DRAFT REPORT

Focusing Resources to Restore and Protect the Chesapeake Bay and its Tributary Waters

Executive Order 13508, Section 202b Report

Disclaimer:
This document reflects the U. S. Department of Agriculture's (USDA) revised report under Section 202(b) of Executive Order 13508 (EO) making recommendations to the Federal Leadership Committee (FLC) for a strategy to target resources to restore and protect the Chesapeake Bay and its tributary waters. This revised document is published to supplement the FLC's publication of a *Draft Strategy for Protecting and Restoring the Chesapeake Bay* (issued November 9, 2009). This revised report includes recommendations that may change as the FLC's draft strategy is further refined based on public comments. This revised document is not a final agency action subject to judicial review; nor is it a rule. Nothing in this revised document is meant to, or in fact does, affect the substantive or legal rights of third parties or bind USDA or other agencies collaborating in the development of this report. While this revised document reflects USDA's and collaborating agencies' current thinking regarding recommendations to protect and restore the Chesapeake Bay, USDA and the collaborating agencies reserve the discretion to modify the recommendations included in the report as they work with the FLC to refine the draft strategy, or act in a manner different from this report as appropriate.

About this Document

Executive Order 13508, Chesapeake Bay Protection and Restoration, issued a call to action *"to protect and restore the health, heritage, natural resources, and social and economic value of the Nation's largest estuarine ecosystem."* Section 202(b) of the Executive Order directs the U.S. Department of Agriculture (USDA), in coordination with other Federal, State, and local stakeholders to develop recommendations for targeting resources to better protect the Chesapeake Bay and its tributaries. Section 401 clarifies that the Secretary of Agriculture should concentrate programs, as appropriate, on priority conservation practices to reduce nutrient and sediment losses from agriculture within priority watersheds in the Chesapeake Bay watershed.

This draft report provides a series of recommendations for focusing technical and financial resources to protect and restore the Chesapeake Bay watershed and its tributaries. The recommendations were developed in consultation with Federal agencies and State and local government agencies and stakeholders from the six states and the District of Columbia with lands in the Chesapeake Bay watershed.

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Executive Summary

The Chesapeake Bay ecosystem is a national treasure, a place of deep historical and cultural values, and a major force in shaping the region and the Nation. Farms and forests are an important component of this landscape, providing a reliable source of food, feed, and fiber. But these uses of the land are under tremendous development pressure. As farm and forestland is developed the expanded impervious cover increases surface water runoff, while access to local fresh foods and forest products and environmental services decline. There are also unintended impacts of agriculture and forestry activity in the Bay watershed. Agriculture is a major source of the nutrients and sediments that have contributed to the decline in Bay water quality. Forest loss and sediment from timber harvest and road development also pose challenges. Yet, maintaining healthy, sustainable farms and forests is an essential component to protecting and restoring the Chesapeake Bay and successes have been documented. Through an aggressive voluntary conservation approach, we will work to sustain and enhance agricultural and forest landscapes that provide local products to rural and urban communities alike, increase carbon sequestration, and contribute to a healthy Chesapeake Bay ecosystem and economy.

The Chesapeake Bay watershed stretches over 44 million acres in six states and the District of Columbia. Agriculture and forest land accounts for 75 percent of the Chesapeake Bay watershed, which also has the largest land to water ratio of any estuary (14:1). Consequently, the stewardship of these lands has a tremendous influence on the quality of natural resources in the watershed. These lands also anchor rural communities and provide precious open space, wildlife habitat, and other amenities important to the fabric of the Chesapeake Bay watershed.

About 25 percent of the Chesapeake Bay watershed is used for agriculture, producing a diverse array of fresh vegetables, fruits, grain, dairy, beef, poultry, and much more. While agriculture is an important component of the landscape and economy, it is also a major source of nutrients and sediment that adversely affect the quality of the Bay and its tributary waters. Through a long-standing partnership approach, the agriculture sector has reached nearly 50 percent of its goals for nitrogen, phosphorus, and sediment reduction, yet much more remains to be done.

Forests once covered 95 percent of the watershed and still account for 50 percent of the land cover. Chesapeake forests are still one of the most expansive hardwood forests in the world, providing diverse habitats for plants and animals, and providing valuable ecosystem services like clean air and water. About 80 percent (20 million acres) of the Chesapeake forest area is privately owned.

While agriculture and forestry remain the predominant land uses in the Bay watershed, they are under increasing pressure from development. Among the consequences of losing these agricultural and forested areas are declines in access to local, fresh foods; reduction in the capture of carbon in soils and plants; reduction in groundwater

recharge; and increased runoff from roads, roofs, and parking lots. Consider that a one-acre parking lot produces about 16 times the volume of runoff that comes from a one-acre meadow.

The challenge ahead is substantial, but one thing is clear – losing farms and forests is not in the best interest of the Chesapeake Bay ecosystem. Maintaining healthy, sustainable farms and forests is to protecting and restoring the Chesapeake Bay. While we focus is on the quality of the Bay waters, the approach must include dimensions of increasing farm viability and rural prosperity, strengthening and building markets for local foods, wood products, and ecosystem services, and protecting the natural heritage that makes the Chesapeake Bay watershed a national treasure.

An aggressive, voluntary partnership approach is called for, working with farmers, forest landowners, and other private land managers to continue to improve water quality while sustaining agriculture and forestry as valued components of the Chesapeake Bay watershed. This report presents six major recommendations with specific action areas:

- **Focus on the highest priority watersheds** by identifying the watersheds and their most critical acres for immediate conservation action in order to better protect the Bay and its tributary waters. Prioritizing public and private actions offers the best opportunity for success.
- **Focus and integrate Federal and State programs** by focusing programs on priority conservation practices, better coordinating U.S. Department of Agriculture (USDA) and U.S. Environmental Protection Agency (USEPA) resources for voluntary conservation, and delivering programs and assistance most effectively. Strong partnerships with states and local governments, communities, and the private sector are essential to achieve the environmental objectives for the Bay watershed.
- **Accelerate conservation adoption** by working with partners to increase incentives, simplifying program participation, and encouraging private sector investment in conservation actions to restore the health of the Bay. Coordinated programs that empower voluntary actions through incentives, and technical and financial assistance are a fundamental part of improving the Bay.
- **Accelerate development of new conservation technologies** by increasing public-private research partnerships and focusing Federal funding to foster and promote innovation to expand the "conservation toolbox." New technologies that increase revenue opportunities for farmers and their communities will also increase rural prosperity and sustain the restoration of the Bay.
- **Foster and support ecosystem markets** by increasing coordination across Federal agencies to promote market development, and accelerating development and implementation of a Bay-wide market framework.
- **Implement a sound accountability system** by establishing environmental outcomes; tracking, monitoring, and assessing progress; ensuring that federally supported conservation measures are applied and maintained; and using science

to adapt and improve the strategy to protect and restore the Chesapeake Bay watershed. This system of accountability has many parts, starting with ensuring that public agencies deliver their resources and assistance effectively to restore and protect the Bay.

The initiative set forth by this Executive Order reflects public and private interest in sustainable solutions to the long-standing plight of the Chesapeake Bay ecosystem. Never before have agriculture and forestry been as central to current national policy issues – climate change, water resources, renewable energy, and rural America's role in creating a 21st century economy. This momentum will be sparked by the richness of new data and analytical tools that can be used to build sound, science-based conservation policies and program approaches. We are committed to a new spirit of collaboration with multiple stakeholders and integration of Federal resources to accelerate actions *"to protect and restore the health, heritage, natural resources, and social and economic value of the Nation's largest estuarine ecosystem."*

Table 1. Summary of Recommendations and Proposed Actions

Recommendation / Action	Recommended Timeframe	Primary Partners
Recommendation: Focus on the highest priority watersheds		
Identify high priority watersheds	Immediately for USDA programs	USDA, USDOI, EPA, State Agencies
Identify critical acres	Immediately for USDA programs	USDA, USDOI, EPA, State Agencies
Recommendation: Focus and integrate Federal and State programs		
Prioritize high impact practices	Immediately for most programs; Fall, 2010 for CSP. Additional Federal programs – 2010. State programs based on annual funding.	USDA, Chesapeake Bay restoration partners, States,
Coordinate USDA-EPA voluntary programs and resources	Immediately	USDA, EPA
Deliver programs most effectively	2011	USDA, USDOI, State Agencies
Recommendation: Accelerate conservation adoption		
Increase incentives through partnerships	2010 – State programs based on annual funding	USDA, State Agencies, NGOs and Private Investment Organizations
Simplify program participation	By 2011	USDA
Recommendation: Accelerate development of new conservation technology		
Increase public – private research partnerships	2009	USDA, Industry Representatives

Recommendation / Action	Recommended Timeframe	Primary Partners
Foster and promote innovation	2010	USDA, EPA
Recommendation: Foster and support ecosystem markets		
Increase coordination across Federal agencies to promote market development	Begin 2010	USDA, USDOI, USDOC, EPA, State Agencies, Public/Private Investment Companies
Accelerate development of a Bay-wide market framework	Begin 2010	USDA, EPA, USDOI, USDOC State Agencies, Public/Private Investment Companies
Recommendation: Implement a sound accountability system		
Establish environmental outcome measures	Developed by 2012	Partners
Create a conservation practice implementation database	Begin 2009, In place by 2012.	USDA, State Agencies, USDOI, Chesapeake Bay Program Office
Monitor and assess progress in priority watersheds	In place by 2012	USDOI, Chesapeake Bay Program Office, USDA
Use science to adapt the strategy	In place by 2012	USDA, USDOI

Background

The Chesapeake Bay is the largest estuary in North America, supporting more than 3,600 species of plants, fish, and animals. The Chesapeake Bay watershed, home to nearly 17 million people, stretches over 44 million acres in six states and the District of Columbia (*Figure 1*). An essential economic engine, the Bay Watershed supports significant agricultural, forest, fishery, and tourism sectors. The Chesapeake Bay Watershed Blue Ribbon Finance Panel (2004) observed that the economic value of the Bay may be over $1 trillion annually, but noted that the experiential and deep historical and cultural values of the Bay are beyond calculation.

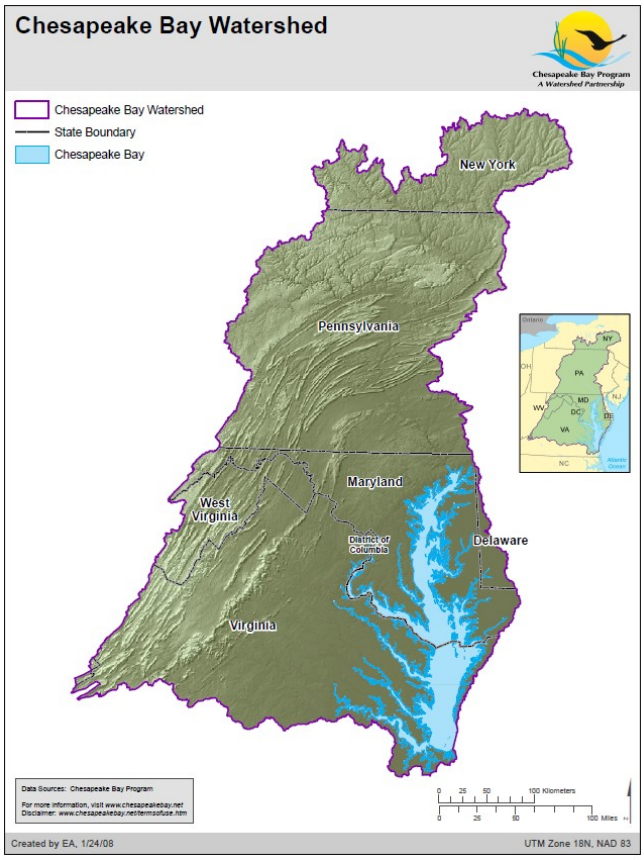


Figure 1. The Chesapeake Bay Watershed. This watershed has the highest land to water ratio of any estuary in the United States. Land-based activities heavily influence the condition of the Bay.

Agriculture and forest land accounts for 75 percent of the Chesapeake Bay watershed, which also has the largest land to water ratio of any estuary (14:1). About 25 percent of the land is used for agricultural purposes – the 2007 Census of Agriculture reported nearly 84,000 farms covering 12.6 million acres. Agriculture in the Bay watershed is diverse – yielding fresh vegetables, fruits, grain, dairy, beef, and poultry, among other products. In 2006, the Chesapeake Bay Executive Council noted Chesapeake agriculture's regional and national significance – "producing 5.7 percent of the Nation's agricultural receipts and contributing 13 percent of the region's Gross Domestic

Product" (CBEC, 2006). While agriculture is an important component of the landscape and economy, it is also a source of nutrients and sediment that adversely affect water quality in the Bay. The Chesapeake Bay Program reported in 2008 that nutrients and sediment from agriculture accounted for 43 percent of the nitrogen, 43 percent of the phosphorus, and 60 percent of the sediment reaching Bay waters.

Through a strong partnership approach, agriculture has made good strides, reaching nearly 50 percent of its goals for nitrogen, phosphorus, and sediment reduction since 1985 (*Figure 2*). Progress toward these goals is measured and reported through the Chesapeake Bay Program Office using the monitoring and tracking data gathered by Bay Program partners. The Chesapeake Bay Model is used to estimate the amount of pollution control efforts implemented in relation to the commitments made by the Bay jurisdictions in their cleanup strategies. These estimates may not account for all conservation measures installed by private landowners. Clearly, agriculture can make a positive contribution to addressing the challenges facing the Chesapeake Bay watershed, from preserving open space and providing wildlife habitat to generating water quality improvements (*Sidebar: Conservation Leads to Proposed Delisting of the North Fork River*).

Figure 2. Agriculture - Progress toward Established Goals for Nutrient and Sediment Reduction, 1985 - 2008

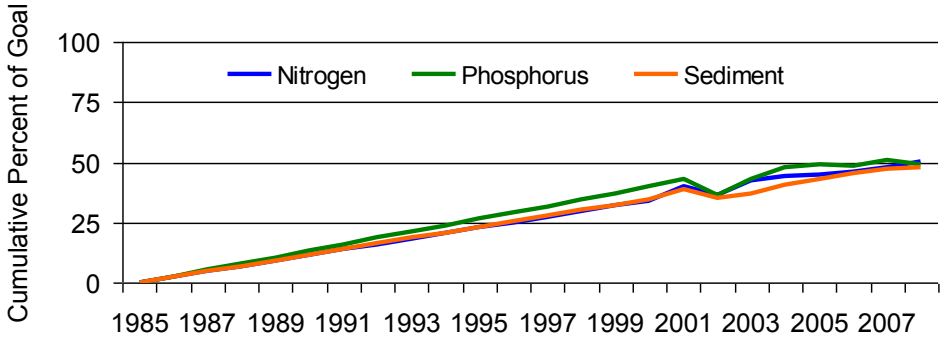


Figure 2 Source: Chesapeake Bay Program, http://www.chesapeakebay.net/status_agriculture.aspx?menuitem=19861

Conservation Effects Lead to Proposed Delisting of the North Fork River

The North Fork Project in the Potomac Headwaters illustrates that agricultural conservation delivered through a coordinated partnership approach can work effectively to solve a water quality problem. Based on recent water quality monitoring results and the extent of conservation practices installed, the West Virginia Department of Agriculture is proposing that the North Fork River be delisted from the 303(d) list of impaired waters in West Virginia.

The North Fork River is a scenic high-quality trout stream in the rural Potomac Headwaters area. The watershed is predominantly in forest and agricultural uses – primarily beef and poultry production that is concentrated in the valley bottoms and floodplains. High levels of bacteria and sediment were adversely affecting the North Fork and South Branch watersheds. Based on the South Branch Potomac watershed Total Maximum Daily Load (TMDL) allocations, the North Fork required a 35 percent reduction in fecal coliform bacteria loading from agricultural land to meet West Virginia's water quality standards.

Cooperative conservation efforts to address the water quality challenges in the watershed began in the early 1990s. To date, 12 agricultural Section 319 projects, one forestry Section 319 project, and 19 land treatment watershed (PL-534) contracts have been implemented in the North Fork watershed to control agricultural runoff. Eighty-five percent of the farmers in the project area have participated by implementing priority conservation practices to reduce nutrient and sediment delivery to streams. The forestry community is also responding and developing plans to promote conservation and reforestation.

More information: http://www.epa.gov/nps/success/

Agriculture and forestry are the predominant land uses in the watershed, but are under increasing pressure from development. Between 1982 and 2003, nearly 2 million acres of crop, pasture, and forest land were converted to large and small built up areas (*Figure 3*) – an area greater than the entire State of Delaware. Now, about 12 percent of the land in the Chesapeake Bay watershed is classified as developed, up from 8 percent in 1982 (National Resources Inventory, 2003). Approximately 130,000 new residents move to the Chesapeake Bay watershed each year, driving a continuing market for development. Population growth in the Bay watershed is projected to increase to 20 million by 2030, and at the current rate of development this may increase impervious surface by 15 percent.

