625
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	1,039	0	1,039
Urban Nutrient Management	Acres	67,122	0	67,122
FOREST				
Dirt & Gravel Road Practices	Feet	0	T	0
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	5,280	0	5,280
MULTIPLE LANDUSE				
Wetland Restoration	Acres	722	91	631
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight				
T = indicates that the practice is being implemented but tracking has not been completed				

Table A-44: Lower Susquehanna West Watershed
Summary of Non-Point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	11,798,918	3,740,947	-8,057,971	8,642,023	-3,156,895	-4,901,076
Forest	1,332,179	1,207,721	-124,458	1,334,608	2,429	-126,887
Urban/Developed	1,299,815	630,202	-669,613	1,234,235	-65,580	-604,033
Mixed Open	1,325,406	1,247,658	-77,748	1,291,090	-34,316	-43,432
Air Dep. to Water	113,224	86,319	-26,905	111,356	-1,868	-25,037
Septic Systems	804,987	651,031	-153,956	909,279	104,292	-258,248
Totals	16,674,529	7,563,878	-9,110,651	13,522,591	-3,151,938	-5,958,713

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	687,813	323,655	-364,158	634,614	-53,199	-310,959
Forest	12,585	9,953	-2,632	12,518	-67	-2,565
Urban/Developed	94,148	30,488	-63,660	74,975	-19,173	-44,487
Mixed Open	98,927	97,659	-1,268	97,351	-1,576	308
Air Dep. to Water	5,749	5,749	0	5,749	0	0
Septic Systems	0	0	0	0	0	0
Totals	899,222	467,504	-431,718	825,207	-74,015	-357,703

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	304,731	125,241	-179,490	298,008	-6,723	-172,767
Forest	22,351	21,705	-646	22,485	134	-780
Urban/Developed	16,900	4,310	-12,590	18,685	1,785	-14,375
Mixed Open	26,308	31,209	4,901	25,756	-552	5,453
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	370,290	182,465	-187,825	364,934	-5,356	-182,469

Juniata Watershed

The Juniata watershed is located in south central Pennsylvania and includes portions of Bedford, Blair, Cambria, Centre, Franklin, Fulton, Huntingdon, Juniata, Mifflin, Perry, Snyder, and Somerset Counties. DEP Field operations for the watershed are through the South Central Regional Office.

The major tributaries with the watershed include Augwick and Tuscarora Creeks and the Juniata River. Overall, the Juniata watershed is about 15 percent of Pennsylvania's Bay watershed. Forest is the main land use within the watershed; followed by agriculture mixed open and urban/developed lands. The land use acres are listed in Table A-45.

Table A-45
Juniata Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	1,482,691	2,317	68.1%
Agriculture	453,625	709	20.8%
Mixed Open	161,820	253	7.4%
Urban/Developed	60,655	95	2.8%
Open water	18,382	29	0.8%
Total	2,177,174	3,402	100%
		Portion of Pennsylvania's Bay Watershed	15.0%

The 2010 nutrient and sediment goals for the Juniata watershed are listed in table A-46. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-46
Juniata Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	9,205,142	428,109	183,416
Delivered Loads	8,522,000	235,900	84,220

The suite of non-point source management practices to reach these goals is listed in Table A-47. These include principally agricultural and urban management practices with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-48.

Table A-47 Juniata Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	980	445	535
Carbon Sequestration	Acres	33,790	T	33,790
Conservation (Farm) Plans	Acres	336,077	141,761	194,316
Conservation Tillage	Acres	127,179	81,319	45,859
Cover Crops (early)	Acres	108,979	T	108,979
Forest Buffers	Acres	16,037	1,025	15,011
Grass Buffers	Acres	7,181	113	7,068
Land Retirement	Acres	27,472	10,208	17,264
Managed Precision Agriculture	Acres	151,419	T	151,419
Mortality Composters	Systems	2	T	2
Non-Urban Stream Restoration	Feet	7,000	T	7,000
No-Till	Acres	57,000	T	57,000
Nutrient Management	Acres	52,305	171,469	-119,164
Off Stream Watering w/Fencing	Acres	40,213	3,723	36,490
Off Stream Watering w/o Fencing	Acres	24,128	403	23,725
Precision Rotational Grazing	Acres	9,651	T	9,651
Rotational grazing	Acres	6,434	2,419	4,015
Horse Pasture Management	Acres	42,000	T	42,000
Tree Planting	Acres	215	0	215
Yield Reserve	Acres	51,928	0	51,928
Ammonia Emission Reductions - Poultry	AEUs	6,026	0	6,026
Ammonia Emission Reductions - Swine	AEUs	18,665	0	18,665
Ammonia Emission Reductions - Dairy	AEUs	30,190	0	30,190
Precision Feeding - Dairy	AEUs	90,569	T	90,569
Phytase Feed additive - Swine	AEUs	36584	T	36,584
Phytase Feed additive - Poultry	AEUs	7,089	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	789	793	-4
Dirt & Gravel Road Practices	Feet	140,000	T	140,000
Forest Buffers	Acres	845	0	845
Non-Urban Stream Restoration	Feet	2,000	T	2,000
Nutrient Management	Acres	151,451	0	151,451
Tree Planting	Acres	4,339	4,372	-33
URBAN				
Erosion & Sediment Controls	Acres	1,102	1,125	-23
Forest Buffers	Acres	86	0	86
Grass Buffers	Acres	1,516	T	1,516
Septic Denitrification	Systems	31,731	3,373	28,358
Street Sweeping	Acres	1,700	T	1,700
Stormwater Management - Filtration	Acres	17,867	0	17,867
Stormwater Management - Infiltration Practices	Acres	17,867	0	17,867
Stormwater Management - Wet Ponds & Wetlands	Acres	17,867	0	17,867
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	822	0	822
Urban Nutrient Management	Acres	38,456	0	38,456
FOREST				
Dirt & Gravel Road Practices	Feet	140,000	T	140,000
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	2,000	0	2,000
MULTIPLE LANDUSE				
Wetland Restoration	Acres	518	226	293
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight				
T = indicates that the practice is being implemented but tracking has not been completed				

Table A-48: Juniata Watershed
Summary of Non-Point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	9,764,074	4,173,490	-5,590,584	8,460,958	-1,303,116	-4,287,468
Forest	3,629,823	3,396,923	-232,900	3,668,985	39,162	-272,062
Urban/Developed	639,989	278,019	-361,970	545,314	-94,675	-267,295
Mixed Open	910,653	801,759	-108,894	883,472	-27,181	-81,713
Air Dep. to Water	193,412	148,392	-45,020	188,549	-4,863	-40,157
Septic Systems	533,375	406,559	-126,816	516,730	-16,645	-110,171
Totals	15,671,326	9,205,142	-6,466,184	14,264,008	-1,407,318	-5,058,866

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	710,521	309,382	-401,139	673,895	-36,626	-364,513
Forest	39,316	32,616	-6,700	39,289	-27	-6,673
Urban/Developed	46,460	13,543	-32,917	33,400	-13,060	-19,857
Mixed Open	67,349	62,157	-5,192	66,230	-1,119	-4,073
Air Dep. to Water	10,411	10,411	0	10,411	0	0
Septic Systems	0	0	0	0	0	0
Totals	874,057	428,109	-445,948	823,225	-50,832	-395,116

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	222,923	84,907	-138,016	181,484	-41,439	-96,577
Forest	73,556	73,874	318	74,776	1,220	-902
Urban/Developed	10,181	2,453	-7,728	10,359	178	-7,906
Mixed Open	20,608	22,182	1,574	20,140	-468	2,042
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	327,268	183,416	-143,852	286,759	-40,509	-103,343

Potomac Watershed

The Potomac watershed is located in south-central Pennsylvania and includes portions of Adams, Bedford, Fulton and Somerset Counties. DEP Field operations for the watershed are through the South Central Regional Office.

All tributaries within the watershed drain into the Potomac River. Major tributaries include Conococheague, Licking, Tonoloway and Willis Creeks. The Potomac watershed is about 7 percent of Pennsylvania's Bay watershed. Forest is the main land use within the watershed; followed by agriculture, mixed open and urban/developed lands. The land use acres are listed in Table A-49.

Table A-49
Potomac Watershed Land Uses

Landuse	Acres	Square Miles	Percent of Area
Forest	594,644	929	59.2%
Agriculture	304,673	476	30.3%
Mixed Open	62,309	97	6.2%
Urban/Developed	41,343	65	4.1%
Open water	2,232	3	0.2%
Total	1,005,201	1,571	100%
Portion of Pennsylvania's Bay Watershed			6.9%

The 2010 nutrient and sediment goals for the Potomac Watershed are listed in Table A-50. Both local edge-of-stream nutrient and sediment 2010 cap goals and the corresponding delivered nutrient and sediment 2010 cap loads to Chesapeake Bay are included in the table.

