Water Quality Improvement Plan

Mossy Creek, Long Glade Run and Naked Creek

A plan to reduce bacteria and sediment in the creeks

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North River Elementary School
Shenandoah RC&D
Valley Conservation Council

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Executive Summary

Water Quality Problems in Mossy Creek, Long Glade Run and Naked Creek

TMDLs were developed for Mossy Creek and Long Glade Run in 2004, and Naked Creek in 2002 when water quality monitoring showed:

1) The creeks were all violating the State's water quality standard for bacteria

2) Mossy Creek was violating the general standard for aquatic life use. The primary stressor on the aquatic community was identified as sediment.

Mossy Creek, Long Glade Run and Naked Creek TMDL Implementation Plan

Once a TMDL is developed for a stream, the next step is to create a plan identifying how the pollutant reductions identified in the TMDL can be achieved. A TMDL Implementation Plan describes actions that can be taken by landowners in the watersheds, which can include the use of better treatment technology and the installation of best management practices (BMPs), that will ultimately result in improved water quality in the stream. Collecting input from the public on conservation and outreach strategies to include in the TMDL Implementation Plan was a critical step in this planning process. Since the plan will be implemented primarily by watershed stakeholders on a voluntary basis with some financial incentives, local input and support are the primary factors that will determine the success of this plan.

Sources of Bacteria in the Watersheds

Agricultural runoff and wildlife have been identified as the primary sources of bacteria. Non-point sources of bacteria in the watersheds include failing septic systems and straight pipes, livestock (including manure application loads), wildlife, and domestic pets. Point sources including individual residences can contribute bacteria and sediment to streams through their discharges.

Table ES-1. Goals for bacteria reductions in Mossy Creek, Long Glade Run and Naked Creek. Note: DD=direct deposit, PLS=pervious land surface)

Watershed	Fecal Coliform Reduction from Source Category (%)						
	Cattle DD	Cropland	Pasture	Loafing Lot	Wildlife	Straight Pipes	All Residential PLS
Mossy Creek	94%	95%	98%	100%	0%	100%	95%
Long Glade Run	99%	95%	95%	100%	30%	100%	30%
Naked Creek	100%	0%	97%	N/A	55%	100%	97%

Sources of Sediment in Mossy Creek

The sediment in Mossy Creek comes primarily from non point source pollution. The major sources of sediment are agricultural and urban land. Agricultural lands, such as cropland and pasture/hay areas, can contribute excessive sediment loads through erosion and build-up/washoff processes. Agricultural lands are particularly susceptible to erosion due to less vegetative coverage.

Table ES-2. Goals for sediment reductions in Mossy Creek

Sediment Reduction from Source Category (%)				
Cropland	**Pasture**	**Urban**	**Forestry**	**Channel Erosion**
75%	75%	75%	75%	75%

Implementation Actions

Livestock Direct Deposit

The TMDL studies specify a 94-100% reduction in the direct deposit of waste into the stream from livestock. Some form of exclusion of livestock from streams is needed to meet these goals. Farmers who wish to exclude their livestock from the stream have several options through state and federal cost share programs. Table 3 shows an estimated breakdown of the types of fencing systems that could be installed in the watersheds to achieve the livestock exclusion goals.

Table ES-3. Livestock exclusion BMPs

Exclusion system	Mossy Creek		Long Glade Run		Naked Creek	
	No. of Systems	Linear ft.	No. of Systems	Linear ft.	No. of Systems	Linear ft
LE-1T	4	11,663	6	18,280	6	15,253
LE-2T	4	11,663	6	21,536	5	15,253
WP-2T	4	3,888	6	6,093	5	5,084
CRP	2	6,221	3	9,749	13	8,135
CREP	15	44,321	23	69,463	19	57,963
TOTAL	**29**	**77,756**	**44**	**125,121**	**48**	**101,688**

Pasture

One pasture practice that will help water quality is improved pasture management through rotational grazing systems and rotational loafing lot systems. Based on input from the working groups, it is unlikely that a large number of farmers would be interested in installing upland buffers, so the use of this best management practices was minimized in implementation scenarios (Table 4).

Table ES-4. Pasture BMPs

BMP		Units	Mossy Creek	Long Glade Run	Naked Creek
Riparian buffer	CREP buffers	acres	35	66	36
	CRP buffers	acres	3	5	3
	LE-1T buffers	acres	9	17	9
	WP-2T buffers	acres	3	6	3
Loafing lot management		system	2	1	1
Improved pasture management		acres	5,802	7,246	9,444
Reforestation of erodible pasture (upland buffers)		acres	508	725	1,180

Straight Pipes and Failing Septic Systems

Since state law requires that failing septic systems and straight pipes be corrected once identified, this plan includes a 100% reduction in bacteria from straight pipes and failing septic systems.

Table ES-5. Residential wastewater BMPs needed

Watershed	Septic system repair	Septic system replacement	Alternative waste treatment system
Mossy Creek	36	34	2
Long Glade Run	35	29	7
Naked Creek	60	49	11
TOTAL	**101**	**112**	**20**

Residential Areas

In addition to failing septic systems and straight pipes, pet waste is a key source of bacteria from residential areas in the watersheds. The development of a pet waste education program will help to reduce the amount of bacteria from pet waste entering the streams. In order to address sediment coming from residential areas in Mossy Creek, rain gardens could be installed to catch and treat runoff from yards and driveways. A typical rain garden should be designed to receive runoff from approximately 1 acre of land. Residential BMPs are shown in Table 6.

Table ES-6. Residential BMPs

BMPs	Units	Mossy Creek	Long Glade Run	Naked Creek
Pet waste digester	digester	221	209	150
Pet waste education program	program	1	1	1
Rain garden	garden	19	0	10

Cropland

Bacteria from the spreading of manure on cropland can end up in a stream unless the appropriate management practices are in place. Sediment can run off of cropland when soils are exposed and will make its way to the stream unless filtering practices like riparian buffers are in place to trap it.