In addition to population growth, other pressures lead to agricultural and forest land conversion, such as the economic viability of agriculture, complexity of doing business in the rural–urban interface, and diminishing access to agricultural and forest-related infrastructure. As watersheds shift from agriculture and forest to developed uses, the fabric of the community also begins to change leading to further conversions.

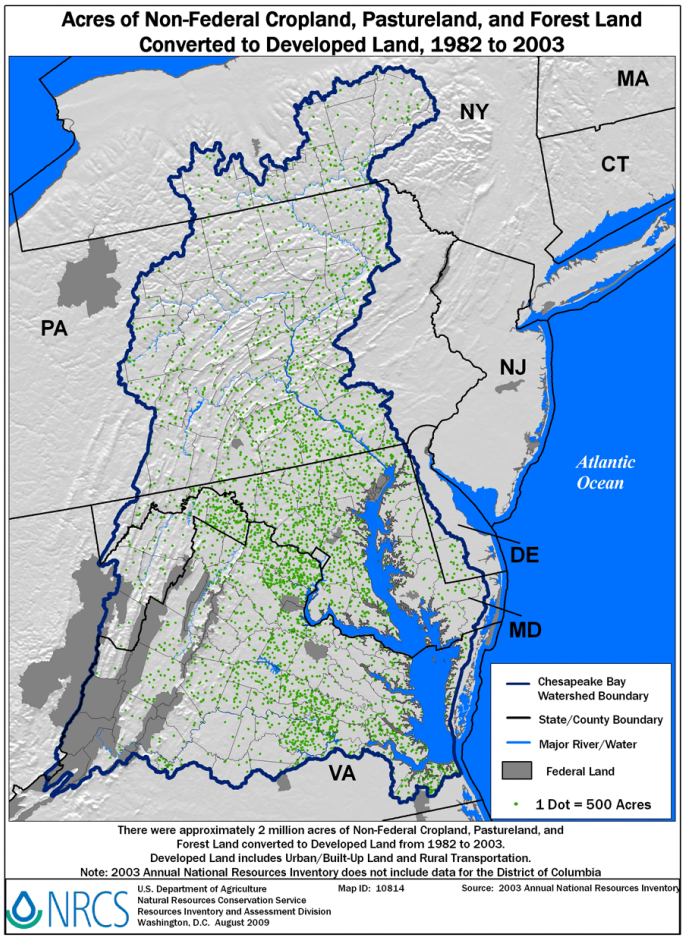


Figure 3. Conversion of Agricultural and Forest Land to Developed Uses, 1982 – 2003. Conversion increases impervious surface, but also diminishes many ecosystem services such as aquifer recharge, and carbon capture.

Multiple impacts are associated with conversion of agricultural and forested areas to developed uses. Access to local, fresh foods declines and carbon sequestration in agricultural and forestland vegetation and soils diminishes along with aquifer recharge capacity, which negatively affects groundwater flows. Impervious surfaces – such as roads, roofs, and shopping malls – increase. Consider that a one-acre parking lot produces about 16 times the volume of runoff that comes from a one-acre meadow (Beach, D. 2002). Once impervious surfaces cover more than 4 percent of a watershed, rivers, creeks, and estuaries begin to degrade biologically, and by the time 10 percent of a watershed is in impervious surface, the aquatic system becomes seriously degraded.

The challenge ahead is substantial, but one thing is clear – losing farms and forests is not in the best interest of the Chesapeake Bay ecosystem. Indeed, agriculture and forestry are preferred land uses in the watershed. ***An aggressive, voluntary partnership approach is called for, working with farmers, forest landowners, and other private land managers to continue to improve water quality while sustaining***

agriculture and forestry as valued components of the Chesapeake Bay watershed. This approach, while focused on water quality, must include dimensions of increasing farm viability and rural prosperity, strengthening and supporting markets for local foods, ecosystem services, and wood products, and protecting the natural heritage that makes the Chesapeake Bay watershed a national treasure.

Current Investments and Approaches

Concerns about the Chesapeake Bay and its living resources date back as early as the 1930s (GAO, 2005). The 1980s brought new emphasis on restoration of the Bay Watershed with the establishment of the Chesapeake Bay Commission and subsequently the Chesapeake Bay Program. Since that time significant public and private investment has been devoted to identifying and working to solve the problems facing the Bay.

Numerous Federal and State and local programs are delivered in the Chesapeake Bay watershed. These program approaches range from voluntary working lands conservation and land retirement to Federal land management, research, education, extension, and municipal water treatment and infrastructure assistance. Incentives include financial assistance, grants, loans, and educational and technical assistance for planning and implementing needed measures. Program participants are equally diverse ranging from individuals and communities to States and Tribes, among others (*Appendix A. Summary of key Federal programs delivered in the Chesapeake Bay watershed*).

State and Federal agencies make significant investments in activities that have a direct impact on Bay restoration. The Chesapeake Action Plan reported that between 2007 and 2009, over $2.6 billion had been devoted to such activities (CAP, 2009). State programs accounted for nearly 78 percent of that total investment, Federal programs for 21 percent, and nongovernmental organizations for about 1 percent. Nine Federal partners estimate that nearly $2.5 billion was directed to Chesapeake Bay restoration activities through over 30 Federal programs between 2004 and 2008 (*Table 2. Selected Federal Program Investments, 2004 – 2008*).

The program portfolio is diverse, investment has been significant, and successes have been documented. The good news is that these facts indicate we have the capability and the tools to restore and protect the Chesapeake Bay. Today, we are challenged to improve coordination and focus program resources across the public-private partnership as never before. Through an aggressive voluntary conservation approach, we will work to sustain and enhance agricultural and forest landscapes that provide local products to rural and urban communities alike, increase carbon sequestration, and contribute to a healthy Chesapeake Bay ecosystem. Our partnership will encourage and support private markets for ecosystem services that provide new income streams for farmers and forest owners, and drive private sector innovation for new markets and technologies to accelerate progress toward the vision established by the Executive Order for the health of the Chesapeake Bay watershed.

Table 2. Summary of Investment in the Chesapeake Bay Watershed, Estimates for Selected Federal Programs, 2004 - 2008

Agency	Program	2004	2005	2006	2007	2008	Total
		— millions of dollars —					
NRCS [1]	Environmental Quality Incentives Program	$ 24.0	$ 27.1	$ 31.0	$ 31.7	$ 43.9	**$ 157.7**
NRCS [2]	Farmland Protection Program	$ 10.9	$ 14.6	$ 5.7	$ 7.3	$ 15.0	**$ 53.6**
NRCS [3]	Wetlands Reserve Program	$ 2.6	$ 1.9	$ 3.0	$ 2.6	$ 7.1	**$ 17.2**
NRCS [1]	Wildlife Habitat Incentives Program	$ 1.3	$ 1.6	$ 1.3	$ 1.3	$ 3.7	**$ 9.2**
NRCS [1]	Agricultural Management Assistance	$ 2.3	$ 2.3	$ 3.0	$ 0.8	$ 1.7	**$ 10.1**
NRCS [1]	Conservation Security Program	$ 0.2	$ 6.4	$ 5.3	$ 10.7	$ 1.7	**$ 24.3**
NRCS [1]	Conservation Innovation Grants	$ -	$ 4.6	$ 3.8	$ 2.1	$ 5.0	**$ 15.5**
NRCS [4]	Conservation Technical Assistance	$ 21.2	$ 19.5	$ 20.4	$ 16.5	$ 17.7	**$ 95.3**
NRCS	Conservation Reserve Program - TA	$ 2.2	$ 3.4	$ 3.7	$ 3.5	$ 2.7	**$ 15.6**
FSA	Conservation Reserve Program - FA	$ 38.7	$ 42.5	$ 39.4	$ 40.4	$ 43.1	**$ 204.1**
FSA	Emergency Conservation Program	$ 0.04	$ 0.14	$ 0.50	$ 1.36	$ 1.44	**$ 3.5**
FSA	Grassland Reserve Program	$ 0.04	$ 0.25	$ 1.08	$ 1.74	$ 2.45	**$ 5.6**
FS [5]	Chesapeake Watershed Forestry	$ 1.0	$ 1.0	$ 1.0	$ 0.9	$ 1.0	**$ 4.9**
RD	Water and Waste Disposal Loan and Grant Program	$ 10.1	$ 14.3	$ 21.8	$ 23.6	$ 46.0	**$ 115.7**
NIFA	National Integrated Water Quality Program Grants, Water and Watershed Program Grants, and Noncompetitive Grant funds	$ 1.33	$ 1.25	$ 2.62	$ 1.81	$ 2.03	**$ 9.04**
ARS	Conservation Effects Assessment Project	$ 0.8	$ 0.9	$ 1.7	$ 1.7	$ 2.0	**$ 7.1**
ARS	Choptank River Watershed Studies	$ 0.4	$ 0.5	$ 0.5	$ 0.6	$ 0.6	**$ 2.6**
ARS	Watershed Modeling Assessment Project	$ 1.2	$ 1.2	$ 1.2	$ 1.2	$ 1.2	**$ 6.0**
ARS	Manure Treatment and Nutrient Management	$ 3.1	$ 3.1	$ 3.4	$ 3.4	$ 3.4	**$ 16.5**
USFWS	Partners for Wildlife	$ 1.9	$ 1.9	$ 2.5	$ 2.6	$ 2.5	**$ 11.4**
USFWS	Coastal Program	$ 1.3	$ 1.5	$ 1.3	$ 1.2	$ 1.4	**$ 6.7**
EPA	State Pollution Control Grant Program – Clean Water Act Section 106	$ 24.0	$ 25.0	$ 25.0	$ 25.0	$ 31.5	**$ 130.5**
EPA	Clean Water State Revolving Loan Fund	$ 309.0	$ 221.0	$ 228.0	$ 228.0	$ 201.0	**$ 1,187.0**
EPA	Nonpoint Source Management Program Grants - Clean Water Act Section 319	$ 30.0	$ 24.0	$ 23.0	$ 26.0	$ 19.0	**$ 122.0**

EPA	Chesapeake Bay Program - Clean Water Act Section 117	$ 23.0	$ 23.0	$ 22.0	$ 27.0	$ 30.5	**$ 125.5**
EPA	Targeted Watershed Grants	$ 0.8	$ 1.1	$ 0.8	$ 0.5	$ 3.3	**$ 6.5**
USACE/6	Water Resources Development Act - Investigations	$ 1.83	$ 2.18	$ 1.95	$ 2.41	$ 2.88	**$ 11.3**
USACE/6	Water Resources Development Act - Construction (Specifically Authorized)	$ 16.13	$ 14.06	$ 13.76	$ 13.46	$ 13.77	**$ 71.2**
USACE/6	Water Resources Development Act – Construction (Small Projects)	$ 3.24	$ 1.40	$ 3.29	$ 2.51	$ 4.22	**$ 14.7**
USACE/6	Water Resources Development Act – Operations & Maintenance	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10	**$ 0.5**
USACE/6	Water Resources Development Act – Regulatory & Enforcement Functions	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	**$ 0.3**
	Total	**$ 532.9**	**$ 461.8**	**$ 472.0**	**$ 482.2**	**$ 512.0**	**$ 2,460.9**

/1 Data reflect Federal funding for financial and technical assistance and does not include program participant investment in the costs of conservation practices implemented. Participants share average between 25 and 50 percent.

/2 Data reflect Federal financial and technical assistance funding for purchase of easements and does not include partner contribution of the total cost of the easement. Partner shares average between 30 and 60 percent of the total easement cost.

/3 Data reflect Federal funding for financial and technical assistance for purchase of wetlands easements and restoration cost share and does not include participant investment in the costs of wetlands restoration.

/4 Data reflect Federal funding for technical assistance only and does not include program participant investment in the conservation practices implemented.

/5 Data reflects congressionally designated funds that directly support Chesapeake Bay Program goals. Funding through other Forest Service program areas, such as Forest Legacy, Forest Stewardship, Urban and Community Forestry, and funding through Forest Service Research and National Forest System may indirectly affect the health of the Bay.

/6 USACE WDRA - U.S. Army Corps of Engineers Water Resources Development Act work includes: Environmental Ecosystem and Infrastructure; Environmental Stewardship; Stream and Shoreline Erosion Control; Navigation Harbor and Channels; Flood Plain Management; and Flood Risk Management efforts. Expenditure data are limited to Federal funding and does not include Local Sponsors Contributions ranging between 25-35 percent of the work.

Source: Funding estimates presented in this table were provided by each listed Agency.

Recommendations

Substantial investment over the past several decades has put conservation practices in place throughout the Chesapeake Bay watershed. We have seen successes in certain parts of the ecosystem. However, the Chesapeake Bay continues to have poor water quality, degraded habitats, and low populations of many fish and shellfish species. The 2008 Bay Health and Restoration Assessment reported that only 38 percent of the Bay health goals and 61 percent of the restoration goals were being met (CBP, 2009). A more focused, integrated strategy is essential to achieve the vision of a "fully restored ecosystem" – a balanced and sustainable ecosystem that includes healthy fish and wildlife populations, thriving agriculture and forestry, and strong rural communities.

The following recommendations present a long-term roadmap for leveraging public and private resources in an aggressive, voluntary approach to protect and restore the Chesapeake Bay Ecosystem:

- Focus on the highest priority watersheds.
- Focus and integrate Federal and State conservation programs.
- Accelerate conservation adoption.
- Accelerate development of new conservation technologies.
- Foster and support ecosystem services markets.
- Implement a sound accountability system.

Recommendation I: Focus on the highest priority watersheds.

Conservation applied on any acre delivers an environmental benefit, but to date conservation applied in the Chesapeake Bay watershed has not reached dimensions needed to achieve the broader goals for improving the aquatic health of the Bay and its tributary waters. Applying lessons learned, we will use science-based tools and input from local experts to determine where to invest program and human resources in order to deliver the greatest environmental benefit. Much work has already been done in this regard, including identifying impaired waterways under the Clean Water Act process, which provides a good foundation for further refining priority areas for immediate attention. Specifically, we will: 1) identify high priority watersheds in which a variety of Federal investments can make the greatest difference, and 2) identify critical acres within high priority watersheds on which conservation practices will have a greater impact.

Identify high priority watersheds for immediate conservation action.

Identifying the high-priority watersheds is the foundation for a successful Bay restoration strategy. The essential ingredients are sound science to identify natural resource stressors and isolate the most strategic locations, and regional stakeholder expertise. The partnership approach used to identify high priority watersheds for the USDA's Chesapeake Bay Watershed Initiative (CBWI) – created by the 2008 Farm Bill – is a starting point for focusing resources in the Bay. The NRCS, USEPA, and the U.S. Geological Survey (USGS) collaborated to identify watersheds expected to have the

greatest influence on Bay water quality using a variety of analytical tools, databases, and local knowledge. These watersheds were identified based on natural resource condition and vulnerabilities, land use in different regions of the watershed, existing conservation practices, and their relationship to key Bay pollutants – nitrogen, phosphorus, and sediment *(Figures 4 and 5).* Key criteria considered in identifying priority watersheds included:

1. Nitrogen, phosphorous, and sediment loads from agricultural sources
2. Stream Impairment status
3. Availability of partner resources (technical and financial)
4. Ability to produce results (where conservation is expected to have a positive impact)

While factors such as potential risk and vulnerability based on climate change are important, data limitations minimize their use in priority setting currently. The effect of mosaics of developed and agricultural lands in producing discharges and elevated nutrient concentrations is another important consideration in identifying high priority watersheds for conservation action (see also 202e).

Through the priority setting process, approximately 500 small watersheds were identified (*Appendix B*) covering 10.5 million acres (or nearly 25 percent of the Chesapeake Bay watershed) on which a suite of conservation actions can be applied to more efficiently meet water quality goals. These conservation actions would include conservation practices installed with assistance from voluntary programs authorized through the Farm Bill, Clean Water Act, or other authorities. Beginning in 2010, NRCS, USGS, and USEPA will adapt this approach annually, bringing new partners to the table and incorporating evaluation of conservation outcomes and additional data to refine the priority watersheds and practices for subsequent years of the CBWI. The science and information developed through this process will be made widely available to encourage other entities to focus their resources on the highest conservation priorities.