Table A-50
Potomac Watershed 2010 Nutrient and Sediment Goals

Load Type	Nitrogen (lbs/year)	Phosphorus (lbs/year)	Sediment (tons/year)
Edge-of-Stream Loads	4,778,114	322,949	84,689
Delivered Loads	3,280,000	251,600	127,270

The suite of non-point source management practices to reach these goals is listed in Table A-51. These include principally agricultural and urban management practices with additional practices for mixed open and forestland. The historical nutrient and sediment loads and the reductions needed to reach the local edge-of-stream loads are listed in Table A-52.

Table A-51 Potomac Watershed
Tributary Strategy Management Practices

Management Practice	Units	Strategy Goal	2,002 Implementation	Remaining Implementation
AGRICULTURE				
Animal Waste Management Systems	AEUs	565	151	414
Carbon Sequestration	Acres	23,782	T	23,782
Conservation (Farm) Plans	Acres	215,563	90,560	125,003
Conservation Tillage	Acres	93,532	86,600	6,932
Cover Crops (early)	Acres	78,947	T	78,947
Forest Buffers	Acres	11,552	480	11,073
Grass Buffers	Acres	5,240	1	5,239
Land Retirement	Acres	22,748	6,668	16,079
Managed Precision Agriculture	Acres	105,836	T	105,836
Mortality Composters	Systems	7	T	7
Non-Urban Stream Restoration	Feet	0	T	0
No-Till	Acres	44,643	T	44,643
Nutrient Management	Acres	36,424	86,518	-50,094
Off Stream Watering w/Fencing	Acres	19,127	2,160	16,967
Off Stream Watering w/o Fencing	Acres	11,476	327	11,149
Precision Rotational Grazing	Acres	4,591	T	4,591
Rotational grazing	Acres	3,060	1,523	1,537
Horse Pasture Management	Acres	37,430	T	37,430
Tree Planting	Acres	232	0	232
Yield Reserve	Acres	35,677	0	35,677
Ammonia Emission Reductions - Poultry	AEUs	8,947	0	8,947
Ammonia Emission Reductions - Swine	AEUs	16,028	0	16,028
Ammonia Emission Reductions - Dairy	AEUs	16,971	0	16,971
Precision Feeding - Dairy	AEUs	50,913	T	50,913
Phytase Feed additive - Swine	AEUs	31415	T	31,415
Phytase Feed additive - Poultry	AEUs	10,526	>95%	<5%
MIXED OPEN				
Abandoned Mined Land Reclamation	Acres	97	140	-43
Dirt & Gravel Road Practices	Feet	82,876	T	82,876
Forest Buffers	Acres	508	0	508
Non-Urban Stream Restoration	Feet	4,500	T	4,500
Nutrient Management	Acres	53,391	0	53,391
Tree Planting	Acres	1,752	1,752	0
URBAN				
Erosion & Sediment Controls	Acres	1,357	1,370	-13
Forest Buffers	Acres	61	0	61
Grass Buffers	Acres	914	T	914
Septic Denitrification	Systems	12,367	584	11,783
Street Sweeping	Acres	1,432	T	1,432
Stormwater Management - Filtration	Acres	12,270	0	12,270
Stormwater Management - Infiltration Practices	Acres	12,270	0	12,270
Stormwater Management - Wet Ponds & Wetlands	Acres	12,270	0	12,270
Urban Stream Restoration	Feet	0	T	0
Urban Sprawl Reduction	Acres	422	0	422
Urban Nutrient Management	Acres	23,715	0	23,715
FOREST				
Dirt & Gravel Road Practices	Feet	28,936	T	28,936
Forest Harvesting Practices	Acres	0	0	0
Non-Urban Stream Restoration	Feet	4,500	0	4,500
MULTIPLE LANDUSE				
Wetland Restoration	Acres	349	88	261
AEU = Animal Equivalent Unit equal to 1000 pounds of animal weight				
T = indicates that the practice is being implemented but tracking has not been completed				

Table A-52: Potomac Watershed
Summary of Non-Point Source Local Edge-of-Stream Nutrient and Sediment Loads

Summary of Nitrogen Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	7,489,968	2,624,578	-4,865,390	6,350,803	-1,139,165	-3,726,225
Forest	1,260,725	1,207,386	-53,339	1,303,241	42,516	-95,855
Urban/Developed	455,412	224,226	-231,186	429,670	-25,742	-205,444
Mixed Open	436,872	479,428	42,556	437,252	380	42,176
Air Dep. to Water	23,063	17,447	-5,616	22,703	-360	-5,256
Septic Systems	254,238	225,049	-29,189	283,249	29,011	-58,200
Totals	9,920,278	4,778,114	-5,142,164	8,826,918	-1,093,360	-4,048,804

Summary of Phosphorus Loads
(Pounds per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	528,513	252,057	-276,456	548,153	19,640	-296,096
Forest	14,038	12,053	-1,985	14,433	395	-2,380
Urban/Developed	40,867	12,916	-27,951	32,607	-8,260	-19,691
Mixed Open	39,914	44,658	4,744	40,404	490	4,254
Air Dep. to Water	1,265	1,265	0	1,265	0	0
Septic Systems	0	0	0	0	0	0
Totals	624,597	322,949	-301,648	636,862	12,265	-313,913

Summary of Sediment Loads
(Tons per Year)

	Reductions From 1985 Reference Year			Reductions from 2002		
Landuse	1985 Reference	2010 Goal	Reductions to Reach Goal	2002 Implementation	Reductions Through 2002	Remaining Reductions
Agriculture	151,692	53,469	-98,223	118,226	-33,466	-64,757
Forest	18,619	19,424	805	19,391	772	33
Urban/Developed	6,274	1,594	-4,680	6,908	634	-5,314
Mixed Open	8,181	10,202	2,021	8,204	23	1,998
Air Dep. to Water	0	0	0	0	0	0
Septic Systems	0	0	0	0	0	0
Totals	184,766	84,689	-100,077	152,729	-32,037	-68,040

Appendix B.
Ongoing Nonpoint Source Programs

Erosion and Sediment Control

DEP, with the assistance of delegated county conservation districts, administer Pennsylvania's Erosion and Sediment Pollution Control Program. Regulatory requirements for minimizing erosion and preventing sediment pollution for earth disturbance activities are contained within DEP's Chapter 102, Erosion and Sediment Control (E&S) rules and regulations. Chapter 102 defines regulated earth disturbances as those activities which can include but are not limited to: clearing and grubbing, grading, excavations, embankments, land development, agricultural plowing or tilling, timber harvesting activities, road maintenance activities, and mineral extraction activities. Under the current regulations, all earth disturbances must be conducted with E&S BMPs in place. Activities of 5000 square feet or greater require the development of a written E&S Plan for implementation at the site. Further, E&S Plans for certain activities exceeding one acre of earth disturbance and most all activities that exceed five acres of earth disturbance must be submitted to DEP, or a county conservation district that has been delegated that authority, for review and approval before the project may begin. In addition to state requirements, many municipalities administer similar permitting programs related to erosion and sediment control at the local level.

Under the DEP's Chapter 102 regulations, any construction activity of five acres of earth disturbance or greater (including those of less than five acres of earth disturbance that occur as part of a larger common plan of development or sale consisting of five acres of disturbance or more) requires a National Pollutant Discharge Elimination System Permit for Stormwater Discharges Associated with Construction Activities (NPDES Stormwater Construction Permit) prior to commencement of the earth disturbance activities. Effective December 2002, DEP has incorporated the federal NPDES Stormwater Construction Permit requirements affecting construction activities between one and five acres of earth disturbance (including those of less than one acre that occur as part of a larger common plan of development or sale between one and five acres), with a point source discharge. To further advance effective stormwater management and to support the DEP's Chapter 93 water quality protection requirements, NPDES Stormwater Construction Permit applicants must submit a Post Construction Stormwater Management Plan describing BMPs that will be maintained after construction has been completed.

Nutrient Management Plan Implementation Grant Program

Financial assistance to implement BMPs is provided through the Nutrient Management Plan Implementation Grant Program administered by the State Conservation Commission. Up to $75,000 in grants can be awarded to eligible landowners for the installation of BMPs. For implementation of Act 6 nutrient management plans, the grant program works with the AgriLink Loan Program and other financial assistance programs.

Agriculture Linked Investment Program (AgriLink)

The Agriculture Linked Investment Program is a cooperative effort of the Pennsylvania Treasury Department, the Pennsylvania Department of Agriculture, the State Conservation Commission and local lenders. The financial assistance program is available to participants in the Nutrient Management Act Program, and provides low interest loans to assist farmers in implementing

BMPs in approved Act 6 nutrient management plans. AgriLink program funds are provided to eligible farmers through local commercial banks, savings and loan institutions and local offices of the Farm Credit Service.