Table ES-7. Cropland BMPs needed

Land use	BMP	Units	Mossy Creek	Long Glade Run	Naked Creek
Cropland and Pasture (applied manure)	Poultry litter storage	system	2	2	2
	Dairy manure storage	system	1	2	2
	Beef manure storage	system	3	3	0
	Sinkhole protection	system	10	10	10
Cropland	Conservation tillage	acres	1376	0	0
	Field borders (tree & shrub buffers)	acres	264	160	0
	Woodland buffer filter strip	acres	5	14	0
	Grassed buffer filter strip	acres	5	14	0
	Continuous no-till	acres	206	0	0
	Sod waterway	acres	3	0	0
	Cover crop	acres	399	0	0
	Contour farming	acres	222	0	0
	Permanent vegetative cover	acres	124	0	0
	CREP riparian buffer (100 ft)	acres	27	0	0

Education and Outreach

In order to get landowners involved in implementation, it will be necessary to initiate education and outreach programs and provide technical assistance with the design and installation of best management practices. The working groups recommended several education/outreach techniques, which will be utilized during implementation. Outreach at County Fairs has been successful in other watersheds in the past. There are also opportunities for joint events with the Virginia Cooperative Extension Service. It was recommended that Headwaters SWCD work with Cooperative Extension to hold a series of workshops and demonstrations on the benefits of conservation tillage and continuous no-till for farmers cropping in the watersheds. Presentations at local Ruritan and Rotary clubs were mentioned as a good way to reach farmers as well. Landowners in the watersheds noted that it will be important to conduct a mailing promoting programs to assist homeowners with septic system maintenance and the correction of straight pipes.

Costs and Benefits

It was estimated that it would require $50,000 to support one technical full time position. It was determined that one full time position in each watershed (3 total) would be needed in order to complete the implementation effort within a 10 year period. Consequently, the total estimated cost to provide technical assistance during implementation is expected to be approximately $150,000 per year for 10 years.

The costs of residential BMP implementation were estimated based primarily on input from the Augusta County Health Department. The cost estimates developed for pet waste digesters and rain gardens were based on costs associated with a recent grant-funded project conducted by the Shenandoah Valley Soil and Water Conservation District in Rockingham County.

The costs of agricultural best management practices included in the implementation plan were estimated based on data for Augusta and Rockingham Counties from the VADCR Agricultural BMP Database. Cost estimates were further refined following discussions with stakeholders.

Table ES-8. Total estimated costs of full BMP implementation

Watershed	Agricultual BMPs	Residential BMPs	Technical Assistance
Mossy Creek	$1,866,726	$573,510	$500,000
Long Glade Run	$2,585,738	$447,290	$500,000
Naked Creek	$2,263,640	$828,750	$500,000
TOTAL	**$6,716,104**	**$1,849,550**	**$1,500,000**

The primary benefit of implementing this plan will be cleaner water in Mossy Creek, Long Glade Run and Naked Creek. Additionally, an important objective of the implementation plan is to foster continued economic vitality. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide economic benefits to the community, as well as the expected environmental benefits. Specifically, alternative (clean) water sources, exclusion of cattle from streams, improved pasture management, and private sewage system maintenance will each provide economic benefits to land owners. Additionally, money spent by landowners and state agencies in the process of implementing this plan will stimulate the local economy.

A list of potential funding sources available for implementation has been developed. Detailed descriptions can be obtained from the Soil and Water Conservation Districts (SWCDs), VADCR, Natural Resources Conservation Service (NRCS), and Virginia Cooperative Extension (VCE).

While the Headwaters SWCD is currently working with the Augusta County Service Authority to conduct septic system repairs and replacement, this project and associated funding comes to an end in 2009. An additional funding commitment is needed for the residential program.

Some of the most commonly used funding sources include: Virginia Agricultural Best Management Practices Cost-Share and Tax Credit Programs, Virginia Agricultural Best Management Practices Loan Program, Conservation Reserve Enhancement Program (CRP/CREP), Virginia Water Quality Improvement Fund, Environmental Quality Incentives Program (EQIP) Southeast Rural Community Assistance Project (SE/R-CAP), and Clean Water State Revolving Fund.

Partners And Their Role In Implementation

Agricultural and Residential Education Programs

The Headwaters Soil and Water Conservation District (SWCD) will be in charge of initiating contact with farmers to encourage the installation of BMPs. District staff will also conduct outreach activities in the watershed to encourage participation in conservation programs. The Headwaters SWCD has been receiving funding from the VA DCR for a full time agricultural technician to work with producers in several watersheds in Augusta County including Mossy Creek, Long Glade Run and Naked Creek. Targeted cost share funding for best management practices has also been provided to the Headwaters SWCD for agricultural BMPs in these watersheds. These funds have been available since Summer 2006.

A residential education program consisting of educational materials about pet waste and a pet waste digester program could be run through a partnership between the Headwaters SWCD, the Augusta County Service Authority and the Augusta County SPCA. These organizations could assist in the distribution of information on the importance of picking up after your pet including the potential for contamination of drinking water for homeowners with wells.

Monitoring Water Quality

Improvements in water quality will be determined by monitoring conducted by the VA Department of Environmental Quality's (DEQ) ambient and biological monitoring programs. Each stream will have one sampling site that will be visited once a month by DEQ monitors. DEQ will also continue to monitor the biological health of Mossy Creek by sampling the benthic community in the Fall or Spring once a year.

Introduction

Background : Total Maximum Daily Loads (TMDLs)

The Clean Water Act (CWA) requires that all of our streams, rivers, and lakes meet their state's water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards. Through this required program, the state of Virginia has found that many streams do not meet state water quality standards for protection of the five beneficial uses: fishing, swimming, shellfish, aquatic life, and drinking. When streams fail to meet standards they are placed on the state's impaired waters list, and the state must then develop a Total Maximum Daily Load (TMDL) for each pollutant. A TMDL is a "pollution budget" for a stream. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. Non-point source pollution occurs when pollutants are transported across the land to a body of water when it rains. Point source pollution occurs when pollutants are directly discharged into a stream. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

Water Quality Problems in Mossy Creek, Long Glade Run and Naked Creek

TMDLs were developed for Mossy Creek and Long Glade Run in 2004, and Naked Creek in 2002 when water quality monitoring showed:

1) The creeks were all violating the State's water quality standard for bacteria, which is based on the concentration of *E. coli* in the water (the *E.coli* bacteria count should not exceed a geometric mean of 126 cfu per 100 mL of water for two or more samples taken over a 30-day period, and it should not exceed 235 cfu per 100 mL at any time). *E. coli* comes from the gut of warm-blooded animals, and can pose a threat to human health including gastrointestinal illness following injestion, or infection.

2) Mossy Creek was violating the general standard for aquatic life use. This standard states that all state waters should support "the propagation and growth of a balanced indigenous population of aquatic life..." Based on biological monitoring conducted by the Virginia Department of Environmental Quality (VADEQ), it was concluded that Mossy Creek was not meeting this designation. The primary stressor on the aquatic community was identified as sediment.