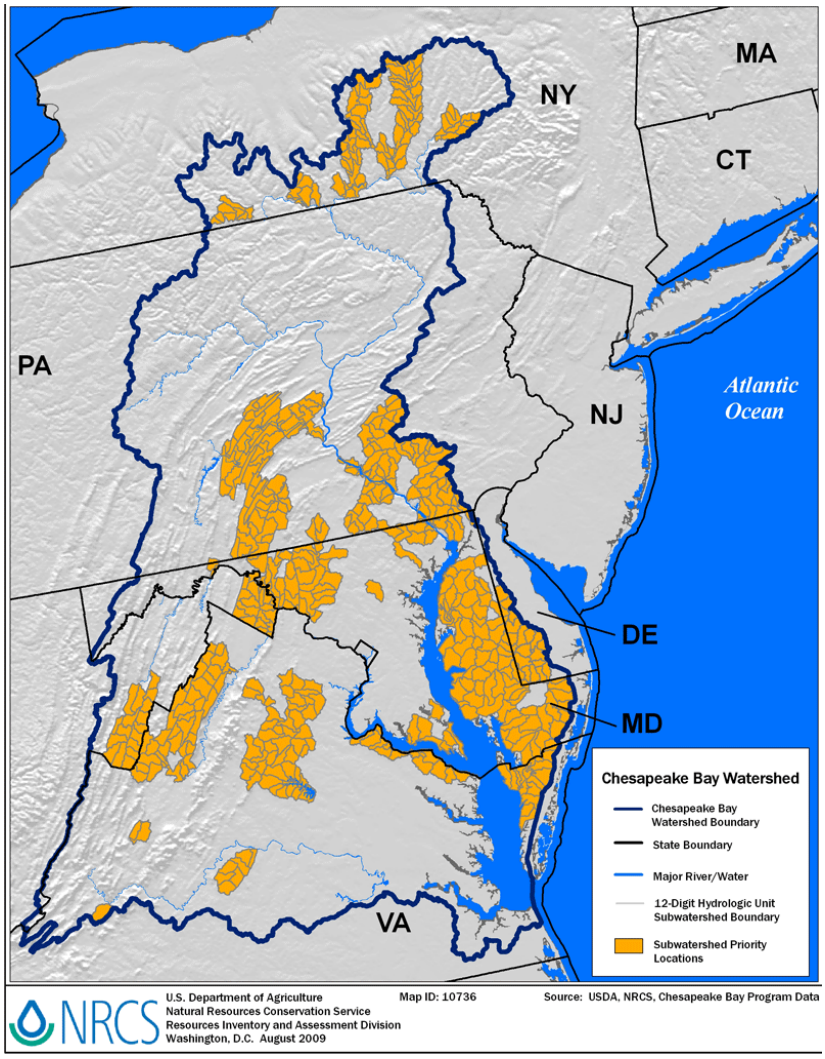


Figure 4. Priority Locations – Chesapeake Bay Watershed Initiative. About one-quarter of the acres in the Chesapeake Bay Watershed in more than 500 small watersheds are potential priorities for conservation treatment in order to improve water quality in the Bay.

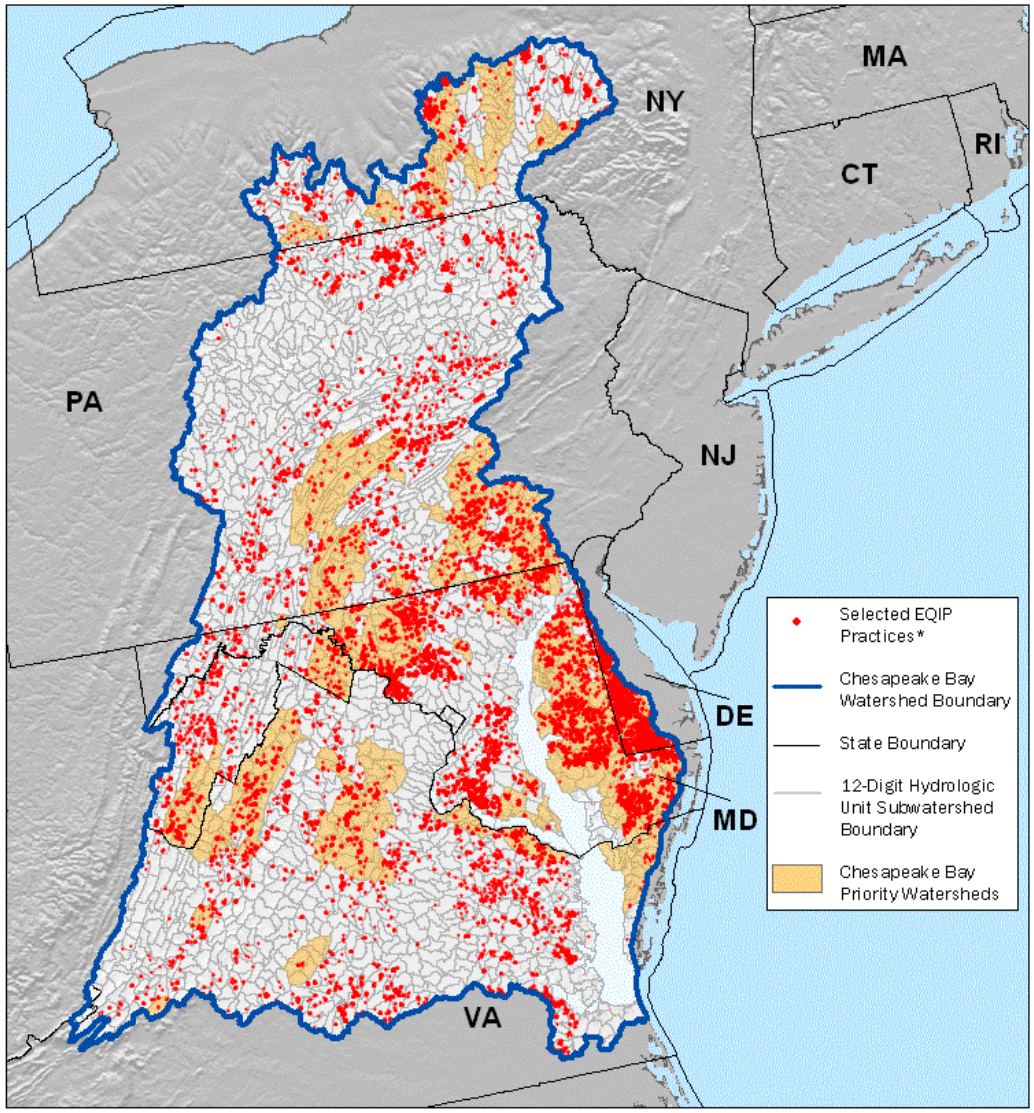


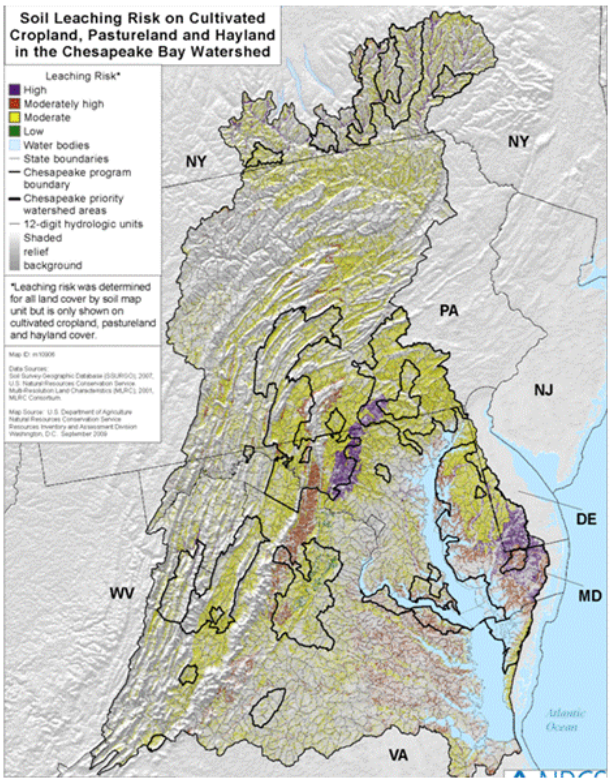
Figure 5. EQIP Practices in the Chesapeake Bay Watershed. Between 2004 and 2008, conservation applied in the CBW through EQIP aligned well with identified priority watersheds. The application ranking process helped ensure that high priority applications received attention.

Identify the most critical acres.

Once high-priority watersheds are identified, conservation efforts should be focused on the most critical acres in those watersheds. Identifying critical acres depends in part on sound assessment of natural resource factors such as inherent vulnerability or proximity to sensitive landscape features, as well as sector or operation characteristics. The Conservation Effects Assessment Project (CEAP) analysis in the Upper Mississippi River Basin will document the considerable acre-to-acre variation in the effects of water erosion control practices. Among many lessons learned from the CEAP analysis, is that to get the most from conservation investment in any watershed, we should focus on the most vulnerable and under-treated acres. Strategically integrating USDA's resources with those of our partners will accelerate sediment and nutrient reduction in critical areas.

Soil vulnerability is an important factor to consider in identifying critical acres in the Chesapeake Bay watershed because of its relationship to potential losses of key pollutants – nutrients and sediment (*Figure 6*). In assessing vulnerability, we account for factors such as soil drainage, rate of water movement, and high water tables – characteristics important in areas on the Delmarva Peninsula and in river valley bottoms. Factors such as soil surface texture, infiltration, and slope also are predictors of vulnerable soils. These factors are important in areas such as Lancaster County, Pennsylvania, West Virginia and the Shenandoah Valley in Virginia. Together these vulnerable soils account for 32.6 million acres in the Chesapeake Bay watershed, of which nearly 7.5 million are within identified high-priority watersheds; two-thirds of the vulnerable acres in high priority watersheds are currently in agricultural or forest land uses. However, inherent soil vulnerability is only one factor to be assessed. The intensity of the land use, hydrologic features, as well as the level of conservation treatment currently in place also must be considered in identifying critical acres. Well-treated, highly vulnerable soils may pose less overall risk than poorly treated, less vulnerable soils.

Soils vulnerable to leaching risk



Soils vulnerable to runoff risk

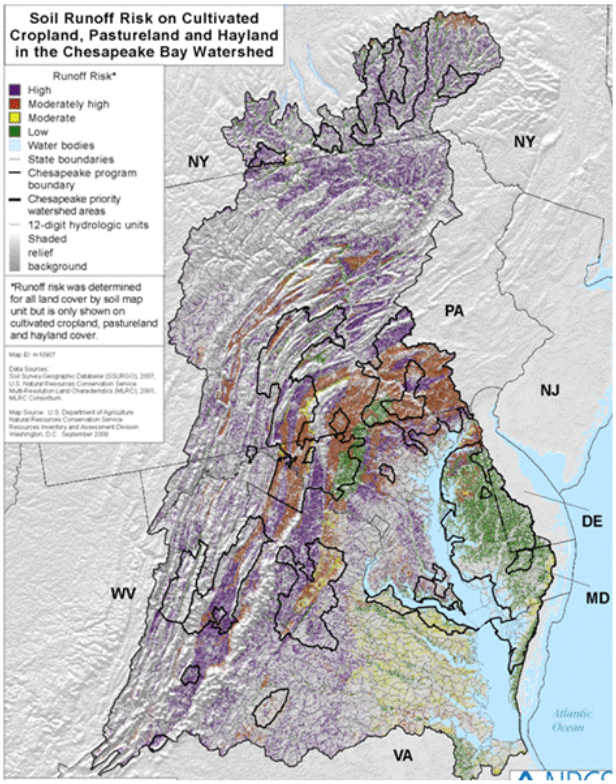


Figure 6. Distribution of Vulnerable Soils in the Chesapeake Bay Watershed. Crop, pasture, and hay land soils with high and moderately high potential for runoff or leaching are shown in purple and rust shades, respectively. Yellow and green shading indicates crop, pasture, and hay land soils with moderate to low vulnerability.

Another approach to identifying critical acres is to focus on land covers that are the most beneficial for water quality and that provide multiple ecosystem benefits. In 2007, the Chesapeake Bay Executive Council signed a Forest Conservation Directive that clarified that the conservation of forests was critical to the Chesapeake Bay ecosystem and set a number of forest related goals for the partnership.

Geographic targeting was a key component of the Directive as was targeting program activities, which focused on three key components: 1) protection of working forests, 2) restoration of riparian and urban forests, and 3) stewardship of rural and community forests. The Forest Conservation Directive identified high-value forests for conservation using a state-led process with significant input by stakeholders (*Figure* 7). The result is a goal to protect 695,000 acres (out of a total of 4.3 million acres) of high value forest lands by 2020. At present, approximately 6 percent of this goal has been achieved. Focusing Federal conservation easement programs (e.g., Forest Legacy, Farm and Ranch Lands Protection Program) as well as fostering and expanding conservation partnerships between public and private entities could accelerate progress toward this

goal to protect forest lands that are important for water quality and threatened by development.

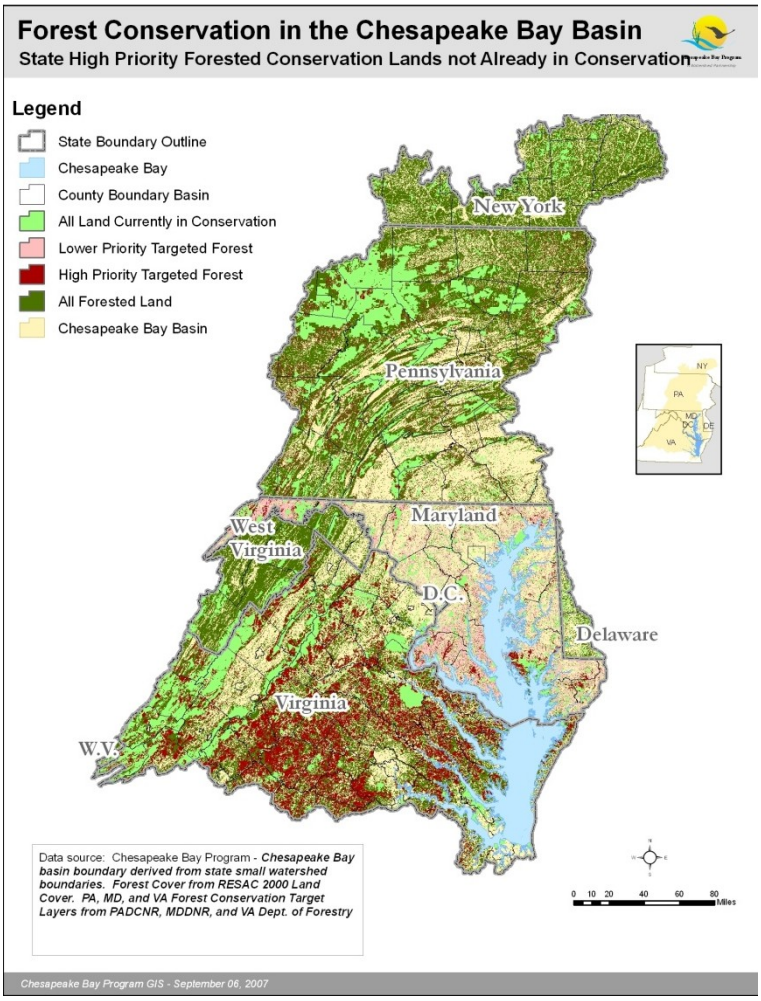


Figure 7. Forest Conservation in the Bay watershed. The forest conservation directive established a goal of protecting 695,000 acres of high value forest lands by 2020. These high-value forests for conservation are given red and pink shading. The lightest green shading reflects forestland currently in conserving uses.

As part of its regular program in forest legacy, the Forest Service (FS) will continue to work with partners to protect high value watershed lands and reduce the loss of forests to development in priority landscapes in the Chesapeake Bay watershed. A landscape-level assessment of priority forest areas would be used to target forest protection projects in those areas in partnership with State agencies, land trusts, conservation groups and local governments, and submitted for the national competitive process.

The Directive also established goals to increase riparian forest buffers to cover 70 percent of the riparian area of the watershed. An accelerated goal for forest buffers was repeated in the 2-year milestones established by Bay States in May 2009. Over 6,000 miles of riparian forest buffers had been established by the close of 2008, of which 90

percent were installed through the Conservation Reserve Enhancement Program (CREP). The Chesapeake Bay Program has developed tools to improve targeting placement of riparian forest buffers to enhance their contributions to improving water quality.

The 2008 Farm Bill placed additional emphasis on forest lands in voluntary conservation programs, which will benefit conservation on forest lands in the Bay Watershed. The State-Federal Forest Stewardship Program has already provided technical assistance to over 220,000 of the 900,000 forest landowners in the Chesapeake Bay watershed. The Spatial Analysis Project tool is available to states to help in refining priority areas needing heightened forest stewardship. In addition, State Resource Assessments and Strategies underway by State forestry agencies will add more geographic information and facilitate additional focusing of programs when they are complete in May 2010.

Recommendation II: Focus and integrate Federal and State programs.

A substantial number of Federal and State programs are delivered in the Chesapeake Bay watershed with objectives related to restoring and protecting the Bay. With so many entities involved, it is critical to coordinate and integrate programs on the ground to ensure that they are working toward common objectives, maximizing synergistic opportunities, and preventing potential duplication of efforts. Among the many benefits of increasing integration of programs on the ground is the potential to simplify program delivery for potential participants – developing the virtual "one-stop-shop" for individuals and communities that will need to participate in conservation efforts in order to accomplish Chesapeake Bay watershed restoration and protection objectives. Coordinating programs across all of with the Bay Partners, including the authorities under the Farm Bill, State and Private Forestry, the Clean Water Act, as well as Department of the Interior programs such as Partners for Wildlife, offers the best opportunity for success.

Prioritize high impact practices.