Dirt and Gravel Road Program

The Pennsylvania State Conservation Commission's Dirt & Gravel Road Program is an innovative effort to fund environmentally sound maintenance of unpaved roadway sections that have been identified as sources of dust and sediment pollution. Signed into law in April 1997 as Section 9106 of the PA Vehicle Code ($9106), the program is based on the principle that informed and empowered local control is the most effective way to stop pollution.

The law created a dedicated, non-lapsing fund - $4 million per year - to provide money and training to local communities for local road maintenance, specifically to halt and prevent pollution of water and air. The funds are distributed by the State Conservation Commission to 65 county conservation districts in Pennsylvania (out of 67 counties) that administer the Dirt & Gravel Road Program. The Conservation Districts work with local road owning entities, usually townships, to develop a work plan to correct verified pollution problems on unpaved roads. Townships are required to attend a two day "Environmentally Sensitive Maintenance of Dirt and Gravel Roads" to be eligible to apply for funding. Training and technical support is contracted through the Penn State Center for Dirt & Gravel Road Studies.

Stream Releaf Program

In 1996, the Bay Program Partners agreed to restore 2,010 miles of forest buffer along the streamsides of the Chesapeake Bay watershed, to increase the use of all streamside buffers and to conserve existing buffers. Pennsylvania's portion of this goal was to restore 600 miles of buffer by 2010. Recognizing the value of streamside buffers to improve water quality, Pennsylvania launched a statewide effort to re-establish, maintain and conserve streamside buffers. DEP led the initiative to develop the Stream Releaf Program, with active support from other state agencies, principally the Department of Conservation and Natural Resources (DCNR). This plan encourages a voluntary approach to buffer restoration and conservation, focusing on education, partnerships and incentives. The original 600 - mile goal was achieved in 2003.

In December of 2003, the Chesapeake Bay Program and its partners agreed to a new riparian forest buffer goal of 10,000 miles by 2010. Pennsylvania's portion of the 10,000 - mile goal was 3,330 miles. During development of the Tributary Strategy, Pennsylvania increased its goal to 10,000 miles of riparian forest buffers to help meet its water quality goals. Progress is reported through the state and federal programs participating in the Stream ReLeaf Program. To date, over 800 miles of riparian forest buffers greater than 35 feet wide are reported. Growing Greener watershed projects and the investment in the Conservation Reserve Enhancement Program (CREP) will significantly increase this number in the near future.

Forest Stewardship Program

The Forest Stewardship Program (FSP) provides cost-share funds for tree planting, timber stand improvement and site preparation. The Natural Resources Conservation Service (NRCS) and the Forest Service, in cooperation with the Department of Conservation and Natural Resource's (DCNR) Bureau of Forestry, jointly administer this program. The FSP provides information, education, and technical assistance to private landowners to encourage sound management of

their resources. Landowners work one-on one with foresters and other natural resource professionals to develop a written resource management plan, called a Forest Stewardship Plan.

Clean Water Act (CWA) Section 319 Program

The Section 319 program, administered by DEP, uses federal funds to address nonpoint source problems with priority being given to the CWA 303(d) List of Impaired Waters and watersheds where Total Maximum Daily Loads (TMDLs) have been developed. The Nonpoint Source Management Program provides a comprehensive statewide plan to control, prevent and remediate nonpoint sources of polluted runoff. It supports the development of, passive treatment systems for treating mine discharge, managing storm water and the abatement of nonpoint source pollution from agriculture. Although the Section 319 Program addresses statewide problems, efforts within Pennsylvania's portion of the Bay watershed are integral to Pennsylvania's efforts to reduce nutrient loads to the Bay.

Abandoned Mine Reclamation Program

The Bureau of Abandoned Mine Reclamation (BAMR) administers and oversees Pennsylvania's Abandoned Mine Reclamation Program. The Bureau is responsible for resolving abandoned mine land problems such as mine fires, mine subsidence, dangerous highwalls and other hazards that are the result of past mining practices, and for abating or treating acid mine drainage from abandoned mines. Abandoned mineral extraction lands can be a source of acid, metals and sediment. "Reclaim PA" is a DEP initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands by enhancing mine operator, volunteer and DEP reclamation efforts. DEP BAMR's programs for reclamation of mining disturbed land will continue to reduce the amount of sediment from abandoned mine lands that reach Pennsylvania's waterways and the Chesapeake Bay.

Municipalities with Separate Storm Sewer Systems (MS4)

In March 2003, the federal NPDES Phase II stormwater regulations for Municipalities with Separate Storm Sewer Systems (MS4) were initiated. These regulations among other things, require that six Minimum Control Measures (MCM) be established under NPDES Phase II permit requirements.

Regulated small MS4s are generally systems located in "urbanized areas" as defined by the Bureau of Census, or systems designated by the Department. The Department issued a general permit (NPDES General Permit for Stormwater Discharges from Small Separate Storm Sewer Systems, PAG-13) that can be used by all dischargers not located in HQ or EV watersheds. MS4 municipalities located in HQ and EV watersheds and others, as determined by DEP, will be required to obtain an individual permit. Each permittee must implement and enforce a stormwater management program designed to reduce the discharge of pollutants to the maximum extent practicable, with the goal of protecting water quality and satisfying water quality requirements of state and federal law. The program must contain a schedule of activities, best management practices and measurable goals for the six MCMs. These MCMs are narrative effluent limitations under the NPDES permit.

The six MCMs specified by NPDES Phase II regulations are:

1. Public outreach and education
2. Public participation and involvement
3. Illicit discharge detection and elimination
4. Construction site runoff control
5. Post-construction stormwater management in new development and re-development
6. Pollution prevention and good housekeeping for municipal operations

The Department has developed a *Protocol* that recommends an approved approach to complying with each of the six MCMs. MS4s choosing to follow the *Protocol* do not need specific approval from DEP for their program. To date, approximately 98% of MS4s have accepted and are implementing the DEP *Protocol.*

Villanova Urban Stormwater Partnership (VUSP)

DEP and Villanova University co-founded the Villanova Urban Stormwater Partnership (VUSP) in July of 2002 to create a long-term research effort to support change in stormwater management philosophy, and to bring together government, industry and academia. VUSP membership is open to industry, consultants and others interested in hastening the development of innovative stormwater management practices. The mission of VUSP is to advance the evolving comprehensive stormwater management field and to foster public and private partnerships through research on innovative BMPs, directed studies, technology transfer and education.

Villanova University and the Department have worked together to build a Stormwater BMP Park to advance stormwater management practices in Pennsylvania and to focus on stormwater management education. Currently the park consists of four sites: stormwater wetlands, bio-infiltration traffic island, a porous concrete plaza, and an infiltration trench. The park will be expanded with the addition of a rooftop garden. EPA has accepted these facilities as part of the National Monitoring Site program. Future planned projects include filter practices, and traditional wet and dry ponds. Innovative stormwater practices like those in the Demonstration Park are relatively new technologies that have not yet been fully accepted by the engineering community.

EPA Chesapeake Bay Small Watershed Grants Program

The National Fish & Wildlife Foundation, in cooperation with the EPA Chesapeake Bay Program, administers the Chesapeake Bay Small Watershed Grants Program that provides financial support to local governments and non-profit organizations to improve watershed management at the local level. The program seeks to engage organizations in projects that support meeting the commitments outlined in the Chesapeake 2000 Agreement while building citizen-based resource stewardship.

In 2004, groups in Pennsylvania were successful in obtaining over $977,000 to implement local programs to improve water quality and reduce non-point sources of pollution. With the help of programs like this and Growing Greener, Pennsylvania's watershed groups can continue to implement water quality improvements that will result in restoration of the Chesapeake Bay.

Federal Farm Bill Programs

Under the Federal Farm Bill there are an array of programs that support implementation of BMPs on farm and other privately owned lands. The technical assistance provided through conservation districts and funded under the Chesapeake Bay Program Implementation grant have supported the delivery of these assistance programs in the Bay watershed. The state NRCS office also actively supports funding for projects and pursues funding opportunities that benefit the Bay. Some recent examples include:

- Conservation Innovation Grants for development of a pollutant trading program in the Conestoga watershed;
- Conservation Security Program approved watershed projects include the Raystown, Swatara and Conodoguinet watersheds;
- A Third Party Service Provider grant of $600,000 was obtained to support technical assistance resources for Comprehensive Nutrient Management Plan development and implementation; and
- The project ranking system for EQIP funds gives preference to projects that enhance water quality and those located in watersheds of agricultural impaired waterbodies.