The TMDLs specified the maximum bacteria and sediment (only in Mossy Creek) that creeks can handle and still meet the water quality standard for bacteria while also supporting a healthy and diverse aquatic population.

Mossy Creek, Long Glade Run and Naked Creek TMDL Implementation Plan

Once a TMDL is developed for a stream, the next step is to create a plan identifying how the pollutant reductions identified in the TMDL can be achieved. A TMDL Implementation Plan describes actions that can be taken by landowners in the watersheds, which can include the use of better treatment technology and the installation of best management practices (BMPs), that will ultimately result in improved water quality in the stream. There are nine components included in an implementation plan:

1. Causes and sources of bacteria and sediment that will need to be controlled to meet the water quality standards
2. Reductions in pollutants needed to achieve water quality standards
3. Management measures (BMPs) that will need to be implemented to achieve the pollutant reductions
4. Technical and financial assistance needed, associated costs, and the authorities that will be relied upon to implement the plan
5. An information/education component that will be used to enhance public understanding on the project and encourage participation in selecting and implementing best management practices
6. A schedule for implementation of the practices identified in the plan
7. Goals and milestones for implementing best management practices
8. A set of criteria for determining if bacteria and sediment reductions are being achieved and if progress is being made towards attaining water quality standards
9. A monitoring program to evaluate the effectiveness of the implementation effort

Review Of TMDL Studies

Watershed Characteristics

Mossy Creek, Long Glade Run and Naked Creek are part of the Shenandoah River Basin. The Mossy Creek, Long Glade Run and Naked Creek watersheds are approximately 10,077 acres, 11,781 acres and 14,674 acres, respectively. Land use in all three of the watersheds is predominantly agricultural, ranging from 68% to 75% of each watershed. The remainder of the watersheds is a mix of forest and rural developments.

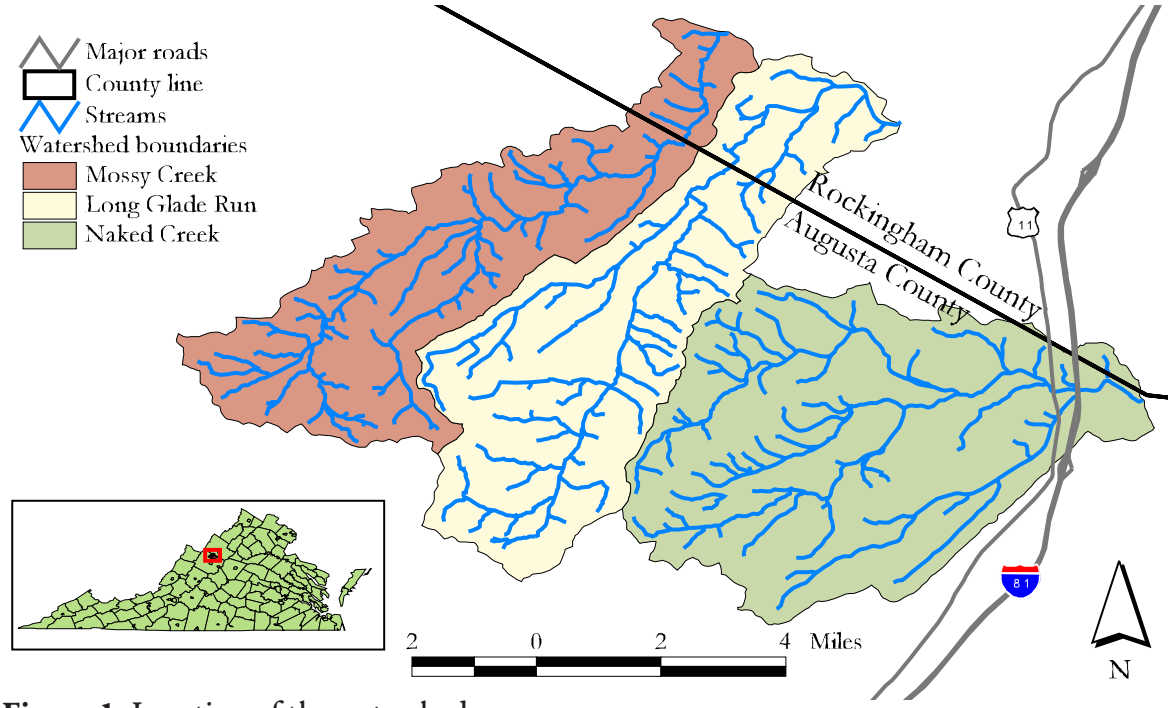

Figure 1. Location of the watersheds

Sources of Bacteria in the Watersheds

Agricultural runoff and wildlife have been identified as the primary sources of bacteria. Non-point sources of bacteria in the watersheds include failing septic systems and straight pipes, livestock (including manure application loads), wildlife, and domestic pets. Point sources including individual residences can contribute bacteria and sediment to streams through their discharges. There are currently 7 point source permits in the Mossy Creek, Long Glade Run and Naked Creek watersheds.

Sources of Sediment in Mossy Creek

The sediment in Mossy Creek comes primarily from non point source pollution. The major sources of sediment are agricultural and urban land. Agricultural lands, such as cropland and pasture/hay areas, can contribute excessive sediment loads through erosion and build-up/washoff processes. Agricultural lands are particularly susceptible to erosion due to less vegetative coverage. There is one point source in the Mossy Creek watershed that is permitted to discharge sediment to the stream.

Goals for Reducing Bacteria

The TMDL studies completed for the creeks identified goals for reducing bacteria from the different sources in the watersheds. These goals are based on what it would take to never violate the water quality standard for *E. coli* (Table 1). This standard is designed to protect human health and reduce the risk of illness or infection upon primary contact with the water (e.g. swimming or splashing in the creek).

Table 1. Goals for bacteria reductions in Mossy Creek, Long Glade Run and Naked Creek. Note: DD=direct deposit, PLS=pervious land surface)

Watershed	Fecal Coliform Reduction from Source Category (%)						
	Cattle DD	Cropland	Pasture	Loafing Lot	Wildlife	Straight Pipes	All Residential PLS
Mossy Creek	94%	95%	98%	100%	0%	100%	95%
Long Glade Run	99%	95%	95%	100%	30%	100%	30%
Naked Creek	100%	0%	97%	N/A	55%	100%	97%

Goals for Reducing Sediment in Mossy Creek

Sediment was identified as the primary pollutant stressing the benthic community (aquatic insects that live at the bottom of the stream). When too much sediment gets into the stream, it alters the stream bottom by filling in the spaces between gravel and other materials in the stream. This harms aquatic insects that live in the spaces by eliminating their habitat. In order to correct this problem, sediment reduction goals were developed for the Mossy Creek TMDL. The recommended sediment reduction scenario for Mossy Creek is shown in Table 2. Sediment loads from point sources were not reduced because these facilities are currently meeting their pollutant discharge limits and other permit requirements.