Coordinating across existing programs is a significant task, but essential to a comprehensive approach for focusing resources on the highest conservation priorities. Focusing program resources may be accomplished through a variety of methods, from identifying priority areas to assigning priorities for specific practices. USDA's Chesapeake Bay Watershed Initiative (CBWI) will focus funding on the most needed conservation practices in the identified high priority watersheds, while USEPA may look for opportunities to target Section 319 and 117 or State Innovation Grant funds through guidance that provides preference for priority watersheds or practices. Other collaborating agencies may focus on complementary restoration efforts, such as restoring wildlife habitat in conjunction with agricultural or forest conservation activities. Reaching consensus on priority watersheds and practices through a robust, science-driven collaborative process will serve as a much-needed platform for effectively focusing program resources on conservation priorities (*Sidebar: The Potomac Watershed Partnership*).

Another mechanism for focusing assistance in the most critical areas is to assign a greater priority in the application ranking process to conservation activities that will result in nutrient and sediment reductions in the Bay. In the CBWI, for example, landowners offering to implement conservation in the Priority Watersheds received a higher environmental score for their application, thus moving them up the list for funding. The Chesapeake Bay partners could agree to assign higher priority to applications from individuals, communities in the Bay Watershed that propose to reduce nutrient and sediment loading to the Bay, or to undertake actions that complement such reductions. Indeed, reducing nutrient and sediment delivery is only part of the answer for restoring the Bay, equally important are the efforts to recover the Bay's living resources, such as oysters, that play a critical role in filtering and maintaining a healthy ecosystem.

Identifying the most economically and environmentally effective conservation practices suitable to the priority areas (watersheds and acres) can improve program efficiency in reducing nutrient and sediment delivery to the Chesapeake Bay. USDA is establishing high impact targeted (HIT) practices, to promote the most essential conservation actions, streamline delivery of assistance, and increase transparency for participants. In the case of the CBWI, the Federal–State partnership identified a specific list of priority agricultural conservation practices based on efficiencies in producing water quality benefits per dollar expended and capacity for rapid implementation to provide the greatest reduction in potential nutrient losses from farm fields (*Table 3*). Integrating ongoing research on conservation effects and conservation technologies into the process of identifying HIT practices will be critical to identifying the highest performing practices, particularly important in the area of nutrient and sediment reduction where nutrient imbalances exist (*see Recommendation VI*).

While there is significant similarity across these State priority practice lists, there is also variability, which is important. Over 160 conservation practices are contained within the NRCS Field Office Technical Guide (FOTG), and they address a wide variety of conservation challenges. In addition, the conservation practices in the FOTG are suitable to a diversity of operation and production approaches. Practices emphasized for funding are identified at the local and State level, which brings in the local sector information needed.

Monitoring ecosystem response to the application of conservation practices will be a decisive input for partners in identifying conservation practice priorities. In each successive year, the HIT practice list will be reviewed with local and State partners to determine revisions to the list and to coordinate funding sources toward practice implementation. That review and adjustment process must be informed by credible and complete data on practice implementation, conservation effects, and ecosystem condition, to be in place by 2012 (*see Recommendation VI)*. This approach provides flexibility, and allows local selection of HIT practices needed to achieve the Chesapeake Bay watershed objectives.

Table 3: Priority conservation practices identified by States for the Chesapeake Bay Watershed Initiative, 2009

Pennsylvania	New York	Virginia
Cover Crops Diversions Feed Management Grassed Waterways Nutrient Management Precision Application Techniques Residue Management Riparian Buffers Stream Bank Fencing Terraces Vegetative Cover	Cover Crops Diversions Grassed Waterways Nutrient Management Pasture and Hayland Planting Prescribed Grazing Riparian Buffers Stream Bank Fencing	Conservation Cover Conservation Crop Rotation Cover Crop Fence Nutrient Management Pasture and Hayland Planting Pest Management Residue and Tillage Management Riparian Forested Buffer Riparian Herbaceous Cover Tree Planting
Maryland	**Delaware**	**West Virginia**
Grassed Waterways Nutrient Management Precision Application Techniques Residue Management Riparian Buffers Stream Bank Fencing Structures for Water Control Vegetative Covers – filter strips, field borders Waste Storage Facilities	Cover Crops Heavy Use Area Protection Irrigation Water Management Nutrient Management	Cover Crop Fence Heavy Use Area Protection Nutrient Management Pest Management Residue Management Shoreline Protection Waste Storage Facility

While this larger concept of focusing and integrating programs on the ground poses challenges, in the near term, we can begin to improve coordination of Federal programs by communicating more effectively on where actions are planned or under way. For example, immediate coordination of existing conservation programs across Departments with projects under the American Recovery and Reinvestment Act (ARRA) could co-locate efforts that will provide Chesapeake Bay water quality improvements. USEPA's Clean Water State Revolving Fund will have $870.9 million from ARRA to assist communities in the Chesapeake Bay watershed states with water quality infrastructure needs, including nutrient reduction upgrades of wastewater facilities. Approximately 20 percent of the funding is directed toward innovative "green infrastructure" projects. In addition, 1 percent from this fund is set aside to be used for water quality management planning (e.g., tributary strategies, Total Maximum Daily Loads (TMDL), two-year restoration milestones, etc.). Looking for opportunities to leverage agricultural and forest land conservation near communities that are also improving municipal systems could accelerate benefits.

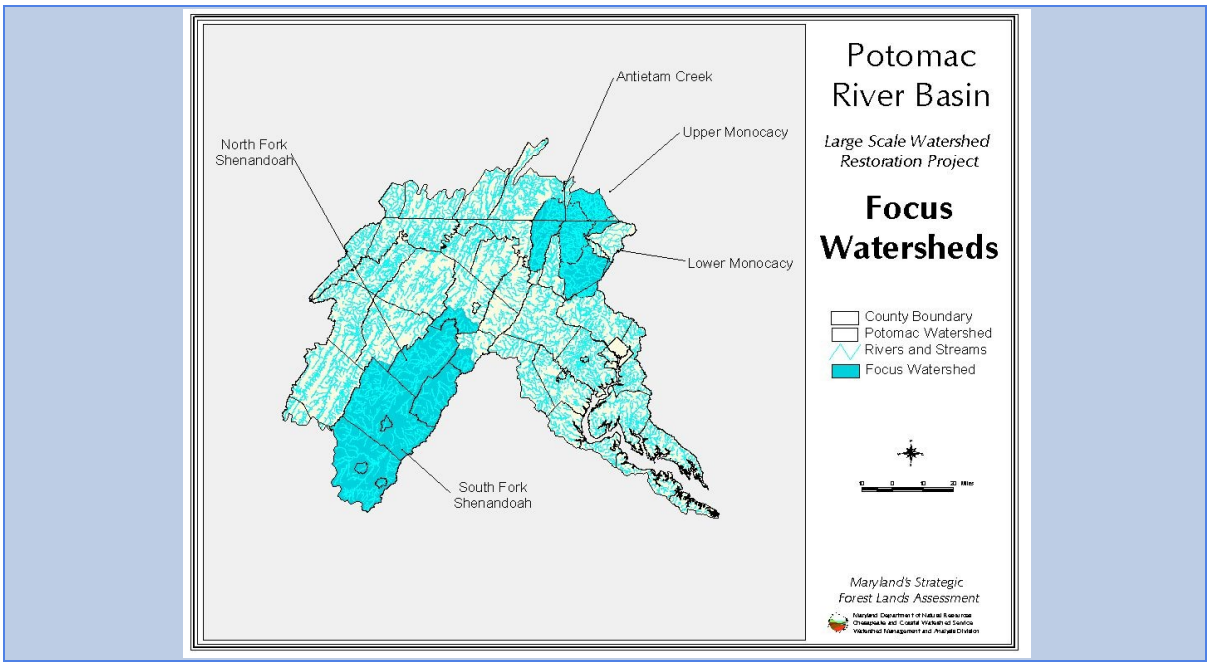
The Potomac Watershed Partnership

Centuries of intensive land use have threatened the watershed health and water quality of our Nation's River, the Potomac. The Potomac Watershed Partnership was one of the community based watershed restoration initiatives formed in 2000 by the US Forest Service. The Partnership is built on the leadership and work of five primary partners: US Forest Service - Northeastern Area, State and Private Forestry and the George Washington National Forest, Maryland DNR Forest Service, Virginia Department of Forestry, Ducks Unlimited, Inc., and the Potomac Conservancy. Over time it has expanded to include collaborative relationships among many additional local, State and Federal natural resource agencies and private conservation groups and communities interested in and who contribute resources to accelerate watershed and forest stewardship efforts in the Potomac River Basin. It was one of the first large-scale collaborative efforts to focus on the region's land use and water quality and still going strong today. The partners work on the following six goals:

1. Accelerate riparian and wetland restoration
2. Promote land protection and stewardship
3. Enhance forest stewardship and reduce wildfire risk
4. Create more livable and greener communities
5. Increase and spread knowledge through assessment, monitoring, and education
6. Sustain and expand partnerships

In its first year, the partnership completed a strategic assessment and began targeting their efforts in the Shenandoah River, Monocacy River, and Antietam Creek subwatersheds. These watersheds had some of the lowest percentages of healthy riparian forests and wetlands; among the highest levels of nutrient and sediment pollution; the most forest tracts affected by forest pests; and some of the greatest development pressures in the Potomac basin.

In five years, the partnership restored over 800 miles of riparian forests, protected over 10,000 acres of forest land, and conducted 12,000 acres of prescribed burns. Credit for these achievements goes to the alliances and combined resources of the Federal, State, and private groups that came together on common goals and priorities. Citizens benefit from these efforts through healthier streams and landscapes; improved flood and fire control; and increased land values, education, and stewardship.



Coordinate USDA – USEPA voluntary programs and resources.

Meeting the challenges in the Chesapeake Bay watershed will involve the creativity and collaboration of Federal, State, and local partners. USDA and USEPA have a meaningful opportunity to foster this wider collaboration by better integrating and focusing their voluntary programs in high priority watersheds (see 202a, Healthy Waters – Thriving Agriculture Initiative). USDA and USEPA already work together on many issues in the Chesapeake Bay watershed, but expanding the visibility of these voluntary efforts through demonstration projects would draw attention to the benefits of significant and innovative conservation approaches to address key issues, such as reducing nutrient and sediment losses. Important opportunities include improving the targeting of USDA and USEPA resources in priority watersheds (*see Recommendation I*), establishing high profile projects *(Sidebar: Coordinating to Meet Water Quality Challenges)*, focusing on high priority practices such as improved nutrient management (*see Recommendation II*), and encouraging innovation and accelerating development of improved conservation technologies (*see Recommendation IV*). Through the alignment of resources and continued work with Federal, State, and local partners, the collaboration of USDA and USEPA could accelerate the wider adoption of conservation practice and support innovative efforts to address some of the most pressing challenges to meeting water quality and agricultural goals in the Bay.

Coordinating to Meet Water Quality Challenges

Excluding livestock from streams is a long-standing conservation practice for reducing nutrient and sediment delivery to surface waters. Research indicates that animal health and pasture condition also improve as livestock have access to in-field watering stations and are encouraged to forage more evenly. Watershed-wide implementation of this offers the best opportunity to improve water quality. USDA and USEPA could collaborate to establish livestock exclusion as a "centerpiece project" to demonstrate the significant benefits to be achieved through coordinated action at the watershed level.

USDA and USEPA could pair resources to focus on livestock exclusion in certain priority watersheds; establishing participation and conservation implementation goals needed to achieve projected nutrient and sediment reductions. In the selected watersheds, USDA conservation programs could prioritize applicants offering to participate in a livestock exclusion pilot, potentially establishing a ranking pool or other preference. For example, streambank fencing is a priority practice in USDA's Chesapeake Bay Watershed Initiative, which means that preference is provided for participants whose offers include livestock exclusion. USEPA could direct its State Innovation Grants, or CWA Section 117 or 319 funds to provide additional technical resources through Districts or State agencies for outreach and communication, as well as for technical assistance to participating producers. Leveraging State programs, such as the NRCS – State of Maryland nutrient management model, could increase the rate of financial assistance, further increasing participation incentives. Partnering with private sector interests in water quality trading could provide additional revenue options for producers that could increase incentives for participation.

Reporting on progress, participation and environmental, will be crucial to building interest to replicate the approach in key watersheds throughout the Chesapeake Bay watershed. USDA's practice implementation database can provide information on the extent of livestock exclusion applied, while USGS stream gauging and USEPA support for State water quality monitoring could provide the in-stream results.

Polywire livestock exclusion fencing, Rockingham County, VA

Deliver programs most effectively.

Technical assistance is an essential ingredient in delivering conservation programs effectively. We will develop a coordinated plan to assess technical assistance capacity across the partnership and identify and create strategies to fill technical gaps to ensure success of this effort. This will include seeking opportunities to align partner resources, such as USEPA's Section 319 and State Innovation Grants funds. We will also explore new ways to develop local capacity, taking into account innovative approaches for delivering assistance, opportunities to build third-party capacity, and the need to reach out to landowners who may not have traditionally participated in conservation programs. As we broaden and strengthen the traditional conservation partnership, these local advocates will help to leverage the interest and participation needed to accelerate the application of conservation on the ground.

We will coordinate outreach in priority watersheds to accelerate progress and ensure that the most effective conservation message is delivered, irrespective of organizational affiliation. USDA supports extension education programs in the Bay watershed through a partnership with land grant universities that work with audiences from agricultural to urban to raise awareness of water quality issues and communicate strategies. Through coordination we will ensure that Partner authorities and strengths are knitted together effectively. For example, NIFA or USEPA outreach and education resources might be used to build interest in conservation programs delivered through USDA or the U.S. Fish and Wildlife Service (USFWS).

The FS will continue its effort and partnerships to offer additional grants targeting watershed stewardship through forest protection, restoration, and improved management. These grants have brought people and groups together and fostered collaborative action throughout the Chesapeake Bay watershed to plant trees, restore forest areas, and manage them for water quality improvement. This program would allow greater opportunity to work with cities and communities to improve watershed health and expand urban tree canopy through strategic tree planting that reduces stormwater runoff, improves air quality, and helps cities adapt to climate change.

Recommendation III: Accelerate conservation adoption.

Nearly 75 percent of the Chesapeake Bay watershed is in the hands of agricultural and forest landowners and managers. Economic and non-economic incentives play an important role in encouraging these landowners to make the day-to-day stewardship decisions that shape conservation in the Chesapeake Bay watershed. Between 2004 and 2008, through USDA conservation programs alone, nutrient management was applied on 600 thousand acres; while an important achievement, we must accelerate conservation adoption if we are to achieve objectives for restoring the health of the Bay. Existing incentive approaches will be improved on to increase their effectiveness by better coordinating programs and streamlining processes to simplify program participation.

Leverage incentives through partnerships.

Most USDA agriculture conservation programs involve a shared investment between the government and the landowner. For example, participants in the Environmental Quality Incentives Program (EQIP) regularly share 50 percent of the cost of the conservation practice. So while program funds are aimed at critical areas, farmers, ranchers, or private forestland owners must be economically willing and able to participate. When essential practices are expensive, such as those requiring significant engineering work, the economic challenge is even greater. A typical animal waste management system in the Chesapeake Bay watershed, for example, may run between $100,000 and $250,000 for an average dairy operation.

Coordinated approaches between Federal and State programs may offer opportunities to overcome economic disincentives. For example in Maryland, NRCS and the Maryland Department of Agriculture coordinate on important practices such as cover crops and animal waste systems to allow Federal and State program cost-share to be combined and thereby reduce the costs to participants. Incentives through the Conservation Reserve Program (CRP) and the Federal-State partnerships under the Conservation Reserve Enhancement Program (CREP) have been important tools in encouraging land owners to install specific conservation practices to protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water in and around the Chesapeake Bay.

Another role for coordination is to reach more potential participants. The State of Virginia and NRCS reviewed their respective funding authorities and determined it would more effective for each partner to focus their funding on different conservation practices in order to provide a more diverse set of practices. Such an approach may be particularly suited to areas with substantial diversity in land uses and operation types. While this approach may not increase the proportion of funding available, it can increase the spectrum of individuals that can participate.

Two new conservation program authorities, the Cooperative Conservation Partnership Initiative (CCPI) and the Agricultural Water Enhancement Program (AWEP), also offer opportunities to increase financial incentives by leveraging non-Federal contributions for conservation efforts. Both of these programs operate under a competitive process to select partnership proposals that focus on priority resource issues in specific geographic areas. Partners contribute additional resources to the overall cost of the project, as well as bringing technical or other types of assistance. Flexibilities allowed for under the CCPI also could allow for higher financial assistance levels for participants, if required to overcome barriers to participation.

Simplify program participation.

While significant resources are available to assist landowners in the Chesapeake Bay watershed with planning and installing conservation measures, some participants and potential participants see the enrollment process as burdensome and complex. Opportunities exist under current program authorities to streamline some of these processes. For example, under the CCPI, partners may request flexibilities that

streamline the application ranking process, or otherwise accelerate participant acceptance into the program. In some cases, even greater flexibilities may be needed, for example, where cultural or other mores prevent traditional participation in programs. The Conservation Delivery Streamlining Initiative underway at NRCS is developing business processes and tools that will bring greater efficiencies to program delivery in the future. Potential exists for this process to allow a planner to work with a landowner , develop a conservation plan, and in some cases, approve a contract application on-site if it meets identified criteria (such as being located in a priority watershed, focusing on critical acres, including HIT practices). Some components of the new Streamlining Initiative business model are slated for implementation in 2011.