Environmental Quality Incentives Program (EQIP)

EQIP is a voluntary USDA-NRCS conservation program for producers to treat soil, water, and related natural resource concerns. EQIP provides both technical and financial assistance. The 2002 Farm Bill (which is effective through 2007) greatly expanded funds available in EQIP. Pennsylvania received approximately $9 million in the FFY03-04 period. Agricultural producers engaged in livestock or agricultural production may participate in EQIP. Producers comply with the Highly Erodible Land/Wetland conservation provisions. The EQIP is a competitive program, providing contracts having a minimum term of one year after the last conservation practice is installed, or up to a 10-year maximum lifespan. A 75% cost-share rate can be achieved if a Resource Management System (RMS) with a practice to benefit "at-risk species" is planned. Limited Resource farmers and Beginning farmers can receive up to 90% for part of their contract. The Pennsylvania NRCS identified the following natural resource concerns for EQIP in 2004: Erosion and sedimentation; Nutrient Management; Water pollution concerns from livestock production; Wildlife habitat degradation; Odor problems from animal waste.

Conservation Security Program (CSP)

The CSP program recognizes and rewards farmers who promote conservation on their land, and provides an incentive to farmers just beginning that process. It focuses on working or production agricultural lands. Established as part of the 2002 Farm Bill, the CSP received its first round of funding in FFY2004 when 18 watersheds nationally were selected to participate in the first year. The Raystown (Raystown Branch Juniata River) watershed in south-central Pennsylvania was one of the initial watersheds. Approximately 91 producers applied and 36 contracts totaling $190,000 were awarded in the Raystown watershed. Two hundred and two watersheds were selected nationally for the 2005 CSP program. The Schuylkill River watershed and the Lower Susquehanna River-Swatara Creek watershed were selected for the FFY 2005 CSP. All or a part of seventeen counties are included in the two new watersheds.

Conservation Reserve Program (CRP)

CRP is administered by the USDA Farm Service Agency. The goal of CRP is to establish long-term land covers on farmland by taking highly eroding and other sensitive farmland out of crop production for a 10 to 15 year period. This results in reduced erosion on the land and reduced nutrient and sediment loads to Pennsylvania waters and the Chesapeake Bay. Farmers are compensated by annual rental payments based on the agriculture rental value of the land, and cost-share assistance for up to 50 percent of the costs of approved conservation practices. The NRCS, Cooperative State Research and Education Extension Service, state forestry agencies and local Soil and Water Conservation Districts provide additional program support.

Air Quality Program

For mobile sources, Table 1 shows the federal strategies in place or to be implemented with their expected emissions reductions. The federal Clean Air Act preempts most state regulation of vehicles.

Table B-1. Federal Regulatory Programs

What	NOx impact upon full effectiveness	When
Light-duty vehicles (Tier 2) for new vehicles and low sulfur requirements for all gasoline	74 percent reduction by 2030	In place (2004 for gasoline and 2004 model year for vehicles)
Motorcycles (highway)	Reduce hydrocarbons + NOx by 50 percent compared to today's models	Phase in by size 2006 - 2010
New heavy-duty highway engines	2.4 million tons per year in 2030.	In place. (Model years 2002-4)
New heavy-duty highway engines and ultra-low sulfur requirements NOTE: PA has adopted California standards for 2005 and beyond engines (currently identical to federal standards)	2.6 million tons per year in 2030. Reduces emissions 90% compared to 2002 model year engines	Mid-2006 (diesel fuel) Model year 2007 (engines)
Miscellaneous new engines including applications such as forklifts, airport baggage equipment, snowmobiles and ATVs, recreational boats	Reduces NOx emissions by 80 percent compared to current models.	Phased in 2004 - 2007
Miscellaneous handheld engines such as garden trimmers	70 percent reduction in hydrocarbon + NOx and fuel efficiency benefits	Phased in from 2002 - 2007
Nonroad diesel equipment and diesel fuel (construction, agriculture, industrial equipment)	90 percent reduction (all pollutants) and 738,000 tons annually of NOx once fully effective	Phased in 2008 - 2014
Diesel fuel for locomotives and marine applications	Enables application of pollution control technology for which rules will be proposed	2007 and then next phase in 2010
Aircraft	Not easily regulated because of international issues	
Locomotives	Regulations will be proposed for additional control	
Ocean-going marine vessels not flagged in US	Not easily regulated because of international issues	

Appendix C.
Chesapeake Bay Program Best Management Practices

Agriculture BMPs – Approved for CBP Watershed Model

BMP	Description	Units
Animal Waste Management System – Livestock	Animal Waste Management Systems are designed for the proper handling, storage, and utilization of wastes generated from animal confinement operations and include a means of collecting, scraping, or washing wastes from confinement areas into appropriate waste storage structures. Lagoons, ponds, or steel or concrete tanks are used for the treatment and/or storage of liquid wastes, and storage sheds or pits are common storage structures for solid wastes. Land use applied to: manure acre Reductions per system = system AEU's/145 times manure acre loading rate times reduction efficiency** (see footnote)	AEU's*
Animal Waste Management System – Poultry	Animal Waste Management Systems are designed for the proper handling, storage, and utilization of wastes generated from animal confinement operations and include a means of collecting, scraping, or washing wastes from confinement areas into appropriate waste storage structures. Land use applied to: manure acre Reductions per system = system AEU's/145 times reduction efficiency** (see footnote)	AEU's*

BMP	Description	Units
Barnyard Runoff Controls - With Storage & Without Storage	This practices includes the installation of practices to control runoff from barnyard areas. This includes practices such as roof runoff control, diversion of clean water from entering the barnyard and control of runoff from barnyard areas. Use the first percent efficiency if controls are installed on an operation with a manure storage; and the second percent if the controls are installed on a loafing lot without a manure storage. The sediment efficiency has not been incorporated into the current watershed model but will be included in the updated model that is under development at this time. Land use applied to: manure acre Reductions = Total animals using barnyard (counted as AEU's)/145 times manure acres loading rate times reduction efficiency.	Acres/ AEU's
Carbon Sequestration	Carbon Sequestration refers to the conversion of cropland to hayland (warm season grasses). The hay land is managed as a permanent hayland providing a mechanism for sequestering carbon within the soil. (Note: this practice has not been incorporated into the watershed model nor has specifications been developed for its use as an approved BMP) Land use conversion: conventional till and conservation till to hayland Reduction = original land use loading rate – hayland loading rate times total acres converted. (Temporary reduction methodology not officially approved for use)	Acres
Cereal Cover Crops	Cover crops grown to provide winter cover of cropland, non-harvested Land use applied to: conventional till and conservation till Reduction = land use loading rate times total acres planted times reduction efficiency. Efficiency varies by when planted. If planted up to 7 days prior to published first frost date use early value. If planted up to 7 days after published first frost date use late value.	Acres

BMP	Description	Units
Commodity Cereal Cover Crops	Commodity cover crops grown to provide winter cover of cropland, harvested. Land use applied to: conventional till and conservation till Reduction = land use loading rate times total acres planted times reduction efficiency. Efficiency varies by when planted. If planted up to 7 days prior to published first frost date use early value. If planted up to 7 days after published first frost date use late value.	Acres
Conservation Plans (Farm Plans)	This is a comprehensive plan that addresses natural resource management on agricultural lands and utilizes best management practices that control erosion and sediment loss and manage runoff. These plans include conservation tillage, crop rotations and structural practices such as grassed waterways, sediment basins and grade stabilization structures. Land use applied to: conventional till, conservation till, hayland and pasture Reductions = land use loading rate times acres of BMP implemented times land use percent efficiency.	Acres
Conservation Till	Conservation Tillage involves planting and growing crops with minimal disturbance of the surface soil. No-till farming is a form of conservation tillage in which the crop is seeded directly into vegetative cover or crop residue with no disturbance of the surface soil. Minimum tillage farming involves some disturbance of the soil, but uses tillage equipment that leaves much of the vegetative cover or crop residue on the surface. Land use conversion – conventional till to conservation till Reductions = conventional till loading rate minus conservation till loading rate times total acres converted Note: Through 2002 progress reporting, the amount of conservation-tilled land for Pennsylvania has been based on data acquired by the Chesapeake Bay Program from the Conservation Technology Information Center (CTIC). The CTIC provides an estimate of the amount of conservation-tilled acres by year. PA has not reported this practice as a BMP and has deferred to the CTIC data.	Acres

BMP	Description	Units
Nutrient Management-Agriculture	Nutrient Management is a comprehensive plan that describes the optimum use of nutrients to minimize nutrient loss while maintaining yield. These plans detail the type, rate, timing, and placement of nutrients for each crop. Land use applied to: conventional till, conservation till and hay The reductions associated with implemented nutrient management plans are computed by the model for each model run. Reductions vary by land use and by model segments and range between 20 to 30 percent.	Acres
Phytase Feed Additives – Poultry	Use of Phytase as a poultry feed to reduce phosphorus concentrations in poultry litter. Reduction applies as a change in manure phosphorus content. This practice is currently being credited automatically in all model assessment runs.	AEUs
Retirement of Highly Erodible Land	Retirement takes marginal and highly erosive agricultural cropland out of production by planting permanent vegetative cover such as shrubs, grasses, and/or trees. Land retired and planted to trees would be reported under the “tree planting” BMP. Land use conversion: conventional till and conservation till conversion to mixed open land use Reductions = original land use loading rate minus mixed open land use loading rate times total acres converted	Acres