Table 2. Goals for sediment reductions in Mossy Creek

Sediment Reduction from Source Category (%)				
Cropland	Pasture	Urban	Forestry	Channel Erosion
75%	75%	75%	75%	75%

Public Participation

Collecting input from the public on conservation and outreach strategies to include in the TMDL Implementation Plan was a critical step in this planning process. Since the plan will be implemented primarily by watershed stakeholders on a voluntary basis with some financial incentives, local input and support are the primary factors that will determine the success of this plan.

Public meetings were held at the North River Elementary School on the evenings of June 20th, 2007 and June 18, 2009 to kick-off and conclude the implementation planning process. Both meetings served as opportunities for local residents to learn more about the creeks, and to work together to come up with new ideas to protect and restore water quality in their community. A draft implementation plan and presentation was distributed to attendees at the final public meeting. In addition, informational pamphlets describing programs associated with Headwaters SWCD, VADCR, and VADEQ were made available.

The role of the Agricultural Working Group was to review conservation practices and outreach strategies from an agricultural perspective. During the first agricultural working group meeting on June 20th, the group expressed concerns that more water quality monitoring needed to occur in Mossy Creek prior to the development of an implementation plan for the watershed. At the second on October 4, 2007, the working group discussed livestock exclusion fencing , maintenance issues with riparian buffers, and current pasture management practices in the watersheds. The group agreed that buffer maintenance needs frequently deter individuals from signing up for state and federal programs.

The primary role of the Residential Working Group was to discuss methods needed to reduce human and pet sources of bacteria entering the creeks. Two meetings were held in June and September 2007. The group suggested that the septic tank pumpout portion of this program should be focused on homes that are 5 years or older and within 500 ft of a stream. Postcards, letters and a bulletin/

newsletter were identified as effective outreach methods. A participant also suggested implementing a well-testing program. Pet waste digesters were identified as a great idea in urban areas, though the working group thought that people living in these more rural watersheds would probably not use them. The group discussed specific locations for riparian buffers and rain gardens. The group though that the vet clinic in Naked Creek would be a good place for a riparian buffer since they own land right down to the stream. Tyco in Mt. Sidney drains to Naked Creek, and could be a great place for a rain garden. Oak Manor Horse Center in Burketown was sold to Bridgewater College recently, and the property abuts Naked Creek. This would be a good site for a riparian buffer.

The Government Working Group met in December 2008 to discuss existing programs and technical resources that may enhance implementation efforts. The group discussed both state and federal agricultural cost share programs, and NRCS and Headwaters SWCD staff made recommendations based on their experiences working with landowners in the watersheds. The group recommended increasing the number of CREP practices included in the plan, as this is a more popular practices than the other fencing practices currently available through cost share programs. There was some discussion of drawbacks expressed by farmers in the watersheds to livestock exclusion fencing, namely flooding. The group thought that Mossy Creek does not tend to come out of its banks quite as often as Long Glade Run and were unsure about Naked Creek. There was some interest expressed in starting a fencing insurance program. It was suggested that it would be helpful if an individual could be kept "on retainer" by the Soil and Water Conservation District and NRCS in order to provide farmers with assistance putting fencing back up or fixing broken pumps on wells etc.

There was significant concern that the sediment load coming from cropland was overestimated. Historically, there was a lot of cropland in Mossy Creek, but it has been reduced. The creek also has an old mill dam that may be contributing to the sediment issue. It was recommended that crop rotation to perennials be included in the plan as well as a small amount of contour farming. While most people are already doing this, there are still a few that have yet to implement it.

Lastly, the group discussed ideas for education and outreach. It was recommended that more material be made available on livestock health and drinking dirty water through presentations such as those that have been given by Scott Nordstrom, a local veterinarian. The transfer of livestock diseases through creek water was discussed as a way to encourage livestock exclusion. The group talked about the possibility of working with students and professors at James Madison University to see if a project could be done to investigate how easily different diseases could be transferred to herds in a watershed.

Implementation Actions

An important part of the implementation plan is the identification of specific actions that will improve water quality in the watersheds. This section provides a summary of what is needed to achieve the pollutant load reductions specified in the TMDLs. Since this plan is designed to be implemented by landowners on a voluntary basis, it is necessary to identify actions including management strategies that are both financially and technically realistic and suitable for this particular community. As part of this process, the costs and benefits of these actions must be examined and weighed. Once the best actions have been identified for implementation, we must also develop an estimate of the number of each action that would be needed in order to meet the water quality goals established during the TMDL studies.

Management Actions Selected through Stakeholder Review

While management actions such as livestock exclusion and straight pipe removal were directly prescribed by the TMDLs, a number of additional measures were needed to control fecal bacteria and sediment from land-based sources. Various scenarios were developed and presented to working groups, who considered both economic costs and the water quality benefits. The majority of these best management practices (BMPs) are included in state and federal agricultural cost share programs that promote conservation. In addition, innovative management practices suggested by local producers and technical conservation staff were considered. The final set of practices identified and the efficiencies used in this study are listed in Table 3.

Livestock Direct Deposit

The TMDL studies specify a 94-100% reduction in the direct deposit of waste into the stream from livestock. Some form of exclusion of livestock from streams is needed to meet these goals. To estimate fencing needs, information on the stream network was compared with land use data. Stream segments that flowed through or were adjacent to pasture were identified. If the stream segment flowed through a pasture, it was assumed that fencing was needed on both sides of the stream. If a stream segment flowed adjacent to a pasture, it was assumed that fencing was required on only one side of the stream. Not every pasture has livestock on it at any given point in time. However, it is assumed that all pasture areas have the potential for livestock access, meaning that livestock exclusion fencing should be installed.