Recommendation IV: Accelerate development of new conservation technologies.

Current conservation technologies and tools, such as conservation tillage and comprehensive nutrient management, have demonstrated successes in reducing nutrient and sediment losses from agricultural operations. Despite progress, current Bay reports still point to nutrients and sediment from agriculture as substantial contributors to the problems affecting the Bay. Accelerating progress toward improving the condition of the Chesapeake Bay watershed will depend on expanding the "conservation toolbox".

Substantial investment is made through the agricultural research system, much of which is basic research, refined and brought to market by the private sector. USDA's research mission through the Agricultural Research Service (ARS) and the National Institute for Food and Agriculture (NIFA) is engaged in a substantial partnership effort with public and private sector interests to identify needed research and focus Federal researchers and grant programs on developing solutions. The resulting knowledge is leveraged by the private sector to develop needed technologies and tools.

Increase public–private research partnerships.

Focusing Federal research responsibilities on the Chesapeake Bay watershed and public-private partnerships will be essential for developing the new technologies and tools to reduce nutrient and sediment delivery to the Bay and its tributaries. Increasing the collaboration between research organizations, industry, and practitioners can stimulate development of affordable technology that works for agriculture and forestry as well as for the Chesapeake Bay watershed.

Bringing advanced nutrient management technologies to the market will expand the options for agriculture and help to keep a productive and sustainable agriculture as a valued component of the Chesapeake Bay watershed. USDA research programs in ARS and NIFA have established priorities for technology development emphases to assist agriculture in improved nutrient management, including a focus on manure nutrients and imbalances, where manure nutrients generated are in excess of crop nutrient needs. A recent ARS-led discussion with fertilizer industry leaders in the Choptank watershed highlighted the nutrient management challenges facing producers

and is stimulating industry interest in advancing nutrient technologies to reduce potential for leakage.

Algal Turf Scrubber

Dr. Walter Adey's 1980s algal turf scrubber (ATS) process, which is being used increasingly in Everglades cleanup work, has not yet been applied to tackle the Chesapeake Bay nutrient problems. Dr. Kangas, University of Maryland professor, and Dr. Adey would like to see that change. ATS uses pretty simple technology – nutrient-laden water is diverted into raceways containing screens with algae. The algae absorb the nutrients and oxygenate the water, which is returned to its source. The two scientists are conducting a pilot in Lancaster County, PA to test the ATS technology in a temperate climate. Partnering with Exelon Power Company, which owns and operates Muddy Run Storage and the Conowingo Dam, the project is generating encouraging results. On-site researchers have measured a near doubling of oxygen concentration in waters after their journey through the raceways, while water samples analyzed at USDA's Beltsville facility showed nitrogen reductions of over 30 percent. The hardworking algae are harvested periodically to keep them at peak performance and the residue offers another opportunity according to the researchers – conversion to biofuels. The partners in this pilot are already talking about scaling up. Adey and Kangas have a vision of ATS systems on small strips of farmland along the rivers and creeks of the Chesapeake Bay watershed (Chesapeake Quarterly, 2009). And they may not be alone in that vision, the Caroline County Conservation District is doing just that – testing a field-scale application of the ATS technology to achieve nutrient load reductions from agricultural drainage systems in the Upper Choptank River watershed. The project was funded in 2008 through the Chesapeake Bay Conservation Innovation Grants program, supported by USDA and the National Fish and Wildlife Foundation. The project team will be evaluating the feasibility of this innovative approach to nutrient reduction, including the overall maintenance costs and barriers to acceptance.

The Perdue AgriRecycle litter recycling plant on the Delmarva peninsula is an example of an industry led solution to a significant environmental issue. The plant has handled more than 500,000 tons of poultry litter in its first seven years of operation; reducing potential nutrient loading into the Bay by 40 million pounds of nitrogen, 20 million pounds of phosphorus and 30 million pounds of potassium. Another example is the industry adopting an additive (Phytase) in feed formulations that reduces phosphorus in poultry waste by nearly 25 percent. A third example is research conducted by the University of Maryland on new technologies and tools for precision application of nitrogen and phosphorus to crop fields. Early results show that through the use of these technologies, producers can reduce nitrogen application by up to 20 percent.

Foster and promote innovation.

A number of Federal agencies (e.g., NRCS, FS, NIFA, USEPA) and federally supported organizations such as the National Fish and Wildlife Foundation operate grant and related research programs that can foster conservation innovation, research, and related efforts. Focusing grant programs on the key natural resource challenges in the Chesapeake Bay watershed can help produce the next generation of conservation tools to accelerate progress in sustainable management of agriculture and forest systems in the watershed. Coordinating Partners' Innovation Grant and related programs, such as Conservation Innovation Grants and State Innovation Grants, can promote collaboration across Agencies in identifying innovation and research needs, avoid redundancy, and result in funding the most critical efforts.

Through the grant process, Federal agencies can also stimulate development of infrastructure and markets essential for new conservation approaches to be effective and enduring. Two recent NRCS Conservation Innovation Grants have been awarded in the Chesapeake Bay watershed to stimulate the development of water quality trading programs (*Sidebar: Focusing Conservation Innovation Grants*)

Fostering Innovation

Innovation is fundamental to the next generation of environmental improvements in the Chesapeake Bay watershed. USDA fosters innovation through research and program authorities. For example, NIFA Mid-Atlantic Regional Water project has fostered interdisciplinary collaboration to develop innovative strategies to improve water quality in the Chesapeake Bay. Collaborators from a cohesive network of extension and research faculty from nine land grant universities are engaged in facilitating the development and transfer of innovative technologies and effective strategies to improve water quality within the Bay watershed.

The Conservation Innovation Grant (CIG) process provides another opportunity to engage researchers and the private sector in conservation innovation. Through the Chesapeake Bay Watershed Category, grants are made to encourage innovation to solve the specific problems in the Bay. In 2009, over $2.1 million was awarded in six grants focusing on a variety of mechanisms to reduce nutrient and sediment loading. One project in the Potomac River Watershed is a three-phased approach to develop and implement a water quality credit trading program in the West Virginia area of the Potomac River Watershed. Another project in Maryland is piloting Point

source to Non-Point Source Nutrient Trading in the Upper Chesapeake Bay. As both of these projects move forward, important lessons will be learned on how to effectively develop markets and infrastructure to implement water quality trading projects designed to improve the quality of Bay waters.

Future Chesapeake Bay conservation innovation grants will be used to leverage work with other public and private entities and individuals to accelerate transfer of promising technologies and approaches to address some of the Region's most pressing natural resource concerns. The grants will ultimately benefit agricultural producers by providing more options for environmental enhancement and compliance with Federal, State, and local regulations.

Recommendation V: Foster and support ecosystem markets.

Chesapeake Bay protection and restoration must also involve private markets in order to reach the level and scope of progress needed. Markets for carbon sequestration, water quality, wetlands, wildlife habitat, and species protection have great potential to complement existing federally supported conservation efforts and drive private investment to improve the health of the Chesapeake Bay. These markets connect the critical ecosystem services provided by farms, forests, and ranches to beneficiaries who are willing, or required, to pay for their stewardship – such as urban water utilities, industry, and land developers who must mitigate unavoidable negative impacts to the watershed. Potential income from ecosystem markets provides new incentives for landowners to engage in restoration and conservation activities on their land (*Figure 8*).

Many existing ecosystem markets, such as wetland mitigation banks or water quality trading markets, emerged in response to regulation, and although carbon is not regulated, many would suggest that the market emerged in anticipation of legislation. Generally, markets for ecosystem services are slow to develop – most transactions are one-time trades between a buyer and a landowner, for an individual project involving a single management activity. A coordinated, unified market framework is needed for carbon, water, and biodiversity markets to grow to a volume that has measureable landscape-level impact. Supporting market development efforts in this region, such as the Bay Bank Marketplace and the Chesapeake Fund, is an important way to foster market innovation aimed at strategically directing resources to protect and restore the Chesapeake Bay.

Figure 8. New Markets for Agricultural Lands. Potential income from ecosystem markets provides new incentives for landowners to engage in restoration and conservation activities on their land.

New Markets for Agricultural Lands

With the emergence of markets for ecosystem services, landowners will find new income streams in the form of tradable credits for ecosystems like water, carbon, and biodiversity, to augment revenues from traditional products like grain, livestock, and timber.

Water Quality Credits

Agricultural lands provide critical water filtering services that ensure the provision of quality water to downstream users. Nutrient management, wetland enhancement, and establishment of buffer strips are some of the practices that help reduce or eliminate nutrient and sediment runoff from these lands. Landowners who adopt these practices may generate water quality credits that may be sold to urban water utilities and industrial polluters that must comply with the Clean Water Act.

Carbon Offset Credits

Agricultural lands are a critical component of nature's storehouse of carbon dioxide taken from the atmosphere. Conservation tillage practices, perennial grass plantings, tree plantings, and reforestation and conservation of forested land are activities that may increase the amount of CO_2 farmlands sequester. Landowners who adopt these practices may generate offset credits that may be sold to industrial emitters of greenhouse gases in anticipation of future federal climate regulation.

Biodiversity Credits

Critical wildlife habitat and species protected under federal and state regulations are often found on or near agricultural lands. Landowners who set aside areas for wildlife habitat and species protection, through a conservation easement or other such contract, may create a "biodiversity bank." In exchange for permanently protecting the land for its natural resource values, the landowner may sell credits to land developers and other entities that must comply with the Endangered Species Act.

Commodity	Percentage of Farm Revenue	Buyer
Water Quality Credits	10%	Urban Consumers Industrial Emitters
Carbon Offset Credits	15%	Energy Industry Transportation
Biodiversity Credits	5%	Land Developers Conservation Org.
Renewable Energy	10%	Energy Market
Traditional Farm Income	60%	World Market
Total	100%	

Adapted from Scientific American (2005) by the USDA Office of Ecosystem Services and Markets

Increase coordination across Federal Agencies to support market development.

USDA's new Office of Ecosystem Services and Markets (OESM) is leading the effort to create a Federal framework for ecosystem markets that will facilitate market development and ensure that markets are credible, accessible, and robust. OESM will bring executive departments and agencies together to address the challenges of emerging markets, foster market innovation, and shape national market infrastructure that will enhance land conservation and community well being. Through NRCS and the Forest Service, OESM will support landowners as they integrate ecosystem values into their land management decisions and engage in stewardship activities that deliver ecosystem services to the public.

Implementation of a Bay-wide ecosystem market framework.

To facilitate the implementation of a Bay-wide ecosystem market framework, collaborating agencies need to coordinate support for existing ecosystem market projects as well as new efforts that together mobilize private capital investments for restoration activities in the Chesapeake Bay. Potential new funding streams through an effective Bay-wide market could pay farmers for activities that may not only offset carbon or other greenhouse gases (GHGs), but also contribute to nutrient reductions and watershed/biodiversity benefits in the Bay watershed. Pilot projects could inform the design of a new "ecosystem credit" that would represent an optimal suite of ecosystem services that have greater value than a single carbon or nitrogen credit. Highlighting these co-benefits could demonstrate the inter-connection between all of the ecosystem services provided by a conservation activity. Such pilots could also offer one opportunity to examine and resolve some of the research and tool-related questions on how to operationalize multi-credit trading within a watershed, potentially helping to shape a robust ecosystem market for the Bay that allows for interstate trades. It will be important for new efforts to relate to and expand upon emerging market activities to foster development of a Bay-wide system that could serve as a model to be replicated in other watersheds throughout the country.

Recommendation VI: Implement a sound system of accountability.

A sound system of accountability is critical to monitoring progress toward the goals for the Bay. That system of accountability has many parts starting with ensuring that objectives are clearly defined and achievable, and that adequate resources are dedicated to make restoring and protecting the Bay possible. An adaptive management approach is fundamental to an effective accountability system, including monitoring how well programs are working, evaluating and refining priorities, and incorporating new science and strategies to improve results. Adaptive management for the Chesapeake Bay watershed will be data intensive, and will depend on effective collaboration across the broad Bay partnership.

Establish environmental outcome measures.

In order to gauge program performance and to effectively adjust our efforts over time, a discrete set of measures is needed that focus on desired environmental outcomes. To be useful, these measures must be developed in collaboration with the Chesapeake Bay partners and supported with environmental monitoring and assessment. Alignment of these measures with the two-year milestones established by the States could also help drive greater coordination and focus efforts on the most pressing resource concerns.

Many measures and data systems already are in place as a result of ongoing tracking and reporting of activities in the Chesapeake Bay watershed, providing a good foundation for establishing key environmental outcome measures. Because of the lengthy residence time of nutrients in the soil, near term measures from monitoring stations may not reveal the water quality benefits from changes occurring on the landscape. These data should be correlated with conservation practice application data with appropriate recognition of the lag time in effects when assessing the results of practices and programs. Correspondingly, these outcome-based measures will likely need to be supported with annual output measures, such as acres treated with conservation, as well as assessments that draw upon process and system models to project environmental benefits. Annual output measures will be developed and in use by 2011; outcome measures will be developed by 2012.

Create a conservation implementation database.

Beginning in 2010, the Executive Order requires development of an annual Chesapeake Bay Action Plan that describes how Federal funding proposed in the President's Budget will be used to protect and restore the Chesapeake Bay. This plan will be accompanied by an Annual Progress Report reviewing indicators of environmental conditions in the Chesapeake Bay, and an assessment of the implementation of the Action Plan during the preceding fiscal year.

At this time there is no Bay-wide database that contains comprehensive information on conservation practice implementation. Consequently, conservation practice implementation can only be estimated. In order to clearly identify the practice implementation baseline and effectively focus future funding, a Bay-wide database will be needed that contains comprehensive data on conservation implementation in the Chesapeake Bay watershed. Addressing the issues of content, access, and utility will be critical elements in developing the database strategy. Further, the privacy and access requirements outlined in Section 1619 of the 2008 Farm Bill must have significant influence on the database content and design.

Monitor and assess progress in priority watersheds.

With resources (funding and personnel) being focused in priority areas, the public and Bay partners will need information on the effectiveness and outcomes of selected strategies. Credible data on the environmental response to the installed conservation measures will be essential for supporting adaptive management and program decision

making in the Chesapeake Bay watershed. Water quality monitoring in the Bay will need to include in-stream gauges located downstream from selected priority watersheds. Building on established U.S. Geological Survey's stream gauging network offers an opportunity to address this need and better integrate Bay data into the larger water quality database. USEPA's Section 319 resources could also be used to support increased monitoring of water quality benefits. Although the water quality benefits that result from conservation actions on the land may take years or longer to produce measurable results, putting the monitoring capacity in place will set the stage for the needed analysis and in the near term also may be helpful in guiding use of conservation strategies.

The interagency Conservation Effects Assessment Project (CEAP) will provide estimates of expected results from conservation installation (*Sidebar: Conservation Effects Assessment Project*). The companion CEAP Watershed studies are conducting basic research on conservation practices to provide a framework for evaluating and improving performance of CEAP national assessment models. Two CEAP Watershed studies located in the Chesapeake Bay watershed – Choptank (MD) and Spring Creek (PA) – are providing in-depth assessments of conservation effects specifically relevant to the Bay.

Conservation Effects Assessment Project – Strengthening the Science Base in the Chesapeake Bay Watershed

The interagency Conservation Effects Assessment Project (CEAP) will be helping to assess conservation needs as well as the effectiveness of conservation practices. Work is underway on the CEAP cropland assessment for the Chesapeake Bay watershed with an anticipated completion in 2010. Additional CEAP regional components are examining conservation effects on wetlands, wildlife, and grazing lands, which will further enrich the science base for improving the conservation in the Chesapeake Bay watershed. Smaller scale CEAP watersheds provide the detailed investigation needed to advance the science and tools for precision conservation and adoption of practices.

The CEAP cropland report on the Upper Mississippi River Basin (UMRB) is being completed currently. The Chesapeake Bay watershed has cropping systems and characteristics similar to the UMRB, so similarity in some results is expected. Key lessons learned from the UMRB assessment that ***are likely*** to be appropriate to the Chesapeake Bay include:

- Focusing initial conservation efforts to treat the most vulnerable acres, including those that are under-treated relative to their inherent vulnerability, will provide the quickest response to treatment at the watershed level;
- Treatment of the most vulnerable acres will require a system of conservation practices to: control overland flow and concentrated flow, trap materials from leaving the field using appropriate edge-of-field mitigation, and avoid or limit the potential for loss by using strict nutrient management practices (appropriate rate, timing, and method); and
- Some of the most vulnerable acres, even when fully treated, may still have unacceptable losses during the more severe storm events, so consideration of other land use intensity options may be needed.

In addition, other important elements are likely to emerge in the Chesapeake Bay watershed assessment. For example, additional conservation practices not included in the UMRB simulations will be examined, such as drainage water management to promote denitrification or construction of wetlands near interfaces with streams and cultivated cropland. Given the concentration of animal agriculture, there will be special emphasis on conservation needs related to manure management. Lastly, while the influence of proximity to streams was not possible in the UMRB assessment, this will be an important factor in assessing potential vulnerabilities in the Chesapeake Bay watershed.