BMP	Description	Units
Riparian Forest Buffers – Agriculture	Riparian Forest Buffers are linear wooded areas planted along rivers and streams. Reduction credits for riparian include both a percentage reduction and a land use credit for the acres of trees planted. Land use conversion: conventional till, conservation till, hayland or pasture to forest land Reductions = original land use loading rate minus forest loading rate times acres of total acres converted Plus: Upland land use loading rate time's total acres treated times percent efficiency. For nitrogen every 435.6 linear feet of buffer is estimated to treat 5 upland acres of land and for phosphorus and sediment every 435.6 linear feet of buffer is estimated to treat 2 upland acres of land (100 foot buffers). Upland land use efficiency varies by hydrologic setting as follows: Appalachian Plateau Blue Ridge Mesozoic Lowlands Piedmont – Carbonate Piedmont – Crystalline Valley and Ridge – Carbonate Valley and Ridge - Silicicastic	Acres

BMP	Description	Units
	Grassed Buffers are linear strips of maintained grass or other non-woody vegetation between the edge of fields and streams, rivers or tidal waters. Reduction credits for riparian grass buffers include both a percentage reduction and a land use credit for the acres of trees planted	Acres
Rotational Grazing/ Grazing Land Protection with Stream Fencing	This practice involves dividing pasture areas into cells or paddocks. Each paddock is intensively grazed for a short period, and then allowed to rest and recover before being grazed again. The amount of time each cell is grazed and then rested relates to the time of year, quality of the forage and the growth stage of the forage. Land use applied to: pasture Reductions = Pasture land loading rates times acres of pasture with rotational grazing times percent efficiency. A second reduction is calculated to account for the portion of land between the installed fence and the stream that is no longer pastured. This reduction is calculated as land use conversion of pasture to mixed open land Reductions = pasture loading rate minus mixed open land loading rate times total acres excluded.	Acres of Grazed Land and Acres of Excluded Land
Stream Protection with Fencing and with Off-	Stream protection with fencing involves the fencing of narrow strips of land along streams to completely exclude livestock. The fenced areas may be planted to trees or grass. Land use applied to: pasture	Length of Fence and

BMP	Description	Units
Stream Watering	Percent efficiency reductions = upland land use loading rate times total acres treated times percent efficiency (for this calculation every 208 linear feet of buffer is estimated to treat two upland acres of land) A second reduction is calculated to account for the portion of land between the installed fence and the stream that is no longer pastured. This reduction is calculated as a land use conversion of pasture to mixed open land Reductions = pasture loading rate minus mixed open loading rates times total acres excluded	Acres of Excluded Land
Stream Protection without Fencing with Off Stream Watering	This option involves the use of troughs or "watering holes" in remote locations away from streams, as well as the placement of stream crossings. Stream crossings usually have some length of fencing adjacent so that livestock will not bypass the crossings. In some instances, trees are planted away from the stream to provide shade for the livestock. The protected area acts as a buffer between stream and livestock. Land use applied to: pasture Percent efficiency reductions = upland land use loading rate times total acres treated times percent efficiency (for this calculation every 208 linear feet of protected area is estimated to treat two upland acres of land)	Acres
Tree Planting	Reforestation practices or planting of trees that are not classified as riparian forest buffers. Planted trees are considered permanent. Land use conversion: any combination of conventional till, conservation till, hayland, pasture, mixed open, and pervious developed land to forest Reductions = original land use loading rate minus forest loading rate times number of acres planted	Acres
Wetlands – Ag land	Wetland Restoration is the reestablishment of wetlands on agricultural lands where they used to exist. Restored wetlands may be any wetland classification including forested, scrub-shrub or emergent marsh. Land use conversion: conventional till, conservation till, hay or pasture to forest Reductions = original land use loading rate minus forest loading rate times acres converted. Plus:	Acres

BMP	Description	Units
	Upland land use loading rate time's total acres treated times percent efficiency. For nitrogen every 435.6 linear feet of buffer is estimated to treat 5 upland acres of land and for phosphorus and sediment every 435.6 linear feet of buffer is estimated to treat 2 upland acres of land (100 foot buffers). Upland land use efficiency varies by hydrologic setting as follows: Appalachian Plateau Blue Ridge Mesozoic Lowlands Piedmont – Carbonate Piedmont – Crystalline Valley and Ridge – Carbonate Valley and Ridge - Silicicastic	
Yield Reserve	Agricultural Yield Reserve programs are intended to provide incentives through yield insurance for crop losses to farmers who apply nitrogen and phosphorus at levels below their recommended application rates. Participating farmers would be paid to apply 15 percent to 25 percent less nutrients on crops than is recommended in their Nutrient Management Plan. Land use applied to: conventional till and conservation till Reductions estimated for using watershed model simulations. An approved reduction methodology has not been developed. Efficiency varies by land use and model segment.	Acres
Agriculture BMPs – CBP Watershed Model approval pending		
Advanced No-Till	Advanced No Till involves planting and growing crops with minimal disturbance of the surface soil. No-till farming is a form of conservation tillage in which the crop is seeded directly into vegetative cover or crop residue with minimal or no disturbance of the surface soil. To qualify as advanced no-till, a minimum of 50% crop residue must be maintained. Land use applied to: Conservation tillage Reductions = conservation till loading rate times total acres of advanced no-till times reduction efficiency	Acres

BMP	Description	Units
Ammonia Emission Controls	This practice involves a reduction in livestock housing ammonia emissions through use of capture or control technologies. Currently, ammonia emission controls will focus on poultry, swine and dairy production. Land use applied to: N/A – results in a reduction in nitrogen emissions and subsequent air deposition Emission Reductions = Animal Equivalent Units (AEU) within the housing facility times the reduction in pounds per AEU. Reductions apply to nitrogen only. The watershed model will simulate reductions in deposition and subsequent delivered loads.	Reduction per AEU
Horse Pasture Management	Use of rotational grazing practices to minimize nutrient and sediment loss from equine pastures. Practices may include streambank fencing, cross fencing to create paddock areas, off-stream watering structures and stabilization of heavy use areas. This practice assumes 5 acres per AEU is available for full pasturage based operations and 2 acres per AEU for limited pasturage operations that include stabilized heavy use aeas or roofed shelters in additional to rotational paddocks. Land use applied to: mixed open – within the current watershed model, horse pasture areas are not included in the agricultural pasture acres, but are accounted for within the mixed open land use category Reductions = mixed open loading rate times efficiency times acres of horse pasture being managed.	Acres
Managed Precision Agriculture	Use of multiple management systems beyond standard nutrient management practices to further minimize nutrient loses. This practice identifies variables such as soil types, weather conditions and yield data to more specifically apply and vary nutrients within field areas. Land use applied to: conventional till and conservation till Reductions associated with implemented managed precision agriculture are computed by the watershed model for each model run. Reductions vary by land use and by model segments and vary between 25% to 38%.	Acres
Manure Transport	Transport of livestock manure from areas of high concentration to areas of low concentration, or the transport of manure out of the Chesapeake Bay watershed. Because of the difficulty in tracking manure transport and possible transportation issues, this practice has not been considered in the nutrient reduction strategy at this time.	Tons

BMP	Description	Units
Mortality Composter	Composting of mortality carcasses for future land application as a nutrient source. Animal manure is typically used as a nitrogen and carbon source to aid in the composting process. Facilities utilize roof structure and stabilized surface pads to prevent nutrient loses. Land use applied to: manure acre Reductions per system = system AEU's/145 times manure acre loading rate times reduction efficiency** (see footnote)	AEUs
Phytase Feed Additives – Swine	Use of Phytase as a swine feed additive to reduce phosphorus concentrations in swine manure Reduction applies as a change in manure phosphorus content.	AEUs
Precision Feeding of Dairy Livestock	Reduction in overfeeding of dairy livestock through the formulation of improved feed rations to meet specific nutrient needs of individual operations. Includes the targeting of minimum nitrogen and phosphorus feed concentrations while maintaining acceptable production levels so as to minimize the quantity and nutrient content of livestock manure. Land use applied to: N/A - results in a reduction in manure nutrient content The watershed model simulates the reductions for this practice as a decrease in the nitrogen and phosphorus content of manure being land applied based on the AEUs of livestock being precision feed. Within the model, manure is considered a nutrient input. This practice, in effect, reduces the manure nutrient concentrations used by the model to estimate nutrient loads.	AEUs