Photo: Mike Phillips, Shenandoah Valley SWCD

The VADCR Agricultural BMP Database was utilized to determine typical characteristics (e.g., streamside fencing length per practice) of the different livestock exclusion systems offered through the State Agricultural Cost Share Program so that the number of different systems needed could be accurately estimated. In addition, data on stream fencing already in place was collected for each watershed and subtracted from the total fencing needed. Based on queries of the VADCR Agricultural BMP Database, a total of 37,889 linear feet of fencing has already been installed in Mossy Creek. In the Long Glade Run watershed 32,316 linear feet of fencing has been installed, and 91,099 linear feet of fencing has been installed in Naked Creek.

Farmers who wish to exclude their livestock from the stream have several options through state and federal cost share programs. Incentive payments vary based on the width of the streamside buffer that is installed between the fence and the stream, and the type of fencing that is installed. The portion of fencing that will be accomplished using a variety of available fencing practices based on historical data and input from farmers and agricultural conservation professionals.

Farmers who cannot afford to give up a significant amount of land for a streamside buffer can receive 50% cost share for the installation of exclusion fencing with a ten foot setback, cross fencing, and to provide an alternative water source for their livestock. It is estimated that 15% of the total fencing needed in the watersheds will be installed using this particular practice (code LE-2T). If a landowner can afford to give up 35 feet for a buffer along the stream, then they are eligible to receive cost share at a rate of 85% to cover the costs of the stream fencing, cross fencing and providing alternative water. It is estimated that 15% of the total fencing will be installed using this particular practice (code LE-1T). For producers who are not interested in installing an alternative water source, there is a stream protection practice that provides cost share for fencing with a 35 foot riparian buffer and hardened crossings with access points for livestock to get water. This practice (code WP-2T) also provides an up front incentive payment for fence maintenance in the amount of $0.50/linear foot of fence. It is estimated that 5% of fencing will be installed using this practice. In addition, it is expected that the Conservation Reserve Program will be utilized by farmers. For farmers who are willing to install a moderate riparian buffer, there is the CRP practice, which requires a 20 foot setback from the stream in order to receive cost share for fencing and off stream watering. It is estimated the approximately 8% of fencing would be installed using the CRP practice. For those who are willing to install a 35 foot buffer or larger and plant trees in the buffer, the Conservation Reserve Enhancement is an excellent option. This practice provides cost share ranging from 50% to 115% for fencing, planting materials, and alternative water source development. It is estimated that 57% of fencing will be installed through this program.

The average streamside fencing length for an LE-1T system was initially estimated at 1,467 linear feet. Since this is a brand new practice in the state cost share program, this estimate was based on the average length of a similar practice (grazing land protection). This figure was increased to 3,000

linear feet based on parcel data indicating that a 3,000 foot system better matched the average length of stream on a typical farm in the watersheds. CREP and CRP systems were also estimated at 3,000 linear feet/system. The average WP-2T system was 1,028 linear feet, and the average length of the LE-2T system was estimated at 3,000 feet. Since this is a new practice in the state cost share program, this estimate was developed based on data provided by the Shenandoah RC&D through their pilot alternative fencing program and from input from the working groups. To establish the total number of livestock exclusion systems necessary to achieve full implementation, systems were calculated by dividing the potential streamside fencing needed by the average streamside fencing length per system. These estimates are shown in Table 4.

Table 3. Best management practices and associated pollutant reductions.

Practice	**Bacteria reduction**	**Sediment reduction**	**Reference**
Septic tank pumpout	5%	N/A	2
Septic system repair	100%	N/A	1
Septic system replacement	100%	N/A	1
Alternative waste treatment system	100%	N/A	1
Pet waste digester	100%	N/A	4
Rain garden	40%	85%	2,6
Pet waste education program	50%	N/A	3
Improved pasture management	50%	50%	5,8
Riparian buffer	50%	50%	2
Wooded buffer filter strip	60%	50%	2
Grassed buffer filter strip	50%	50%	2
Livestock exclusion	100%	50%	1
Poultry litter storage	99%	N/A	7
Manure storage	80%	N/A	7
Loafing lot management system	75%	40%	6,7
Sod waterway	50%	77%	9
Conservation tillage	N/A	Land use conversion	6
Continuous no-till	N/A	70%	
Cover crop	N/A	20%	2
Contour farming	N/A	41%	10
Permanent vegetative cover on cropland	N/A	50%	11

References (Table 3)

1) Removal efficiency is defined by the practice
2) VADCR and VADEQ TMDL Implementation Plan Development Guidance Manual
3) Modified from Swann, C. 1999. A survey of residential nutrient behaviors in the Chesapeake Bay. Widener Burrows, Inc. Chesapeake Bay Research Consortium. Center for Watershed Protection. Ellicott City, MD. 112pp.
4) Mill and Hawksbill TMDL IP, MapTech, September 13, 2007
5) Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy. www.naturalresources.virginia.gov/Initiatives/TributaryStrategies/
6) Chesapeake Bay Model version 4.3 BMP efficiencies
7) North River TMDL IP, MapTech, July 5, 2001
8) Bacteria efficiency estimated based on sediment and nutrient efficiency
9) Fiener, P., Auerswald, K. Effectiveness of grassed waterways in reducing runoff and sediment delivery from agricultural watersheds. J. Environ. Qual. 32:927-936 (2003).
10) Borisova, T., D'Souza, G., Khandelwal, N., Benham, B., and M.L. Wolfe. Analysis of sediment reduction strategies for Abrams Creek Benthic TMDL using PredICT software. http://www.cafcs.wvu.edu/RESM/PDF/RESMWP-05-06.pdf. Accessed December 17, 2008.
11) Practice efficiency estimated based on grassed buffer filter strip efficiency based on establish ment of vegetative cover using perennial grasses

Table 4. Livestock exclusion BMPs

Exclusion system	Mossy Creek		Long Glade Run		Naked Creek	
	No. of Systems	Linear ft.	No. of Systems	Linear ft.	No. of Systems	Linear ft
LE-1T	4	11,663	6	18,280	6	15,253
LE-2T	4	11,663	6	21,536	5	15,253
WP-2T	4	3,888	6	6,093	5	5,084
CRP	2	6,221	3	9,749	13	8,135
CREP	15	44,321	23	69,463	19	57,963
TOTAL	**29**	**77,756**	**44**	**125,121**	**48**	**101,688**

Straight Pipes and Failing Septic Systems

Since state law requires that failing septic systems and straight pipes be corrected once identified, this plan includes a 100% reduction in bacteria coming from straight pipes and failing septic systems. The options identified for correcting straight pipes and failing septic systems included: repair of an existing septic system, replacement of a conventional septic system, and installation of an alternative waste treatment system. Estimates of the percentages of households served by failing septic systems and straight pipes in the Mossy Creek, Long Glade Run and Naked Creek watersheds are shown in Table 5. These estimates are based on the age of homes in the watershed, and in the case of straight pipes, the proximity of homes to the stream.