Use science to adapt the strategy.

Ongoing scientific assessment throughout the Chesapeake Bay watershed will be needed to assist in the identification of vulnerable landscapes for action, priority conservation practices, and to build the foundation for highly functioning ecosystem markets. These assessments will not only inform where priority conservation implementation is needed, but will also measure program results needed to assess environmental benefits and cost effectiveness.

Increased coordination among Partners in the Chesapeake Bay watershed will help to strengthen the scientific assessment of landscape condition. Currently, the primary source of information comes largely through the Chesapeake Bay Program Office's Bay model. With the completion of the interagency CEAP Chesapeake Bay watershed assessment there will be an opportunity to coordinate between the Bay Model and the CEAP Model to improve the identification of priority landscapes. CEAP will be able to provide estimates of the progress in reducing the delivery of agricultural contaminants, identify remaining under-treated cropland acres, and estimate the environmental results from treating those acres. Identification of priority areas is expected to be an iterative process that improves over time, and shifts as progress is made and new priority areas are identified.

Appendix A. Summary of key Federal programs delivered in the Chesapeake Bay watershed.

Agency	Program Name	Description
NRCS	Environmental Quality Incentives Program	Promotes agricultural production and environmental quality as compatible National goals. Through EQIP, participants may receive financial and technical help to install or implement structural and management conservation practices on eligible agricultural and nonindustrial private forest land.
NRCS	Agricultural Water Enhancement Program	Provides financial and technical assistance to agricultural producers to implement agricultural water enhancement activities on agricultural land for the purposes of conserving surface and ground water and improving water quality. As part of the Environmental Quality Incentives Program (EQIP), AWEP operates through contracts with producers to plan and implement conservation practices in project areas established through partnership agreements.
NRCS	Cooperative Conservation Partnership Initiative	Enables the use of certain conservation programs with resources of eligible partners to provide financial and technical assistance to owners and operators of agricultural and nonindustrial private forest lands. Eligible producers, who participate in a project area identified in an approved partner agreement, may apply for program assistance. Eligible programs include: Environmental Quality Incentives Program (EQIP) Wildlife Habitat Incentive Program (WHIP) Conservation Stewardship Program (CSP) Under CCPI, the Natural Resources Conservation Service (NRCS) enters into partnership agreements with eligible entities that want to enhance conservation outcomes on agricultural and nonindustrial private forest lands.
NRCS	Chesapeake Bay Watershed Initiative	Provides the region's farmers with assistance to implement agricultural conservation practices. The CBWI provides $188 million to support restoration of the Chesapeake Bay and its watershed, which represents one of the largest single federal investments in the clean-up effort and an unprecedented targeting of Farm Bill resources to Priority watersheds. Congressionally authorized future funding levels are $43 million in 2010, $72 million in 2011 and $50 million in 2012.
NRCS	Farm and Ranch lands Protection Program	Offers long-term easements that help keep farm, ranch, and forest land in agriculture and forestry. The program provides matching funds to State, Tribal, or local governments and nongovernmental organizations with existing farmland protection programs to purchase conservation easements or other interests in land.
NRCS	Wetlands Reserve Program	Offers long-term easements to protect and enhance wetlands, wildlife habitat, soil, water, and related natural resource concerns on private land in an environmentally beneficial and cost effective manner. The program provides an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal land from agriculture.
NRCS	Wildlife Habitat Incentives Program	Encourages creation of high quality wildlife habitats that support wildlife populations of National, State, Tribal, and local significance. Through WHIP, NRCS provides technical and financial assistance to landowners and others to develop upland, wetland, riparian, and aquatic habitat areas on their property.
NRCS	Agricultural Management Assistance	Provides cost-share and incentive payments to agricultural producers to voluntarily address issues, such as water management, water quality, and erosion control by incorporating conservation practices into their

Agency	Program Name	Description
		farming operations. Producers may construct or improve water management structures or irrigation structures; plant trees for windbreaks or to improve water quality; and mitigate risk through production diversification or resource conservation practices, including soil erosion control, integrated pest management, or transition to organic farming.
NRCS	Conservation Security Program	Provided financial and technical assistance for the conservation, protection, and improvement of soil, water, and related resources on Tribal and private lands. The program provides payments for producers who historically have practiced good stewardship on their agricultural lands and incentives for those who want to do more. This program was replaced by the Conservation Stewardship Program in the 2008 Farm Bill.
NRCS	Conservation Stewardship Program	Encourages producers to address resource concerns in a comprehensive manner by: undertaking additional conservation activities; and Improving, maintaining, and managing existing conservation activities. CSP is available on Tribal and private agricultural lands and non-industrial private forest lands This program began in 2009.
NRCS	Conservation Innovation Grants	Provides competitive grants to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investments in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, Environmental Quality Incentives Program funds are used to award competitive grants to non-Federal governmental or non-governmental organizations, Tribes, or individuals. CIG enables NRCS to work with other public and private entities to accelerate technology transfer and adoption of promising technologies and approaches to address some of the Nation's most pressing natural resource concerns.
NRCS	Watershed Surveys and Planning	Provides the authority for NRCS to cooperate with other Federal, State, and local agencies in making investigations and surveys of river basins as a basis for the development of coordinated water resource programs, floodplain management studies, and flood insurance studies. NRCS assists public sponsors to develop watershed plans and to mitigate flood damages; conserve, develop, and use water; and conserve land resources.
NRCS	Watershed Operations	Provides technical and financial assistance to States, local governments and Tribes (project sponsors) to implement authorized watershed project plans for the purpose of watershed protection; flood mitigation; water quality improvements; soil erosion reduction; rural, municipal and industrial water supply; irrigation water management; sediment control; fish and wildlife enhancement; and wetlands and wetland function creation and restoration.
NRCS	Flood Prevention Program	Provides assistance to install watershed improvement measures to reduce flood, sedimentation, and erosion damages; further the conservation, development, use, and disposal of water; and the conservation and proper utilization of land.
NRCS	Emergency Watershed Protection Program	Provides financial and technical assistance to undertake emergency measures, including the purchase of flood plain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed.
NRCS / FSA	Grassland Reserve Program	Provides financial and technical assistance through easements and rental contracts to encourage working grazing operations, enhancement of plant and animal biodiversity, and protection of grassland under threat

Agency	Program Name	Description
		of conversion to other uses.
FSA	Conservation Reserve Program	Helps agricultural producers safeguard environmentally sensitive land. CRP participants plant long-term, resource-conserving covers to improve the quality of water, control soil erosion, and enhance wildlife habitat. In return, the federal government provides participants with rental payments and cost-share assistance.
FSA	Conservation Reserve Enhancement Program	A partnership between federal, state, and local governments and other non-governmental entities. Under CREP agreements, USDA provides 80% of funding and other entities provide 20% of funding. Each state in the Chesapeake Bay watershed has at least one CREP agreement.
FSA	Emergency Conservation Program	Provides emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland damaged by natural disasters and for carrying out emergency water conservation measures in periods of severe drought.
FSA	Biomass Crop Assistance Program	Provides cost share for planting biomass crops such as switchgrass and other perennial biomass crops. FSA will also make annual payments for these contracted acres for the duration of the contract until a local conversion facility is available to use the biomass crop. Enrolling more marginal and fragile lands in BCAP may be more cost-effective for producers than planting to traditional commodity crops, and may improve ground and surface water quality and retention due to the conserving nature of the perennial grasses planted for biomass under this program.
FS	Chesapeake Watershed Forestry Program	Chesapeake Watershed Forestry Program (CWF) began in 1990 with the signing of an MOU with the USEPA Chesapeake Bay program. Funding for this program (~$1 million annually) has been Congressionally directed in recent years. This is the only FS program targeted for the Bay. CWF provides forestry leadership in the Chesapeake Bay watershed by working to integrate and coordinate the forestry activities of USFS programs, other USDA and federal agencies, State and local governments, and other partner organizations to achieve Bay goals. In addition to improving coordination among organizations, CWF provides educational, financial, and technical assistance, and oversees grant management and reporting for the program.
FS	Forest Stewardship Program	The Forest Stewardship Program assists private forest landowners in more actively managing their forest and related resources; to keep these lands in a productive and healthy condition for present and future owners; and to increase the economic and environmental benefits of these lands. It is a voluntary program. Since 1991, the Forest Stewardship Program has assisted well over 220,000 landowners in preparing multipurpose management plans for areas encompassing more than 20 million acres of non-industrial private forest (NIPF). These plans promote the long-term sustainability of private forests by balancing future public needs for forest products with the need for protecting and enhancing watershed productivity, air and water quality, fish and wildlife habitat, and threatened and endangered species. Once a plan is in place, landowners are to participate in voluntary USDA landowner assistance programs for technical advice and financial assistance to make their vision for the land a reality.
FS	Urban and Community Forestry Program	UCF is a cooperative program that focuses on the stewardship of urban natural resources. With 80 percent of the nation's population in urban areas, there are strong environmental, social, and economic cases to be made for the conservation of green spaces to guide growth and revitalize city centers and older suburbs. The Urban and Community Forestry Program provides technical, financial, educational, to states, cities, and

Agency	Program Name	Description
		nonprofit groups so they can establish programs to plant, protect, maintain, and utilize wood from community trees and forests to maximize environmental, social and economic benefits.
FS	Forest Health Protection	Forest Health Protection provides technical assistance on forest health-related matters, particularly those related to disturbance agents such as native and non-native insects, pathogens, and invasive plants. The program works through partnerships across lands of all ownerships by providing forest insect, disease and invasive plant survey and monitoring information, and technical and financial assistance to prevent, suppress and control outbreaks threatening forest resources. The program helps to maintain, enhance, and restore healthy forest conditions and look for links between changing climate and pest conditions. The program is active in all of the Bay States and Washington, D.C.
FS	Forest Legacy Program	Forest Legacy Program is a partnership between States and the Forest Service to identify and help conserve environmentally important forests from conversion to non-forest uses. The main tool used for protecting these important forests is conservation easements. The program has been active in the Bay watershed and has protected lands in Maryland, Pennsylvania, Virginia and Delaware.
FS	Forest Service Research Program	The Research branch of the Forest Service operates the Baltimore Ecosystem Study (BES), which does research and develops tools to address forest-related commitments especially as they relate to urban nutrient reduction. Also, USFS Research has invested in assessing the distribution of airborne nitrogen compounds and chemical contaminants on the Bay ecosystem. Forest Service Research has spent over $60 million in the Chesapeake Bay watershed.
FS	National Forest System (NFS)	The 193 million acres of national forests and grasslands in the country provide a wide spectrum of ecosystem services on which society relies, including clean water, scenic beauty, outdoor recreation, fish and wildlife habitat, natural resource jobs, forest products, renewable energy, and carbon sequestration. Chesapeake Bay -- NFS Headwaters Acreage: The GW-Jefferson NF (about 1.3 million acres in the watershed) is involved with the Bay restoration primarily through its participation in the Potomac Watershed Partnership. The Monongahela NF has about 100,000 acres in the watershed."
RD	FFB Guaranteed Loan Program (Electric Program)	Provides guaranteed loans to eligible entities for electric distribution, sub-transmission, bulk transmission, and generation facilities and renewable energy systems. An example would be use of farm animal waste to generate energy.
RD	Water and Waste Disposal Loan and Grant Program	Provides loans, grants and loan guarantees to rural communities with a population of 10,000 or fewer to construct, enlarge, extend or otherwise improve rural water, sanitary sewage, solid waste disposal and storm wastewater disposal facilities. Eligible entities include public bodies (i.e., municipality, county, district, etc), non-profit entities (i.e., cooperative, association, etc) and Native American Indian tribes. The WWD provides approximately $1 billion per Fiscal Year to eligible communities for water and waste disposal projects.
RD	Community Facilities Program	Provides direct loans and small grants for developing essential community facilities for public use in rural areas. These facilities include schools, libraries, childcare, hospitals, medical clinics, assisted living facilities, fire and rescue stations, police stations, community centers, public buildings and transportation. The program is starting to consider

Agency	Program Name	Description
		applying green building standards to these projects, which would include more efficient plumbing and commercial water fixtures and onsite green infrastructure practices that would better capture, cleanse and infiltrate stormwater runoff and recharge groundwater aquifers.
ARS	Conservation Effects Assessment Project	The ARS Conservation Effects Assessment Project (CEAP) Watershed Assessment Study (WAS) is part of the overall USDA CEAP project, providing additional scientific basis for the CEAP National Assessment being led by NRCS. The initial effort focused on croplands, with grazing lands and wetlands being added in 2007. Research is conducted across 14 ARS Benchmark watersheds in cooperation with both government and non-government organizations. Research contributes to developing methods for the assessment of watersheds in key agro-ecological regions around the nation. Research and delivery of practices such as cover cropping, controlled drainage practices, manure management, and use of the P index provide producers with methods to improve nutrient management at the field level.
ARS	Choptank Watershed Studies	ARS has developed innovative use of farm program records, satellite remote sensing, and on-farm sampling to assess nitrogen sequestered in cover crop biomass on farms enrolled in state cover crop cost share programs within the Choptank and Chester River watershed. Results were transferred to the Chesapeake Bay Program, assisting in the development of efficiency estimates for various cover crop scenarios. On-farm experiments were planned and funded in the fall of 2008 to evaluate the effect of reduced fall fertilization on wheat yield and soil nitrate leaching, with implications for setting appropriate incentive rates for commodity cover crops (nonfertilized fall grains). Newly developed methods employ radar and lidar, two remote sensing approaches involving active sensors, to monitor wetlands in agricultural landscapes. Wetland restoration has great potential for mitigating agricultural pollution but managing agricultural landscapes to maximize their effectiveness requires detailed information on wetland hydrology and their connection to the larger landscape. This synergy of information improves understanding of ecological services provided by wetlands ecosystems within agricultural landscapes.
ARS	Watershed Modeling Assessment Project	An integrated modeling approach has been developed as an assessment tool to measure on-site and off-site environmental benefits of conservation programs currently implemented and prospects for attaining additional environmental benefits with further conservation treatment. The approach utilizes farm survey and NRI data, field level modeling using APEX (Agricultural Policy Environmental Extender) and SWAT/HUMUS (Soil and Water Assessment Tool). APEX is used to estimate field-level effects attributable to conservation practices--reductions in nitrogen, phosphorus, pesticide, and soil loss from farm fields as well as soil quality enhancement. Model output from APEX is used as an input to the SWAT/HUMUS model to assess off-site benefits for water quality--reductions in in-stream concentrations of sediment, nutrients, and pesticides attributable to implementation of conservation practices. The USGS SPARROW model is used to calibrate the combined model across large scales (multiple, linked watersheds). The approach has initially been applied by NRCS to make assessments in the Upper Mississippi Basin Watershed and will be subsequently used in the Chesapeake Watershed.
ARS	Manure Treatment and Nutrient	The CB watershed contains significant numbers of confined animal feeding operations, primarily broiler production and dairies. The large quantity of nutrients imported into the watershed via the feed for these

Agency	Program Name	Description
	Management	animals presents a disposal problem and risk to the water quality in the Bay. ARS has a comprehensive national program related to appropriate treatment of animal manures and environmentally safe utilization of manure nutrients.
NIFA	National Integrated Water Quality Program (Integrated Competitive Grants Program)	The goal of the National Integrated Water Quality Program is to improve the quality of our Nation's surface water and groundwater resources through research, education, and extension activities. Projects funded through this program will facilitate achieving this goal by advancing and disseminating the knowledge base available to agricultural and rural communities. Funded projects should lead to science-based decision-making and management practices that improve the quality of the Nation's surface water and groundwater resources in agricultural and rural watersheds.
NIFA	Water and Watersheds (Agriculture and Food Research Initiative)	The goals of the Water and Watersheds program are to protect and enhance the natural resource base and environment by improving and maintaining healthy watershed habitat and water supply protection; improve the quality of life in rural America through clean irrigation and livestock drinking water supplies. This program makes single function research awards.
NIFA	Non-competitive Grant Programs	Hatch Act and Evans-Allen grant funds support for research and extension activities at land-grant institutions through grants to the states on the basis of statutory formulas. Eligibility is limited to the cooperating institutions, most of which are 1862, 1890, and 1994 land-grant institutions.
USFWS	Partners for Fish and Wildlife Program	Provides direct federal assistance to private landowners and local governments to restore habitats on their lands. The Partners for Fish and Wildlife Program is authorized by the Partners for Fish and Wildlife Act of 2006. The mission of the Partners Program is to efficiently achieve voluntary habitat restoration on private lands, through financial and technical assistance, for the benefit of Federal Trust Species. The program has a local presence every Chesapeake Bay watershed state.
USFWS	Coastal Program	Works cooperatively with States, Tribes, governmental and nongovernmental organizations, industry, and private landowners to conserve our nation’s coastal trust resources. The Coastal Program Vision is: To effectively achieve voluntary coastal habitat conservation through financial and technical assistance for the benefit of federal trust species, including threatened and endangered species, migratory birds, inter-jurisdictional fish, certain marine mammals, and species of international concern. The program provides technical and financial assistance in the Chesapeake Bay in the form of cost sharing with partners in support of restoration and protection of coastal habitats.
USACE	Section 510 - Water Resources Development Act of 1996	"Chesapeake Bay Environmental Restoration and Protection" [$40M authorization - This authority allows the Corps to provide environmental assistance to non-Federal interests anywhere in the Bay watershed states of VA, PA, MD. This focuses on design and construction, but also includes planning (studies). Cost sharing is 75%Fed/25% non-Fed. Projects constructed under this program have included WWTP upgrades at Smith Island, Oyster EIS, Trash Interceptors in Baltimore and others.
USACE	Section 219 - Water Resources Development Act of 1992, as amended	($20M for Northeast, Pennsylvania - counties specified) This authority allows for planning, design, and construction assistance for water and sewer-related environmental infrastructure and resource protection and development projects for local communities. Corps must provide private source for engineering, design, and construction and does QA/QC of these services. Cost sharing is 75% Fed and 25% non-Fed. Non-Fed