BMP	Description	Units
Precision Rotational Grazing	The purpose of this BMP is to increase the level of forage and livestock implementation, increase forage nutrient removal, density and average height resulting in improved infiltration and decreased runoff. It Utilizes a Resource Management System (RMS) level grazing plan. Land use applied to: pasture Reductions = Pasture land loading rates times acres of pasture with rotational grazing times percent efficiency. A second reduction is calculated to account for the portion of land between the installed fence and the stream that is no longer pastured. This reduction is calculated as land use conversion of pasture to mixed open land Reductions = pasture loading rate minus mixed open land loading rate times total aces excluded.	Acres of Grazed Land and Acres of Excluded Land
Urban and Mixed Open BMPs – Approved for CBP Watershed Model		
Erosion and Sediment Controls – Urban Land	This practice involves erosion and sediment controls applied during construction activities on urban (developed) land. Due to the relative short nature of permitted construction activities, permitted acres are reported on a yearly basis (not cumulatively). Land use affected: pervious developed land Reductions = pervious developed land use loading rate times acres permitted times percent efficiency	Acres
Impervious Surface Reduction – Non-structural Practices	This practices involves the removal of urban impervious surfaces with pervious surfaces which increases water infiltration and deceases surface water runoff. Land use conversion: impervious developed land to pervious developed land Reductions = impervious developed land use loading rate minus pervious developed land use loading rate times acres converted.	Acres

BMP	Description	Units
Nutrient Management (Developed Land and Mixed Open Land)	Optimum use of nutrients (principally chemical fertilizers) to minimize loss. Includes applications by commercial and residential lawn care companies. Land use applied to: mixed open land and pervious developed land Reduction = land use loading rate times number of acres with implemented nutrient management times efficiency	Acres
Reduction in Urban Growth***	Reduction in 2010 projections for the conversion of urban land. This results in "returning" urban land to forest, mixed open and agricultural land. (see footnote) Land use conversion: impervious and pervious developed land to forest, mixed open and agricultural land uses Reduction = urban land loading rate minus new (non-urban) loading rate times acres of land not converted to urban. This will be credited as a land use projection and not a field practice	Acres
Riparian Forest Buffers – Urban	Riparian Forest Buffers are linear wooded areas planted along rivers and streams. Reduction credits for riparian include both a percentage reduction and a land use credit for the acres of trees planted Land use conversion: pervious developed land to forest land Reductions = original land use loading rate minus forest loading rate times acres of total acres converted Plus: Upland land use loading rate time's total acres treated times percent efficiency. (For this calculation every 435.6 linear feet of buffer is estimated to treat 5 upland acres of land)	Acres
Riparian Grass Buffers-Developed Land	Grassed Buffers are linear strips of maintained grass or other non-woody vegetation between the edge of fields and streams, rivers or tidal waters. Applies to conversion of impervious land to grass. Land use conversion: impervious developed land to mixed open land Reduction = impervious developed land loading rate minus mixed open land loading rate times total acres converted.	Acres

BMP	Description	Units
SWM Wet Ponds & Wetlands	This stormwater management category includes practices such as wet ponds, wet extended detention ponds, retention ponds, pond/wetland systems, shallow wetlands, and constructed wetlands. Land use applied to: pervious and impervious developed land Reductions = Urban loading rate times BMP drainage area times percent efficiency	Acres
SWM Dry Detention & Hydro-dynamic Structures	This stormwater management category includes practices such as dry detention basins and hydrodynamic structures designed to moderate flows. The structures remain dry between storm events Land use applied to: pervious and impervious developed land Reductions = Urban loading rate times BMP drainage area times percent efficiency	Acres
SWM Dry Extended Retention Ponds	This stormwater management category includes practices such as dry extended detention ponds and extended detention basins. Land use applied to: pervious and impervious developed land Reductions = Urban loading rate times BMP drainage area times percent efficiency	Acres
SWM Infiltration Practices	This stormwater management category includes practices such as infiltration trenches, infiltration basins, and porous pavement that reduce or eliminate the runoff. Land use applied to: pervious and impervious developed land Reductions = land use loading rate times BMP drainage area times percent efficiency	Acres
SWM Filtering Practices	This stormwater management category includes swales (dry, wet, infiltration, and water quality), open channel practices, and bioretention that transmit runoff through a filter medium. Land use applied to: pervious and impervious developed land Reductions = land use loading rate times BMP drainage area times percent efficiency	Acres

BMP	Description	Units
Stream Restoration – Urban	Restoration of urban (developed) stream channel to stable configuration Land use applied to: pervious and impervious developed land Reductions = linear feet of channel restored times indicated reduction in lbs per foot.	Linear Feet
Tree Planting Urban and Mixed Open land	Reforestation practices or planting of trees that are not classified as riparian forest buffers. Planted trees are considered permanent Land use conversion: mixed open and pervious developed land to forest land Reductions = original land use loading rate minus forest loading rate times number of acres planted	Acres
Wetlands – Mixed Open Land	Wetland Restoration is the reestablishment of wetlands on mixed open land where they used to exist. Restored wetlands may be any wetland classification including forested, scrub-shrub or emergent marsh. Land use conversion: mixed open Reductions = mixed open land use loading rate minus forest loading rate times acres converted.	Acres
Other BMPs - Approved for CBP Watershed Model		
Abandoned Mined Land Reclamation	This practice involves reclamation of abandoned mined land through planting of grass, shrubs or trees. Applied to: mixed open land Reductions = Mixed Open land loading rate times total acres reclaimed times 2 times percent efficiency (1 to 2 effectiveness)	Acres
Forest Harvesting Practices	Erosion and sediment control practices used during harvesting of timber Land use applied to: forest Reductions = forest loading rate times efficiency times acres of forest land protected by harvest practices	Acres

BMP	Description	Units
Septic System Hookups	Removal of On-lot septic systems by hooking up to a POTW or other treatment system. Since septic systems are accounted for as nonpoint source loads within the watershed model, this action results in a decrease in nonpoint loads and an increase in point source loads for the facility now treating the increased flow. Credit is on the premise that treatment system hook-ups are done because of a need (e.g., failing or aging systems) and not normally for correctly functioning septic systems Applied to: septic systems Reductions: Credited as number of systems removed	Equivalent Domestic Units
Septic System Denitrification (new and refit)	System design that includes an anaerobic biological reduction of nitrate nitrogen (e.g., nitrates in soil or wastewater) to nitrogen gas and/or the removal of total nitrogen from a system. Land use applied to: N/A – applies to individual septic systems Reductions = number of septic systems times loading rate times reduction efficiency.	Units
Other BMPs - CBP Watershed Model approval pending		
Street Sweeping in Urban Areas	This practice reduces the wash off of detritus and air deposited compounds from urban areas by regular sweeping of impervious streets. Land use applied to: impervious developed land Reductions = Impervious developed land loading rate times acres swept times percent efficiency	Acres
Dirt and Gravel Road Erosion and Sediment Controls	Implementation of practices to stabilize dirt and gravel roads adjacent to streams. The purpose of this BMP is to significantly reduce the erosion of sediment and the nutrients within the sediment from the road and adjacent areas into the stream. Land use applied to: forest and mixed open Reductions = length of road with controls times reduction in lbs per foot.	Feet

BMP	Description	Units
Non-urban Stream Restoration	Restoration of stream channels in non-urban areas to stable configuration. The purpose of this BMP is to restore natural stream hydrology and landscape so the stream is neither aggrading nor degrading. Land use applied to: all land uses except pervious or impervious developed land Reductions = linear feet of channel restored times indicated reduction in lbs per foot.	Feet
Voluntary Air Emission Controls	Voluntary practices implemented to reduce air emissions of nutrients. Type and nature of practices will vary depending on the nature and type of the emission source (e.g., utility versus industrial/commercial facility) and the methodology employed. Land use applied to: N/A Reductions calculated from actual reduction measurements or estimated from process change or equipment efficiency.	Pounds Reduction

* AEU = Animal Equivalent Units.

** Animal waste management systems credits are applied against the manure acre land use within the watershed model. For modeling purposes each manure acre is defined as a pasture acre having the equivalent of 145 AEU's of manure applied. The number of manure acres treated by an AWM system is defined as the AEU's that the system services divided by 145. For example, a dairy operation with 218 AEU's of livestock would be credited with 218/145 = 1.5 manure acres effectively treated.