Table 5. Failing septic systems and straight pipes by watershed

Watershed	Failing septic systems	Straight pipes
Mossy Creek	73	1
Long Glade Run	73	0
Naked Creek	118	4
TOTAL	**264**	**5**

Table 6 gives a summary of estimated septic system repairs and replacements needed in the watersheds. The Headwaters Soil and Water Conservation District received a grant in 2007 to provide financial assistance with septic system maintenance including replacing straight pipes in the watersheds. Between October, 2007 and January, 2009, 3 repairs have been made to failing systems, and one failing septic system and two straight pipes have been replaced with conventional systems. These repairs and replacements have been subtracted from the needs shown in Table 5. In addition to these BMPs, an educational effort will be important for successful implementation

Table 6. Residential wastewater BMPs needed

Watershed	Septic system repair	Septic system replacement	Alternative waste treatment system
Mossy Creek	36	34	2
Long Glade Run	35	29	7
Naked Creek	60	49	11
TOTAL	**101**	**112**	**20**

Pasture

Runoff from pastures in the watersheds can carry with it bacteria from manure on the pasture, and can also pick up sediment on its way to the stream. One pasture practice that will help water quality is improved pasture management through rotational grazing systems and rotational loafing lot systems. Vegetated buffers were also included in the implementation plan to treat runoff from pasture. These buffers will act as a filter, trapping bacteria and sediment before it runs into the stream. When considering the effectiveness of a vegetated buffer in trapping pollutants, it is important to consider the area that will be draining to the buffer. In this case, it was assumed that a typical buffer would be able to receive and treat runoff from an area four times its width. For example, a buffer that was 35 feet wide and 1,000 feet long would treat runoff from an area that was 140 feet wide and 1,000 feet long. Once you move beyond four times the buffer width, it was assumed that the runoff would be in the form of channelized flow rather than the sheet flow that a buffer can trap. Consequently, it was necessary to consider both riparian buffers and upland buffers in order to treat runoff from pasture. A combination of grassed filter strips and wooded buffer strips could be used in upland areas (50:50). Based on input from the working groups, it is unlikely that a large number of farmers would be interested in installing upland buffers, so the use of this best management practices was minimized in implementation scenarios (Table 7).

Table 7. Pasture BMPs

BMP		**Units**	**Mossy Creek**	**Long Glade Run**	**Naked Creek**
Riparian buffer	CREP buffers	acres	35	66	36
	CRP buffers	acres	3	5	3
	LE-1T buffers	acres	9	17	9
	WP-2T buffers	acres	3	6	3
Loafing lot management		system	2	1	1
Improved pasture management		acres	5,802	7,246	9,444
Reforestation of erodible pasture (upland buffers)		acres	508	725	1,180

Cropland

Photo: Jeff Vanuga, NRCS (2002)

Bacteria from the spreading of manure on cropland can end up in a stream unless the appropriate management practices are in place. Sediment can run off of cropland when soils are exposed to rainfall, and will make its way to the stream unless filtering practices like riparian buffers are in place to trap it. Bacteria from manure spread on cropland can be reduced either by decreasing the source of the bacteria (spreading less manure or storing it longer so that bacteria will die off) or by the use of filtering practices (buffers), while sediment can be reduced by practices that increase vegetative cover, or provide filtering (Table 8).

Table 8. Cropland BMPs needed

Land use	BMP	Units	Mossy Creek	Long Glade Run	Naked Creek
Cropland and Pasture (applied manure)	Poultry litter storage	system	2	2	2
	Dairy manure storage	system	1	2	2
	Beef manure storage	system	3	3	0
	Sinkhole protection	system	10	10	10
Cropland	Conservation tillage	acres	1376	0	0
	Field borders (tree & shrub buffers)	acres	264	160	0
	Woodland buffer filter strip	acres	5	14	0
	Grassed buffer filter strip	acres	5	14	0
	Continuous no-till	acres	206	0	0
	Sod waterway	acres	3	0	0
	Cover crop	acres	399	0	0
	Contour farming	acres	222	0	0
	Permanent vegetative cover	acres	124	0	0
	CREP riparian buffer (100 ft)	acres	27	0	0

Residential Areas

In addition to failing septic systems and straight pipes, pet waste is a key source of bacteria from residential areas in the watersheds. The development of a pet waste education program will help to reduce the amount of bacteria from pet waste entering the streams. The residential working group agreed that distributing information reminding pet owners to pick up after their pets would be effective. The group could not identify any areas where pet waste stations could be installed in the watersheds where people typically walk their dogs such as public parks. Pet waste digesters were included as a management strategy that homeowners could install in their yards. These digesters allow homeowners to safely compost their pet's waste, which can then be used as a fertilizer for flower beds. In order to address sediment coming from residential areas in Mossy Creek, rain gardens could be installed to catch and treat runoff from yards and driveways. A typical rain garden should be designed to receive runoff from approximately 1 acre of land. These gardens can serve as attractive landscape features while also improving water quality. Residential BMPs are shown in Table 9.

Table 9. Residential BMPs

BMPs	Units	Mossy Creek	Long Glade Run	Naked Creek
Pet waste digester	digester	221	209	150
Pet waste education program	program	1	1	1
Rain garden	garden	19	0	10

Education and Outreach

Photo: Lynn Betts, NRCS (2000)

In order to get landowners involved in implementation, it will be necessary to initiate education and outreach programs and provide technical assistance with the design and installation of best management practices. The working groups recommended several education/outreach techniques, which will be utilized during implementation. Outreach at County Fairs has been successful in other watersheds in the past. There are also opportunities for joint events with the Virginia Cooperative Extension Service. It was recommended that Headwaters SWCD work with Cooperative Extension to hold a series of workshops and demonstrations on the benefits of conservation tillage and continuous no-till for farmers cropping in the watersheds. Presentations at local Ruritan and Rotary clubs were mentioned as a good way to reach farmers as well. Landowners in the watersheds noted that it will be important to conduct a mailing promoting programs to assist homeowners with septic system maintenance and the correction of straight pipes. It was suggested that this mailing clearly state that homeowners who come forward for assistance will not be pursued legally by the Health Department if they have a straight pipe. The following general tasks associated with agricultural and residential programs were identified:

Agricultural Programs

1. Make contact with landowners in the watershed to make them aware of implementation goals, cost-share assistance, and voluntary options that are beneficial.
2. Provide technical assistance for agricultural programs (e.g., survey, design, layout, and approval of installation).
3. Develop educational materials & programs.
4. Organize educational programs (e.g., County Fair, presentations at joint VCE events or club

events).
5. Distribute educational materials (e.g., informational articles in FSA or Farm Bureau newsletters, local media).
6. Handle and track cost-share.
7. Assess and track progress toward BMP implementation goals.
8. Coordinate use of existing agricultural programs and suggest modifications where necessary.