Agency	Program Name	Description
		must use cash and/real estate for its share. Sewer extension projects and water supply projects have traditionally been done using this program. This contains provisions for Richmond and Lynchburg VA combined sewer overflow issues among others.
USACE	Section 5158 - Water Resources Development Act of 2007	This legislation contains several provisions that apply to the Bay or specifically designated geographic areas within the Bay as follows: - $20M for environmental infrastructure and resource protection in DC and MD portions of watershed - $35M for Combined Sewer Overflow plan for DC -$30M for environmental infrastructure projects to benefit Chesapeake Bay including Blue Plains - $40M for water pollution control, Chesapeake Bay region MD and VA - $5M for wastewater infrastructure in Elmira, NY Same cost sharing as Section 219.
USACE	Section 313 - Water Resources Development Act of 1992, as amended	This authority allows for planning, design and construction assistance for water and sewer related environmental infrastructure in designated South Central, PA counties. Cost-sharing is 75% Federal and 25% non-Federal. It is set up in such a way that projects are undertaken locally and the Corps reimburses the local for the Federal share.
USEPA	Water Pollution Control Grant Program – Clean Water Act Section 106	Section 106 of the Clean Water Act authorizes U.S. EPA to provide grants to states, interstate agencies, and tribes to administer programs for the prevention, reduction, and elimination of water pollution. USEPA's current allotment formula is based on six components that reflect the extent of the water pollution problem: surface water area, ground water use, water quality impairment, potential point sources, nonpoint sources, and the population of urbanized areas. States rely on Section 106 grants to fund core water quality programs for each jurisdiction.
USEPA	Clean Water State Revolving Loan Fund	The Clean Water State Revolving Loan Fund (CWSRF) is the largest federal water quality financing program, having funded more than $68 billion for the construction of national water infrastructure. Under the program, the USEPA provides grants to all 50 states and Puerto Rico to address a wide variety of water quality protection projects. The CWSRF program is a powerful partnership between USEPA and the states. It allows states the flexibility to provide funding for projects that will address their highest-priority water quality needs. While traditionally used to build or improve wastewater treatment plants, loans are also used increasingly for: agricultural, rural, and urban runoff control; estuary improvement projects; wet weather flow control, including stormwater and sewer overflows, alternative treatment technologies, water reuse and conservation projects.
USEPA	Nonpoint Source Management Program Grants - Clean Water Act Section 319	USEPA awards grants to state and tribal agencies. Each year, USEPA awards Section 319(h) funds to states in accordance with a state-by-state allocation formula to implement approved nonpoint source management programs. These programs can contain components involving technical assistance, financial assistance, education, training, technology transfer, monitoring, and demonstration projects. Nationally, Nonpoint Source grants total about $200 million a year. The Chesapeake Bay states receive between $20 and $25 million a year
USEPA	Chesapeake Bay Program - Clean Water Act Section 117	The Small Watershed Grants Program provides grants to local governments and nonprofit organizations in the Chesapeake Bay region working at the local level to protect and improve watersheds while building citizen-based resource stewardship. Each grant must address watershed restoration, watershed conservation, and/or watershed planning. The program also provides small grants for project planning and design. Primary program funding is provided by USEPA's Chesapeake Bay Program Office. Additional funding partners include the

Agency	Program Name	Description
		USDA Forest Service, the National Oceanic and Atmospheric Administration Fisheries, the USDA Natural Resources Conservation. USEPA's Chesapeake Bay Program Office awards State Implementation Grants to the signatory jurisdictions of Maryland, Virginia, Pennsylvania, and the District of Columbia to implement their commitments under the Chesapeake 2000 Agreement. These grants require at least a dollar for dollar match. USEPA awards competitive, multi-year grants to the headwater states of Delaware, New York, and West Virginia with an emphasis on providing technical assistance for agricultural conservation practices, outreach, and education. Innovative Nutrient and Sediment Reduction Grants Program awards grants to organizations and state and local governments for projects that vastly accelerate nutrient and sediment reductions with innovative, yet sustainable and cost-effective approaches. Projects focus on one of five categories: "green" approaches for new development, existing development, agriculture, economics, and targeting geographic locations.
USEPA	State Innovation Grants	USEPA's Office of Policy, Economics, and Innovation (OPEI) sponsors the State Innovation Grant program which serves as a resource for states seeking to test innovative approaches to managing priority environmental problems. One of the strategic focus areas supported by these grants is the implementation of Environmental Results Programs (ERPs). ERP is an integrated system of compliance assistance, facility self-certification, and agency inspection and performance measurement that is typically targeted at small businesses.
NOAA	Coastal Nonpoint Source Pollution Control Program (section 6217)	The Coastal Nonpoint Source Pollution Control Program addresses nonpoint pollution problems in coastal waters. Section 6217 requires the 29 states and territories with approved Coastal Zone Management Programs to develop Coastal Nonpoint Pollution Control Programs. In its program, a state or territory describes how it will implement nonpoint source pollution controls, known as management measures, that conform with those described in Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.

Appendix B. Listing of priority tributary watersheds by name, HUC identification number, and acreage.

Delaware

HUC_12	Watershed Name	Estimated Acres
020600050201	Cow Marsh Creek	19,989
020600050202	Tappahanna Ditch-Choptank River	25,947
020600050203	Gravelly Branch-Choptank River	9,650
020600050205	Chapel Branch-Choptank River	4,173
020600050206	Fowling Creek-Choptank River	655
020801090101	Upper Deep Creek	15,699
020801090102	Lower Deep Creek	24,082
020801090201	Hitch Pond Branch	17,310
020801090202	James Branch	14,213
020801090203	Elliott Pond Branch	11,383
020801090204	Little Creek-Broad Creek	19,219
020801090205	Tussocky Branch-Broad Creek	15,133
020801090301	Headwaters Marshyhope Creek	13,238
020801090302	Saulsbury Creek-Marshyhope Creek	26,867
020801090303	Tommy Wright Branch-Marshyhope Creek	15,314
020801090304	Sullivan Branch-Marshyhope Creek	5,646
020801090305	Faulkner Branch-Marshyhope Creek	748
020801090401	Gum Branch	19,290
020801090402	Headwaters Nanticoke River	26,693
020801090403	Gravelly Branch	23,451
020801090404	Clear Brook-Nanticoke River	24,032
020801090405	Butler Mill Branch-Nanticoke River	26,538
020801090406	Gales Creek-Nanticoke River	10,460
020801090504	Barren Creek-Nanticoke River	5,555
Total Area in Delaware		**375,283**

Maryland

HUC_12	Watershed Name	Estimated Acres
020503061502	Tweed Creek-Octoraro Creek	1,552
020503061503	Basin Run-Octoraro Creek	20,693
020503061601	Headwaters Deer Creek	20,213
020503061602	Upper Deer Creek	22,388
020503061603	Deer Creek	29,570
020503061604	Deer Creek	20,901
020503061710	Broad Creek	25,323
020503061711	Conowingo Creek	3,064
020503061712	Conowingo Dam-Susquehanna River	11,431
020600020101	Lower Chester River	19,875
020600020102	West Branch Big Elk Creek	10,854

020600020301	Little North East Creek	11,764
020600020302	North Creek-Frontal Chesapeake Bay	32,637
020600020303	Furnace Bay	18,027
020600020401	Sassafras River	21,466
020600020402	Sassafras River	35,218
020600020501	Stillpond-Fairlee	15,019
020600020502	Stillpond-Fairlee	25,898
020600020603	Upper Chester River	12,874
020600020604	Upper Chester River	15,439
020600020605	Upper Chester River	23,392
020600020701	Middle Chester River	39,863
020600020702	Southeast Creek	35,460
020600020703	Corsica River	25,543
020600020704	Langford Creek	27,400
020600020705	Lower Chester River	14,735
020600020706	Middle Chester River	10,225
020600020707	Corsica River	16,326
020600020708	Lower Chester River	16,443
020600021001	Wye River	31,756
020600021002	Wye River	25,248
020600021003	Miles River	34,864
020600021005	Eastern Bay	24,711
020600030501	Little Gunpowder Falls	37,313
020600031101	Patapsco River L N Br	33,987
020600040404	Patuxent River lower	19,560
020600050104	Upper Choptank	16,222
020600050106	Upper Choptank	22,399
020600050107	Marshyhope Creek	31,038
020600050201	Tuckahoe Creek	21,513
020600050202	Tuckahoe Creek	28,381
020600050203	Tuckahoe Creek	14,064
020600050204	Tuckahoe Creek	34,091
020600050301	Upper Choptank	14,423
020600050302	Upper Choptank	23,948
020600050303	Upper Choptank	29,889
020600050401	Lower Choptank	15,283
020600050402	Lower Choptank	19,685
020600050403	Lower Choptank	29,597
020600050404	Lower Choptank	13,984
020600050405	Lower Choptank	38,515
020600050406	Lower Choptank	42,193
020600050407	Lower Choptank	12,046
020600050501	Little Choptank	24,312
020600050502	Little Choptank	34,591
020600050503	Little Choptank	8,351
020600050601	Little Choptank	29,812
020600060706	Patuxent River lower	28,190
020600070104	Wicomico Creek	19,943
020600070106	Monie Bay	29,272
020600070107	Lower Wicomico River	24,650

020600070201	Transquaking River	35,157
020600070202	Transquaking River	37,912
020600070301	Fishing Bay	19,308
020600070302	Fishing Bay	35,919
020600070303	Fishing Bay	49,332
020600080303	Marshyhope Creek	879
020600080401	Wicomico River Head	358
020600080403	Upper Pocomoke River	1,602
020600080502	Marshyhope Creek	921
020600080503	Marshyhope Creek	10,178
020600080504	Marshyhope Creek	12,492
020600080505	Marshyhope Creek	15,299
020600080506	Marshyhope Creek	25,195
020600080507	Marshyhope Creek	14,654
020600080601	Marshyhope Creek	16,545
020600080602	Nanticoke River	19,159
020600080603	Nanticoke River	15,879
020600080604	Nanticoke River	15,618
020600080605	Nanticoke River	27,529
020600080606	Nanticoke River	30,300
020600090101	Upper Pocomoke River	9,906
020600090102	Upper Pocomoke River	29,947
020600090103	Upper Pocomoke River	33,770
020600090104	Upper Pocomoke River	18,467
020600090201	Nassawango Creek	19,622
020600090202	Nassawango Creek	24,254
020600090301	Dividing Creek	39,717
020600090302	Lower Pocomoke River	20,011
020600090303	Lower Pocomoke River	35,355
020600090305	Lower Pocomoke River	31,344
020600090401	Manokin River	37,436
020600090402	Manokin River	36,872
020600090403	Big Annemessex River	33,712
020600090404	Tangier Sound	20,410
020700040501	Minnow Run-Little Tonoloway Creek	9,931
020700040502	Sir Johns Run-Potomac River	5,564
020700040806	Rockdale Run-Conococheague Creek	6,808
020700040807	Meadow Brook-Conococheague Creek	35,158
020700041004	Little Antietam Creek	15,793
020700041006	Middle Antietam Creek	11,122
020700041008	Antietam Creek	20,488
020700041009	Antietam Creek	36,498
020700041105	Marsh Run	13,425
020700041106	Rattlesnake Run-Potomac River	16,631
020700041108	Harpers Ferry-Potomac River	8,245
020700080101	Catoctin Creek	21,458
020700080102	Catoctin Creek	34,943
020700080103	Catoctin Creek	20,664
020700080201	Potomac River FR Cnty	8,317
020700080202	Piney Run-Potomac River	15,576

020700080401	Tuscarora Creek-Potomac River	18,998
020700080402	Potomac River MO Cnty	12,046
020700090303	Lower Toms Creek	17,482
020700090405	Lower Big Pipe Creek-Double Pipe Creek	35,988
020700090503	Cattail Branch-Monocacy River	9,429
020700090505	Double Pipe Creek	14,319
020700090601	Upper Monocacy River	25,364
020700090602	Upper Monocacy River	26,692
020700090603	Upper Monocacy River	17,804
020700090604	Upper Monocacy River	36,221
020700090701	Lower Monocacy River	39,345
020700090702	Lower Monocacy River	39,021
020700090703	Lower Monocacy River	21,239
020700090804	Lower Monocacy River	21,077
020700090806	Lower Monocacy River	27,210
020700090807	Lower Monocacy River	31,820
020700110505	Potomac River L tidal	5,518
020700110701	St. Clements Bay	35,028
020700110702	Breton Bay	38,611
020700110703	Potomac River L tidal	17,987
020700110902	St. Mary's River	20,287
020700110903	St. Mary's River	12,052
020801110303	Cypress Swamp-Pocomoke River	16
020801110401	Pitts Creek	13,255
020801110402	Bullbegger Creek-Pocomoke River	39
020801110501	Marumsco Creek-Pocomoke Sound	22,985
020801110502	East Creek-Pocomoke Sound	25,143
Total Area in Maryland		**3,038,078**

New York

HUC12	**Watershed Name**	**Estimated Acres**
020501011001	Upper Ouleout Creek	13,165
020501011002	Treadwell Creek	15,929
020501011003	Middle Ouleout Creek	10,985
020501011004	Handsome Brook	17,303
020501011005	Lower Ouleout Creek	12,441
020501011101	Otsdawa Creek	13,057
020501011102	Brier Creek-Susquehanna River	20,712
020501011103	Sand Hill Creek-Susquehanna River	16,538
020501011104	Carrs Creek	18,852
020501011105	Martin Brook-Susquehanna River	12,742
020501020101	Fabius Brook-West Branch Tioughnioga Creek	21,647
020501020102	Upper East Branch Tioughnioga Creek	28,873
020501020103	Labrador Creek	8,623
020501020104	Middle East Branch Tioughnioga Creek	14,402
020501020105	Cheningo Creek	19,817
020501020106	Lower East Branch Tioughnioga Creek	27,184
020501020401	Trout Brook	25,747
020501020402	Gridley Creek	10,135
020501020403	Upper Tioughnioga River	22,446

020501020404	Jennings Creek	9,284
020501020405	Culver Creek-Dudley Creek	20,363
020501020406	Middle Tioughnioga River	16,637
020501020407	Halfway Brook	13,924
020501020408	Lower Tioughnioga River	16,201
020501020501	Upper Sangerfield River	20,442
020501020502	Middle Sangerfield River	10,646
020501020503	Lower Sangerfield River	7,071
020501020504	Callahan Brook-Chenango River	14,948
020501020505	Payne Brook	14,767
020501020506	Eaton Brook-Chenango River	28,906
020501020507	South Lebanon Brook-Cold Spring Brook	9,747
020501020508	Creekooked Brook-Pleasant Brook	15,084
020501020509	Stone Mill Brook-Chenango River	14,826
020501020601	Pleasant Brook	9,154
020501020602	Handsome Brook	15,315
020501020603	Mad Brook-Chenango River	18,744
020501020604	East Branch Canasawacta Creek	16,605
020501020605	Fly Creek-Chenango River	14,856
020501020606	Canasawacta Creek	23,057
020501020607	Thompson Creek-Chenango River	12,172
020501020608	Gilmore Brook-Chenango River	13,379
020501020609	Turner Creek-Fly Meadow Creek	18,452
020501020610	Lyon Brook-Chenango River	13,026
020501020801	Bowman Creek	17,098
020501020802	Mill Brook-Chenango River	10,310
020501020803	Padget Brook-Bear Brook	15,477
020501020804	Wheeler Brook-Chenango River	17,355
020501020805	Spring Brook-Chenango River	27,989
020501020806	Ockerman Brook-Chenango River	10,672
020501020807	Page Brook	22,465
020501020808	Osborne Creek	15,953
020501020809	Castle Creek	19,421
020501020810	Thomas Creek-Chenango River	20,261
020501030401	Headwaters East Branch Owego Creek	11,396
020501030402	Upper East Branch Owego Creek	16,196
020501030403	Wilson Creek	10,281
020501030404	Middle East Branch Owego Creek	12,513
020501030405	Upper West Branch Owego Creek	13,345
020501030406	Middle West Branch Owego Creek	11,303
020501030407	Doolittle Creek	10,906
020501030408	Lower West Branch Owego Creek	13,828
020501030409	Lower East Branch Owego Creek-Owego Creek	23,062
020501030502	Little Nanticoke Creek	15,307
020501030503	Pumpelly Creek-Susquehanna River	15,259
020501030504	Chambers Creek-Pipe Creek	29,740
020501030505	Hunts Creek-Susquehanna River	19,420
020501040301	South Branch Tuscarora Creek	12,588
020501040302	Upper Tuscarora Creek	20,322
020501040303	North Branch Tuscarora Creek	20,123