***Change in urban growth is based on a comparison of the projected yearly growth in urban acres through 2010 to the estimated actual urban acres for each year leading to 2010. Reductions are realized as a change (i.e., reduction) in the amount of non-urban land that is consumed by urban growth. If increases in urban land acres occur over that currently projected, increases in the modeled load will also occur

Appendix D.
Point Source Dischargers Within the Watershed Areas

WATERSHED AREA	NPDES	NAME
CENTRAL PENN	PA0020486	BELLEFONTE BORO
	PA0025933	LOCK HAVEN CITY
	PA0110965	MID-CENTRE CNTY AUTHORITY
	PA0010553	PFBC - BENNER SPRNGS FSH RESEARCH STA
	PA0040835	PFBC - LOWER SPRING CK FSH CULTRL STA
	PA0010561	PFBC - PLEASANT GAP FCS
	PA0112127	PFBC - TYLERSVILLE FCS
	PA0044032	PFBC - UPPER SPRING CK FCS
	PA0026239	UNIVERSITY AREA JT AUTH
	PA0009857	US F&WS - LAMAR NAT FISH HATCHERY
UPPER WEST BRANCH	PA0026310	CLEARFIELD MUN AUTH
	PA0024759	CURWENSVILLE MUNICIPAL AUTHORI
	PA0046159	HOUTZDALE BOROUGH MUNICIPAL S
	PA0037966	MOSHANNON VALLEY JT SAN AUTH
SUSQUEHANNOCK	PA0028631	MID-CAMERON AUTHORITY
	PA0027553	PINE CREEK MA-STP
	PA0021687	WELLSBORO MUN AUTH
	PA0043893	WESTERN CLINTON CO MUN AUTH
LOWER NORTH BRANCH	PA0023558	ASHLAND MUNICIPAL AUTHORITY
	PA0023531	DANVILLE MUN AUTH
	PA0110582	EASTERN SNYDER COUNTY REGIONAL
	PA0070041	MAHANOY CITY MUNICIPAL AUTHORI
	PA0008419	MERCK & COMPANY
	PA0024406	MOUNT CARMEL BORO AUTH
	PA0020567	NORTHUMBERLAND BOROUGH COUNCL
	PA0027324	SHAMOKIN-COAL TWP JT SAN AUTH
	PA0070386	SHENANDOAH MUNICIPAL SEWAGE AU
	PA0026557	SUNBURY CITY MUN AUTH
BIG BEND	PA0114821	GREGG TWP MUNICIPAL AUTHORITY
	PA0028665	JERSEY SHORE BORO
	PA0028681	KELLY TWP MUN AUTH
	PA0044661	LEWISBURG AREA JT SA/COLLEGE P
	PA0028461	MIFFLINBURG BOROUGH MUNICIPAL
	PA0020273	MILTON MUNICIPAL AUTHORITY
	PA0020699	MONTGOMERY BORO
	PA0024325	MUNCY BOROUGH MUNICIPAL AUTHOR
	PA0008591	NATL GYPSUM CO-MILTON PLANT
	PA0020800	WHITE DEER TOWNSHIP MUNICIPAL
	PA0027057	WILLIAMSPORT SAN AUTH(CENTRAL)
	PA0027049	WILLIAMSPORT SAN AUTH(WEST)

Appendix D.
Point Source Dischargers Within the Watershed Areas

BRADFORD/TIOGA	PA0020036	BLOSSBURG MUNICIPAL AUTHORITY
	PA0113298	ELKLAND BORO SEWAGE
	PA0021814	MANSFIELD BOROUGH STP
	PA0009024	OSRAM SYLVANIA INC.
	PA0034576	TOWANDA MUN AUTH
	PA0043681	VALLEY JOINT SEW AUTH
UPPER SUSQUEHANNA	PA0007919	POPE & TALBOT WIS INC.
	PA0008885	PROCTER & GAMBLE PAPER PRODUCT
	PA0023736	TRI BORO MUNICIPAL AUTHORITY
WYOMING VALLEY	PA0023248	BERWICK MUN AUTH
	PA0027171	BLOOMSBURG MUN AUTH
	PA0026921	GREATER HAZELTON SEWAGE TREATM
	PA0009270	HEINZ PET PRODUCTS COMPANY
	PA0045985	MOUNTAINTOP AREA WSTWTR TMT FA
	PA0046388	ST. JOHNS SEWER TREATMENT PLAN
	PA0026107	WYOMING VALLEY SANITARY AUTHOR
LACKAWANNA	PA0028576	CLARKS SUMMIT-SOUTH ABINGTON J
	PA0027065	LACKAWANNA RIVER BASIN SEWER
	PA0027081	LACKAWANNA RIVER BASIN SEWER A
	PA0027090	LACKAWANNA RIVER BASIN SEWER A
	PA0026361	LOWER LACKAWANNA VALLEY SAN. A
	PA0026492	SCRANTON CITY SEW AUTH
LOWER SUSQUEHANNA EAST	PA0021806	ANNVILLE TOWNSHIP
	PA0009172	CHLOE TEXTILES INC
	PA0026123	COLUMBIA WASTEWATER TREATMENT
	PA0026484	DERRY TOWNSHIP MUN. AUTH.
	PA0023108	ELIZABETHTOWN BORO STP
	PA0027405	EPHRATA BOROUGH WASTEWATER TRE
	PA0008231	GOLD MILLS-DYEHOUSE
	PA0027197	HARRISBURG AUTHORITY THE
	PA0024040	HIGHSPIRE STP
	PA0042269	LANCASTER AREA SEWER AUTHORITY
	PA0026743	LANCASTER STP-SOUTH PLANT
	PA0027316	LEBANON CITY AUTH - SEW TREATM
	PA0026441	LEMOYNE BOROUGH MUNICIPAL AUTH
	PA0020320	LITITZ SEWAGE AUTHORITY
	PA0043575	LYKENS BOROUGH AUTHORITY
	PA0020893	MANHEIM STP
	PA0021717	MARIETTA DONEGAL JOINT AUTHORI

	PA0020664	MIDDLETOWN WASTEWATER TREATMEN
	PA0022535	MILLERSBURG AREA AUTH. STP
	PA0026620	MILLERSVILLE BORO
	PA0021067	MOUNT JOY SEWAGE TREATMENT PLA
	PA0026654	NEW CUMBERLAND BORO AUTH-STP
	PA0021890	NEW HOLLAND BORO AUTH
	PA0024287	PALMYRA BORO STP
	PA0020915	PINE GROVE BOROUGH AUTHORITY
	PA0046272	PORTER-TOWER JOINT MUNICIPAL A
	PA0026735	SWATARA TWP AUTH
	PA0035092	VICTOR F. WEAVER INC.
LOWER SUSQUEHANNA WEST	PA0026077	CARLISLE STP
	PA0024384	CARLISLE SUBURBAN AUTHORITY
	PA0009229	CONSOLIDATED RAIL CORP - ENOLA
	PA0024431	DILLSBURG BOROUGH AUTHORITY
	PA0020826	DOVER TOWNSHIP SEWER AUTHORITY
	PA0038415	EAST PENNSBORO SOUTH TREATMENT
	PA0081868	FAIRVIEW TWP STP
	PA0080314	HAMPDEN TOWNSHIP S. A.(ROTH)
	PA0028746	HAMPDEN TOWNSHIP SEWAGE TREATM
	PA0026875	HANOVER AREA REGIONAL WWTF
	PA0027189	LOWER ALLEN TOWNSHIP AUTHORITY
	PA0021571	MARYSVILLE MUNICIPAL AUTHORITY
	PA0020885	MECHANICSBURG BOROUGH MUNICIPA
	PA0023183	MOUNT HOLLY SPRINGS BORO AUTH
	PA0043257	NEW FREEDOM WWTP
	PA0020923	NEW OXFORD MUNICIPAL FACILITY
	PA0083011	NEWBERRY TOWNSHIP SUPERVISORS
	PA0023744	NORTHEASTERN YORK COUNTY SEW.
	PA0037150	PENN TWP STP
	PA0008869	PH GLATFELTER CO-WASTE TREAT
	PA0030643	SHIPPENSBURG BOROUGH AUTHORITY
	PA0083593	SILVER SPRING TWP AUTH
	PA0044113	SOUTH MIDDLETON TWP MUN AUTH
	PA0026808	SPRINGETTSBURY TOWNSHIP S.A.
	PA0036269	STEWARTSTOWN BOROUGH AUTHORITY
	PA0024902	UPPER ALLEN TOWNSHIP
	PA0026263	YORK CITY WASTEWATER TMT PLANT