Residential Programs

1. Identify straight-pipes and failing septic systems (e.g., contact landowners in older homes, septic pump-out program).
2. Handle and track cost-share.
3. Develop educational materials & programs.
4. Organize educational programs (e.g., demonstration septic pump-outs, nutrient management, pet waste control).
5. Distribute educational materials (e.g., informational pamphlets on TMDL IP and on-site sewage disposal systems).
6. Assess progress toward implementation goals.

The staffing level needed to implement the agricultural and residential components of the plan were estimated based on discussions with stakeholders and the staffing levels used in similar projects. Staffing needs were quantified using full time equivalents (FTE), with one FTE being equal to one full-time staff member. It was determined that one FTE would be needed for each watershed to provide the technical assistance needed for agricultural and residential implementation.

Implementation Costs

Photo: Mike Phillips, Shenandoah Valley SWCD

Agricultural BMP Costs

The costs of agricultural best management practices included in the implementation plan were estimated based on data for Augusta and Rockingham Counties from the VADCR Agricultural BMP Database. When sufficient data was available, the search for best management practices and their associated costs was limited to 2000 through 2008 so that estimates were as current as possible. Cost estimates were further refined following discussions with stakeholders.

The total cost of livestock exclusion systems includes not only the costs associated with fence installation, repair, and maintenance, but also the cost of developing alternative water sources and installing hardened crossings. The cost of fence maintenance was identified as a deterrent to participation. Financial assistance possibilities for maintaining fences include an annual 25% tax credit for fence maintenance an up front incentive payment on $0.50 per linear foot to maintain stream fencing as part of the WP-2T practice. Based on input from the working group, it was determined that the average cost of fence maintenance is significantly higher. In developing the cost estimates for fence maintenance shown in Table 10, a figure of $3.50/linear foot of fence was used. It was estimated that approximately 10% of fencing would need to be replaced every 10 years. This maintenance cost was not assigned to fencing installed using the LE-2T practice due to the far lower cost of replacing this type of fencing and the fact that it can be taken down prior to a storm that may produce a flooding event.

Residential BMP Costs

The costs of residential BMP implementation were estimated based primarily on input from the Augusta County Health Department (Table 11). The cost estimates developed for pet waste digesters and rain gardens were based on costs associated with a recent grant-funded project conducted by the Shenandoah Valley Soil and Water Conservation District in Rockingham County.

Table 10. Estimated costs of implementing agricultural BMPs

Land Use	BMP	Cost/ Unit	Mossy Creek	Long Glade Run	Naked Creek
Pasture: Livestock Exclusion and Buffers	CREP	$25,460	$376,150	$589,526	$491,925
	CRP	$23,500	$48,728	$71,124	$63,725
	LE-1T	$23,500	$91,364	$143,192	$119,485
	LE-2T	$14,960	$58,356	$91,460	$76,318
	WP-2T	$9,700	$18,912	$57,489	$47,971
	Fence replacement for 10 yrs.	$3.50	$23,133	$36,255	$30,253
Pasture	Loafing lot management	$40,935	$80,790	$40,935	$40,935
	Improved pasture mgmnt.	$107	$620,814	$775,322	$1,010,508
	Reforestation of erodible pasture	$154	$78,268	$111,712	$181,720
Pasture and Cropland: Applied Manure	Poultry litter storage	$24,500	$49,000	$49,000	$49,000
	Liquid manure storage	$63,400	$63,400	$126,800	$126,800
	Dry manure storage	$36,300	$108,900	$108,900	$0
	Sinkhole protection	$2,500	$25,000	$25,000	$25,000
Cropland	Conservation tillage	$100	$40,000	$0	$0
	Field border	$154	$40,733	$24,653	$0
	Woodland buffer filter	$450	$2,171	$6,084	$0
	Grass buffer filter	$50	$241	$676	$0
	Continuous no-till	$100	$20,600	$0	$0
	Sod waterway	$2,060	$6,180	$0	$0
	Cover crop	$40	$62,349	$0	$0
	Contour farming	$40	$3,853	$0	$0
	Permanent vegetative cover	$145	$17,956	$0	$0
	Enhanced riparian buffer (CREP)	$450	$12,059	$0	$0
		TOTALS	**$1,866,726**	**$2,585,738**	**$2,263,640**

Table 11. Estimated costs of implementing residential BMPs

BMP	Cost/Unit	Mossy Creek	Long Glade Run	Naked Creek
Pet waste education program	$3,750	$3,750		
Pet waste digesters	$60	$13,260	$12,540	$9,000
Rain gardens	$10,000	$190,000	$0	$100,000
Septic system repair	$3,000	$108,000	$105,000	$177,000
Septic system replacement	$6,500	$221,000	$188,500	$318,500
Alternative waste treatment system	$20,000	$40,000	$140,000	$220,000
	TOTALS	**$573,510**	**$447,290**	**$828,750**

Technical Assistance Costs

It was estimated that it would require $50,000 to support the salary, benefits, travel, training, and incidentals for education of one technical full time position. Based on work that has been accomplished by staff working in TMDL implementation watersheds, it was determined that one full time position in each watershed (3 total) would be needed in order to complete the implementation effort within a 10 year period. Consequently, the total estimated cost to provide technical assistance during implementation is expected to be approximately $150,000 per year for 10 years.

Total Implementation Costs

The total estimated costs for the implementation of best management practices in the Mossy Creek, Long Glade Run and Naked Creek watersheds is shown in Table 12.