020501040304	Middle Tuscarora Creek	10,539
020501040305	Elk Creek	7,810
020501040306	Lower Tuscarora Creek	10,686
020501040501	Young Hickory Hollow	8,898
020501040502	Upper Troups Creek	10,319
020501050501	North Branch Newtown Creek	11,801
020501050502	Upper Newtown Creek	20,828
020501050503	Lower Newtown Creek	17,885
020501050508	ColdBrook Creek-Chemung River	11,613
020501050604	Baldwin Creek	26,294
020501050606	Wyncoop Creek	22,778
Total Area in New York		**1,290,245**

Pennsylvania

HUC_12	**Watershed Name**	**Estimated Acres**
020402030402	Headwaters Tulpehocken Creek	1,957
020402030408	Cacoosing Creek	1,184
020402030606	Green Hills Lake-Allegheny Creek	129
020402030608	Hay Creek	328
020402030701	Upper French Creek	240
020402050202	Upper West Branch Brandywine Creek	568
020402050203	Doe Run	34
020402050204	Buck Run	182
020402050301	Middle Branch White Clay Creek	54
020402050302	West Branch White Clay Creek	129
020503010601	North Branch Mahantango Creek	23,768
020503010602	Upper West Branch Mahantango Creek	18,379
020503010603	Lower West Branch Mahantango Creek	13,445
020503040101	Saddler Creek	13,230
020503040102	Mill Creek	10,787
020503040103	Hares Valley Creek-Juniata River	46,514
020503040302	Blacklog Creek	27,363
020503040403	Three Springs Creek	20,206
020503040404	Aughwick Creek-Juniata River	39,098
020503040501	West Licking Creek-Juniata River	27,107
020503040502	Musser Run-Juniata River	28,540
020503040503	Strodes Run-Juniata River	28,876
020503040601	Treaster Run	19,966
020503040602	Laurel Creek	15,801
020503040603	Honey Creek-Kishacoquillas Creek	24,218
020503040701	Upper Kishacoquillas Creek	30,952
020503040702	Lower Kishacoquillas Creek	31,266
020503040801	Meadow Creek-Jacks Creek	38,481
020503040802	Little Lost Creek-Lost Creek	25,532
020503040803	Horning Creek-Juniata River	22,884
020503040901	Narrows Branch Tuscarora Creek	16,357
020503040902	Trough Spring Branch-Tuscarora Creek	33,948
020503040903	Horse Valley Run	9,824
020503040904	Willow Run	14,675

020503040905	Lick Run-Tuscarora Creek	31,959
020503040906	East Licking Creek	29,199
020503040907	Tuscarora Creek-Juniata River	36,904
020503041001	Upper Cocolamus Creek	18,222
020503041002	Lower Cocolamus Creek	22,838
020503041201	Doe Run-Juniata River	37,896
020503041202	Raccoon Creek	13,864
020503041204	Juniata River-Susquehanna River	32,905
020503050201	Rowe Run	12,054
020503050202	Lehman Run-Muddy Run	15,754
020503050203	Trout Run-Conodoguinet Creek	40,959
020503050301	Thompson Creek-Burd Run	12,763
020503050302	Middle Spring Creek	16,531
020503050303	Laughlin Run-Paxton Run	11,100
020503050304	Bulls Head Branch	15,398
020503050305	Green Spring Creek	1,834
020503050306	Three Square Hollow Run-Conodoguinet Creek	36,283
020503050601	Upper Little Swartara Creek	15,091
020503050603	Lower Little Swatara Creek	22,501
020503050605	Middle Swatara Creek	26,305
020503050606	Lower Swatara Creek	15,753
020503050701	Crosskill Creek	12,079
020503050702	Upper Little Swatara Creek	25,304
020503050703	Lower Little Swatara Creek	25,058
020503050801	Killinger Creek	9,568
020503050802	Snitz Creek-Quittapahilla Creek	39,476
020503050901	Reeds Run-Swatara Creek	21,225
020503050902	Bow Creek-Swatara Creek	31,161
020503050904	Spring Creek	15,397
020503051009	Fishing Creek-York County	11,389
020503051010	Conewago Creek	33,619
020503051011	Laurel Run-Susquehanna River	29,829
020503060601	Upper South Branch Codorus Creek	20,896
020503060603	Lower South Branch Codorus Creek	25,394
020503060701	Lake Marburo-West Branch Codorus Creek	15,088
020503060702	Oil Creek	10,760
020503060703	Headwaters Codorus Creek	21,229
020503060704	Stoverstown Branch-Codorus Creek	13,393
020503060705	Willis Run-Codorus Creek	16,702
020503060706	Mill Creek	11,834
020503060707	Codorus Creek-Susquehanna River	13,783
020503060801	Upper Chickies Creek	18,943
020503060802	Little Chickies Creek	28,483
020503060803	Donegal Creek	10,982
020503060804	Lower Chickies Creek	22,260
020503060901	Little Cocalico Creek-Cocalico Creek	30,402
020503060902	Middle Creek	20,615
020503060903	Hammer Creek	21,891
020503060904	Cocalico Creek-Conestoga River	15,821
020503061101	Little Muddy Creek	10,081

020503061102	Muddy Creek	22,379
020503061103	Upper Conestoga River	38,296
020503061104	Middle Conestoga River	17,493
020503061106	Muddy Run-Mill Creek	36,096
020503061201	Headwaters Pequea Creek	32,258
020503061202	Eshleman Run-Pequea Creek	30,998
020503061203	Big Beaver Creek	13,695
020503061204	Climbers Run-Pequea Creek	21,696
020503061401	Pine Creek	11,574
020503061402	Valley Creek-East Branch Octoraro Creek	12,947
020503061403	Muddy Run-East Branch Octoraro Creek	33,318
020503061501	West Branch Octoraro Creek	30,750
020503061502	Tweed Creek-Octoraro Creek	22,965
020503061503	Basin Run-Octoraro Creek	638
020503061601	Headwaters Deer Creek	13,871
020503061602	Upper Deer Creek	2,426
020503061701	Conoy Creek	12,183
020503061702	Hartman Run-Susquehanna River	24,070
020503061703	Kreutz Creek	21,871
020503061704	Cabin Creek-Susquehanna River	32,048
020503061705	Fishing Creek	12,206
020503061709	Fishing Creek-Susquehanna River	27,268
020503061710	Broad Creek	445
020503061711	Conowingo Creek	21,859
020503061712	Conowingo Dam-Susquehanna River	3,742
020600020101	East Branch Big Elk Creek	9,971
020600020102	West Branch Big Elk Creek	16,925
020600020103	Little Big Elk Creek	7,959
020600020301	Little North East Creek	287
020600020302	North Creek-Frontal Chesapeake Bay	4,831
020700040303	Little Cove Creek	17,432
020700040305	Lanes Run-Licking Creek	413
020700040501	Minnow Run-Little Tonoloway Creek	6,193
020700040601	Headwaters West Branch Conococheague Creek	16,078
020700040602	Upper West Branch Conococheague Creek	22,225
020700040603	Middle West Branch Conococheague Creek	32,815
020700040604	Licking Creek	21,550
020700040605	Lower West Branch Conococheague Creek	34,210
020700040701	Rocky Spring Branch	11,469
020700040702	Dennis Creek-Back Creek	32,534
020700040703	Campbell Run-Back Creek	14,306
020700040803	Mountain Creek-Conococheague Creek	38,492
020700040804	Muddy Run	12,795
020700040805	Falling Spring Branch-Conococheague Creek	38,347
020700040806	Rockdale Run-Conococheague Creek	22,382
020700040807	Meadow Brook-Conococheague Creek	332
020700041006	Middle Antietam Creek	595
020700090101	Upper Rock Creek	16,353
020700090102	Lower Rock Creek	24,234

020700090203	Lower Marsh Creek	20,788
020700090503	Cattail Branch-Monocacy River	246
Total Area in Pennsylvania		2,555,652

Virginia

HUC_12	Watershed Name	Estimated Acres
020600010204	Tangier Sound	252
020700050401	Skidmore Fork-North River	25,323
020700050402	Little River	16,234
020700050403	Briery Branch	31,626
020700050405	Thorny Branch-North River	28,394
020700050501	Skidmore Fork-Dry River	24,831
020700050502	Black Run-Dry River	21,837
020700050503	Muddy Creek	20,119
020700050504	Honey Run-Dry River	10,014
020700050605	Pleasant Run-North River	25,363
020700050606	Mill Creek-North River	16,243
020700050802	Keezletown-Cub Run	17,151
020700060105	Shoemaker River	23,413
020700060106	Runion Creek-North Fork Shenandoah River	20,320
020700060201	Dry Fork	13,984
020700060202	Mountain Run-Smith Creek	13,687
020700060203	War Branch-Smith Creek	14,338
020700060204	Gap Creek-Smith Creek	25,315
020700060301	Turley Creek-North Fork Shenandoah River	14,771
020700060302	Linville Creek	29,640
020700060303	Long Meadow-North Fork Shenandoah River	34,666
020700060304	Holmans Creek-North Fork Shenandoah River	15,309
020700060305	Crooked Run-Mill Creek	29,770
020700060306	Mt Jackson-North Fork Shenandoah River	17,434
020700060401	Riles Run-Stony Creek	33,134
020700060402	Yellow Spring Run-Stony Creek	11,040
020700060403	Painter Run-Stony Creek	28,336
020700060501	Narrow Passage Creek-North Fork Shenandoah River	39,049
020700060502	Toms Brook-North Fork Shenandoah River	16,214
020700060503	Tumbling Run-North Fork Shenandoah River	23,080
020700060601	Paddy Run-Cedar Creek	26,217
020700060602	Duck Run-Cedar Creek	18,404
020700060603	Fall Run	11,178
020700060604	Froman Run-Cedar Creek	14,257
020700060605	Meadow Brook-Cedar Creek	30,526
020700060701	Upper Passage Creek	32,248
020700060702	Lower Passage Creek	23,913
020700060703	Molly Booth Run-North Fork Shenandoah River	11,908
020700100501	Trapp Branch-Broad Run	24,186

020700100502	Catletts Branch-Broad Run	23,521
020700100503	Kettle Run	16,633
020700100504	Rocky Branch-Broad Run	24,358
020700100601	Mill Run-Cedar Run	18,446
020700100602	Owl Run-Cedar Run	23,646
020700100603	Licking Run	16,323
020700100604	Walnut Branch-Cedar Run	11,099
020700100605	Town Run	25,615
020700100606	Slate Run-Cedar Run	30,251
020700110207	Passapatanzy Creek-Potomac River	10,570
020700110301	Chotank Creek-Potomac River	7,449
020700110305	Gambo Creek-Potomac River	7,347
020700110601	Upper Machodoc Creek	29,780
020700110602	Rosier Creek-Potomac River	14,140
020700110603	Mattox Creek	18,033
020700110604	Popes Creek-Potomac River	23,338
020700110801	Nomini Creek	32,467
020700110802	Nomini Bay-Potomac River	11,161
020700110803	Lower Machodoc Creek-Potomac River	24,342
020700110804	Yeocomico River	31,985
020700110805	Coan River	19,595
020700110806	Hull Creek-Potomac River	21,589
020801030101	Buck Run-Rappahannock River	25,417
020801030102	Jordan River	21,907
020801030103	Lake Mosby-Rappahannock River	8,704
020801030201	Glascock Run-Rappahannock River	10,001
020801030404	Muddy Run	18,878
020801030405	Indian Run-Hazel River	25,051
020801030501	Hiders Branch-Mountain Run	30,917
020801030502	Jonas Run	11,378
020801030503	Flat Run-Mountain Run	15,973
020801030601	Marsh Run	29,802
020801030602	Ruffans Run-Rappahannock River	25,051
020801030603	Rock Run-Rappahannock River	25,766
020801030801	Marsh Run-Rapidan River	24,853
020801030802	Blue Run	20,833
020801030803	Beautiful Run	14,924
020801030804	Poplar Run-Rapidan River	15,953
020801030904	Deep Run-Robinson River	39,528
020801030905	Crooked Run	14,999
020801030906	Great Run-Robinson River	14,332
020801031001	Rapidan-Rapidan River	17,870
020801031002	Cedar Run	18,184
020801031003	Potato Run-Rapidan River	32,294
020801031101	Mill Run-Mountain Run	20,557
020801031102	Mine Run	23,803
020801031103	Fields Run-Rapidan River	25,897
020801031104	Wilderness Run	10,569
020801031105	Hazel Run-Rapidan River	14,069
020801060401	Mountain Run-North Anna River	34,668

020801060402	Hickory Creek	13,110
020801060403	Gold Mine Creek	15,832
020801060404	Christopher Creek-North Anna River	21,264
020801060501	Clear Creek-Pamunkey Creek	37,435
020801060502	Terrys Run	28,229
020801060503	Plentiful Creek-Pamunkey Creek	12,812
020801060601	Contrary Creek	13,966
020801060602	Pigeon Run-Lake Anna	12,958
020801060603	Elk Creek-Lake Anna	28,226
020801100601	Little Annemessex River-Tangier Sound	9,623
020801100602	Smith Island	26,537
020801100603	Lower Tangier Sound Channel	23,051
020801110303	Cypress Swamp-Pocomoke River	190
020801110401	Pitts Creek	8,429
020801110402	Bullbegger Creek-Pocomoke River	19,038
020801110501	Marumsco Creek-Pocomoke Sound	5,936
020801110502	East Creek-Pocomoke Sound	6,127
020801110601	Beasley Bay-Messongo Creek	27,617
020801110602	Guilford Creek-Beasley Bay	34,572
020801110701	The Prong-Pocomoke Sound	13,803
020801110702	Deep Creek-The Thorofare	18,623
020801110703	Chesconessex Creek-Onancock Creek	22,937
020801110704	Pocomoke Sound Channel	26,410
020801110801	Pungoteague Creek-Lower Chesapeake Bay	28,256
020801110802	Nandua Creek-Lower Chesapeake Bay	18,326
020801110803	Occohannock Creek-Lower Chesapeake Bay	22,926
020802011403	Mill Creek-Looney Creek	39,454
020802020204	Walker Creek	17,758
020802020205	Hays Creek	33,767
020802031301	Grease Creek-Slate River	26,463
020802031302	Meadow Creek-North River	22,274
020802031303	Horsepen Creek-Slate River	23,637
020802031304	Ripley Creek-Walton Fork	24,116
020802031401	Joshua Creek-Slate River	23,084
020802031402	Sharps Creek-Slate River	25,354
020802031403	Hunts Creek-Slate River	12,067
Total Area in Virginia		2,611,800

West Virginia

HUC_12	HU_12_NAME	**Estimated Acres**
020700010301	Frank Run-South Branch Potomac River	63
020700010302	Strait Creek	636
020700010303	East Dry Run-South Branch Potomac River	27,223
020700010304	Whitethorn Creek-Thorn Creek	32,071
020700010305	Smith Creek-South Branch Potomac River	27,541
020700010306	Hayes Gap Run-South Branch Potomac River	22,436
020700010307	Reeds Creek	12,853

020700010308	Mill Run-South Branch Potomac River	23,256
020700010401	South Mill Creek	30,078
020700010402	Johnson Run-Mill Creek	36,654
020700010501	Brushy Fork-South Fork South Branch Potomac River	23,356
020700010502	Little Fork-South Fork South Branch Potomac River	17,139
020700010503	Miller Run-South Fork South Branch Potomac River	17,880
020700010504	Hawes Run-South Fork South Branch Potomac River	21,070
020700010505	Rough Run-South Fork South Branch Potomac River	17,080
020700010506	Kettle Creek-South Fork South Branch Potomac River	21,264
020700010507	Rohrbaugh Run-South Fork South Branch Potomac River	19,378
020700010508	Stump Run-South Fork South Branch Potomac River	18,944
020700010509	Stony Run-South Fork South Branch Potomac River	20,198
020700040904	Turkey Run-Opequon Creek	17,503
020700040905	Mill Creek	17,736
020700040906	Middle Creek-Opequon Creek	26,384
020700040907	Tuscarora Creek	16,929
020700040908	Evans Run-Opequon Creek	22,018
020700040909	Hoke Run-Opequon Creek	22,777
020700041101	Harlan Run	10,840
020700041103	Camp Spring Run-Potomac River	14,264
020700041104	Rockymarsh Run	10,526
020700041106	Rattlesnake Run-Potomac River	19,321
020700041107	Elks Run	11,984
020700041108	Harpers Ferry-Potomac River	5,034
020700070202	Dog Run-Shenandoah River	4,369
020700070203	Long Marsh Run	6,938
020700070301	Bullskin Run	13,359
020700070302	Evitts Run	12,858
020700070303	Furnace Run-Shenandoah River	9,353
020700070304	Flowing Springs Run-Shenandoah River	19,158
Total Area in West Virginia		650,469

Appendix C. References.

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