Appendix D.
Point Source Dischargers Within the Watershed Areas

JUNIATA	PA0027014	ALTOONA CITY AUTHORITY-EASTERL
	PA0027022	ALTOONA CITY AUTHORITY-WESTERL
	PA0008265	APPLETON PAPERS INC.
	PA0022209	BEDFORD BOROUGH MUNICIPAL AUTH
	PA0028088	BROWN TWP MUN AUTH-STP
	PA0038920	BURNHAM BORO SEWER PLT
	PA0032883	DUNCANSVILLE SEWAGE TREATMENT
	PA0007552	EMPIRE KOSHER POULTRY/MIFFLINT
	PA0043273	HOLLIDAYSBURG REGIONAL WWTP
	PA0026191	HUNTINGTON BORO
	PA0026280	LEWISTOWN BORO
	PA0032557	LOGAN TWP.(GREENWOOD AREA) S.T
	PA0028347	MARTINSBURG SEWAGE DISPOSAL PL
	PA0020214	MOUNT UNION BORO
	PA0020249	ROARING SPRINGS BORO
	PA0023264	TWIN BOROUGHS SANITARY AUTHORI
	PA0026727	TYRONE BOROUGH SEWER AUTH-STP
POTOMAC	PA0080519	ANTRIM TOWNSHIP MUNICIPAL AUTH
	PA0026051	CHAMBERSBURG BORO
	PA0021563	GETTYSBURG MUNICIPAL AUTHORITY
	PA0020834	GREENCASTLE-FRANKLIN COUNTY AU
	PA0020851	HYNDMAN BOROUGH MUNICIPAL AUTH
	PA0021229	LITTLESTOWN BORO
	PA0080225	WASHINGTON TWP MUN AUTH
	PA0020621	WAYNESBORO BOROUGH AUTHORITY

Appendix E. Pennsylvania Tributary Strategy Cost Table

SAIC Estimates

Best Management Practices	Units	2003-2010 Tributary Strategy Units	Capital Unit Cost	Capital Cost	Annualization Rate	Annualization Term	Annualized Capital (1)	One-time Incentive Payments (2)	O&M Unit Cost	O&M Cost	Annual Incentive Payments (2)	Land Rental (3)	Total Costs (Not including Annualized Capital) (4)
Agriculture													
Forest Buffers	acres	102,258	$1,284	$131,299,086	5%	25	$9,315,993		$16	$1,656,577		$10,982,494	$12,639,071
Grass Buffers	acres	34,849	$132	$4,600,005	5%	10	$595,722		$0	$0		$3,892,580	$3,892,580
Wetland Restoration	acres	3,144	$1,221	$3,838,284	5%	30	$249,686		$37	$116,689		$280,405	$397,094
Land Retirement	acres	260,907	$132	$34,439,683	5%	10	$4,460,096		$0	$0		$23,403,330	$23,403,330
Tree Planting	acres	0	$1,284	$0	5%	25	$0		$16	$0			$0
Carbon Restoration/Alternative Crops	acres	288,442	$100	$28,844,217	5%	10	$3,735,458		$0	$0			$0
Conservation Tillage	acres	445,716	$0	$0	n/a	n/a	n/a		$3	$1,212,347			$1,212,347
No-Till	acres	480c592	$0	$0	n/a	n/a	n/a	$36,044,363	$3	$1,441,775			$1,441,775
Nutrient Management	acres	403,246	$19	$7,661,672	5%	3	$2,813,432		$0	$0			$0
Precision Agriculture	acres	1,186,303	$0	$0	n/a	n/a	n/a		$12.5	$14,828,789			$14,828,789
Enhanced Nutrient Management	acres	401,966	$19	$7,637,351	5%	3	$2,804,501		$0	$0			$0
Daily Precision Feeding	# cows	348,258	$0	$0	n/a	n/a	n/a		$102	$35,318,316			$35,318,316
Swine Phytase	# swine	1,171,918	$0	$0	n/a	n/a	n/a		$0.40	$468,767			$468,767
Ammonia Emission Reduction	# animal units	404,133	$7.50	$3,030,998	5%	3	$1,113,008		$0	$0			$0
Conservation Plans/SCWQP	acres	179,622	$92	$108,525,224	5%	10	$14,054,513		$5	$6,016,072			$6,016,072
Cover Crops – Early	acres	951,577	$0	$0	n/a	n/a	$0		$27	$25,692,582			$25,692,582
Off-Stream Watering w/Fencing	acres	185,655	$578	$107,308,373	5%	10	$13,896,925		$29	$5,406,263			$5,406,263
Off-Stream Watering w/o Fencing	acres	117,723	$417	$49,090,518	5%	10	$6,357,447		$21	$2,472,184			$2,472,184
Off-Stream Watering w/Fencing & Rotational Graze	acres	20,336	$728	$14,804,847	5%	10	$1,917,295		$37	$745,937			$745,937
Precision Grazing	acres	47,197	$150	$7,079,494	5%	10	$916,827		$15	$707,949			$707,949
Animal Waste Management Systems	manure acres	2,163	$35,398	$76,560,868	5%	10	$9,914,983		$3,602	$7,790,271			$7,790,271
Conventional-Till to Pasture	acres	0	$0	$0			$0		$0	$0			$0
Pasture to Mixed Open	acres	0	$0	$0			$0		$0	$0			$0
Stream Restoration	linear feet	33,400	$240	$8,016,000	5%	50	$439,090		$0	$0			$0
Agriculture Subtotal				**$592,736,619**			**$72,584,976**			**$103,874,518**		**$38,558,809**	**$142,433,327**
Forest													
Stream Restoration	linear feet	11,780	$240	$2,827,200	5%	50	$154,865		$0	$0			$0
Dirt & Gravel Road E & S Control – Forest	feet	2,483,036	$9	$22,347,324	5%	50	$1,224,113		$0	$0			$0
Forest Harvesting Practices		515	$0	$0	n/a		n/a		$84	$43,264			$43,264
Forest Subtotal				**$25,174,524**			**$1,378,978**			**$43,264**			**$43,264**
Urban													
Forest Buffers – Mixed Open	acres	10,388	$1,284	$13,337,719	5%	25	$946,344		$16	$168,280			$168,280
Forest Buffers – Pervious	acres	4,295	$1,284	$5,514,926	5%	25	$391,298		$16	$69,581			$69,581
Grass Buffers – Pervious	acres	8,395	$132	$1,108,172	5%	10	$143,513		$0	$0			$0
Tree Planting – Mixed Open	acres	0	$1,284	$0	5%	25	$0		$16	$0			$0
Stormwater Management – Wet Ponds and Wetland	acres	250,891	$3,363	$843,743,937	5%	25	$59,865,706		$168	$42,187,197			$42,187,197
Stormwater Management – Infiltration	acres	250,891	$5,285	$1,325,856,522	5%	10	$171,704,485		$528	$132,585,652			$132,585,652
Stormwater Management – Filtering	acres	250,639	$12,719	$3,187,930,217	5%	25	$226,191,483		$763	$191,275,813			$191,275,813
Stream Restoration – Urban	linear feet	4,000	$240	$959,443	5%	50	$52,555		$0	$0			$0
Stream Restoration – Mixed Open	linear feet	367,070	$240	$88,096,800	5%	50	$4,825,655		$0	$0			$0
Erosion and Sediment Control	acres	17,715	$0	$0	n/a	n/a	n/a		$1,649	$29,207,295			$29,207,295
Nutrient Management – Pervious	acres	442,410	$6	$2,653,695	5%	3	$974,460		$0	$0			$0
Nutrient Management – Mixed Open	acres	1,248,943	$2	$1,896,243	5%	3	$696,317		$0	$0			$0
Urban Sprawl Reduction	acres	7,118	$0	$0	n/a	n/a	$0		$0	$0			$0
Street Sweeping – Impervious	acres	29,957	$9	$269,612	5%	8	$41,715		$15	$449,354			$449,354
Horse Pasture Management – Mixed Open	acres	226,128	$347	$78,466,454	5%	10	$10,161,765		$22	$4,974,818			$4,974,818
Abandoned Mine Reclamation	acres	7,073	$6,180	$43,712,442	5%	20	$3,507,599		$37	$261,709			$261,709
Dirt & Graven E & S Control – Mixed Open	feet	2,857,822	$9	$25,720,398	5%	50	$1,408,879		$0	$0			$0
Urban Subtotal				**$5,619,266,580**			**$480,911,773**			**$401,179,699**			**$401,179,699**
Septics													
Denitrification	systems	288,513	$5,568	$1,606,297,349	7.4%	20	$156,368,894		$519	$149,821,005			$149,821,005
Septics Subtotal				**$1,606,297,349**			**$156,368,894**			**$149,821,005**			**$149,821,005**
Point Sources													
WWTPs	Tier 2 (8 mg/LTN and 1 mg/L TP for significant			$376,379,479	2.5%	20	$24,143,663			$9,840,769			$9,840,769
Point Sources Subtotal				**$376,379,479**			**$24,143,663**			**$9,840,769**			**$9,840,769**
Total Tributary Strategy Implementation Cost:				**$8,219,854,552**			**$735,388,284**	**$36,044,363**	**$7,760**	**$664,759,254**	**$0**	**$38,558,809**	**$703,318,063**

[1] "New" refers to full strategy less existing implementation, except for BMPs implemented on an annual basis (e.g., cover crops).

[1] Annualized over life of practice; represents cost in perpetuity.
[2] Cost paid over and above any offset to capital and o&m costs.
[3] Cost paid to offset opportunity cost for taking land out of production.
[4] Sum of annual payments: o&m, incentive, and land rental.

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