Table 12. Total estimated costs of full BMP implementation

Watershed	Agricultual BMPs	Residential BMPs	Technical Assistance
Mossy Creek	$1,866,726	$573,510	$500,000
Long Glade Run	$2,585,738	$447,290	$500,000
Naked Creek	$2,263,640	$828,750	$500,000
TOTAL	**$6,716,104**	**$1,849,550**	**$1,500,000**

Implementation Benefits

Photo: Jeff Vanuga, NRCS (2002)

The primary benefit of implementing this plan will be cleaner water in Mossy Creek, Long Glade Run and Naked Creek. Specifically, *E. coli* contamination in the creeks will be reduced to meet water quality standards, and sediment loading into Mossy Creek will be reduced to support a healthy aquatic community. It is hard to gage the impact that reducing *E. coli* contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from *E. coli* sources through contact with surface waters should be reduced considerably.

An important objective of the implementation plan is to foster continued economic vitality. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide economic benefits to the community, as well as the expected environmental benefits. Specifically, alternative (clean) water sources, exclusion of cattle from streams, improved pasture management, and private sewage system maintenance will each provide economic benefits to land owners. Additionally, money spent by landowners and state agencies in the process of implementing this plan will stimulate the local economy.

Agricultural Practices

Photo: Mike Phillips, Shenandoah Valley SWCD

Restricting livestock access to streams and providing them with clean water source has been shown to improve weight gain and milk production in cattle (VCE, 2007). Studies have shown that increasing livestock consumption of clean water can lead to increased milk and butterfat production and increased weight gain (Landefeld et al, 2002). Table 13 shows an example of how this can translate into economic gains for producers.

In addition, keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VCE (1998a) reports that mastitis costs producers $100 per cow in reduced quantity and quality of milk produced. Installation of streamside fencing and well managed loafing areas will reduce the amount of time that cattle have access to these areas.

Implementing an improved pasture management system in conjunction with a clean water source will also provide economic benefits for the producer. Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition to reducing costs to producers, intensive pasture management can boost profits by allowing higher stocking rates and increasing the amount of gain per acre.

Table 13 Example of increased revenue due to installing off-stream waterers (Surber et al., 2005)

Typical calf sale weight	Additional weight gain due to off-stream waterer	Price	Increased revenue due to off stream waterer
500 lb/calf	5% or 25 lb	$0.60 per lb	$15 per calf

Note: Table from VCE: Streamside Livestock Exclusion (2007)

Residential Practices

The residential program will play an important role in improving water quality, since human waste can carry human viruses in addition to the bacterial and protozoan pathogens. In terms of economic benefits to homeowners, an improved understanding of on-site sewage treatment systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20 to 25 years if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them (e.g., not driving or parking on top of them), not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance, as outlined here, is relatively inexpensive ($225) in comparison to repairing or replacing an entire system ($6,000 to $22,500).

In addition to the benefits to individual landowners, the economy of the local community will be stimulated through expenditures made during implementation, and the infusion of dollars from funding sources outside the impaired areas. Building contractors and material suppliers who deal with septic system pump-outs, private sewage system repair and installation, fencing, and other BMP components can expect to see an increase in business during implementation.

In general, implementation will provide not only environmental benefits to the community, but economic benefits as well, which, in turn, will allow for individual landowners to participate in implementation

Implementation Timeline

The end goal of implementation is restored water quality in Mossy Creek, Long Glade Run and Naked Creek within 10 years. Progress toward this goal will be assessed through tracking of best management practices installed in the watersheds and continued water quality monitoring.

Two types of milestones will be used to evaluate progress over the 10 year period: *implementation milestones and water quality milestones*. The implementation milestones establish goals for the extent of the different best management practices installed within certain time frames, while the water quality milestones establish the corresponding goals for improvements in water quality.

The timeline for implementation has been divided into two stages: Stage I (years 1-5) and Stage II (years 6-10). Resources and finances will be concentrated on the most cost-efficient best management practices first. Stage I is focused on the practices that will result in the greatest water quality benefits at the smallest cost including livestock exclusion. In Stage II, some of the more expensive practices that will be needed to fully achieve water quality goals such as rain gardens are included.

Table 14. Staged BMP implementation goals for Mossy Creek

Land Use	BMP	Units	Stage I	Stage II
Pasture	Livestock exclusion systems	system	23	6
	Loafing lot management	system	1	1
	Improved pasture management	acres	2901	2901
	Reforestation of erodible pasture (upland buffers)	acres	0	363
Pasture/ Cropland	Manure and litter storage	system	2	5
	Sinkhole protection	system	0	10
Cropland	Conservation tillage	acres	260	140
	Field border	acres	69	195
	Wooded/Grassed buffers	acres	4	6
	Continuous no-till	acres	0	206
	Sod waterway	acres	1	2
	Cover crop	acres	277	53
	Permanent vegetative cover	acres	55	69
	Contour farming	acres	96	0
	Enhanced riparian buffer (CREP)	acres	13	14
Residential	Pet waste program	program	1	1
	Pet waste digesters	digesters	0	221
	Rain gardens	gardens	0	19
	Seprtic system repairs and replacements	systems	51	21

Table 15. Staged BMP implementation goals for Long Glade Run

Land Use	BMP	Units	Stage I	Stage II
Pasture	Livestock exclusion systems	system	43	8
	Loafing lot management	system	1	0
	Improved pasture management	acres	3,623	3,623
	Reforestation of erodible pasture (upland buffers)	acres	0	725
Pasture/ Cropland	Manure and litter storage	system	1	6
	Sinkhole protection	system	0	10
Cropland	Field border	acres	0	160
	Wooded/Grassed buffers	acres	14	12
Residential	Pet waste program	program	1	1
	Pet waste digesters	digesters	0	209
	Seprtic system repairs and replacements	systems	50	21

Table 16. Staged BMP implementation goals for Naked Creek

Land Use	BMP	Units	Stage I	Stage II
Pasture	Livestock exclusion systems	system	36	1
	Loafing lot management	system	0	1
	Improved pasture management	acres	4,722	4,722
	Reforestation of erodible pasture (upland buffers)	acres	0	1,180
Pasture/ Cropland	Manure and litter storage	system	0	4
	Sinkhole protection	system	0	10
Residential	Pet waste program	program	1	1
	Pet waste digesters	digesters	0	150
	Rain gardens	gardens	0	10
	Seprtic system repairs and replacements	systems	61	59

Staged Implementation Costs

Table 17. Cost of implementing Stage I goals (Years 1-5).

Watershed	Agricultural BMPs	Residential BMPs	Technical Assistance
Mossy Creek	$999,582	$254,625	$250,000
Long Glade Run	$1,238,786	$305,625	$250,000
Naked Creek	$1,289,919	$373,125	$250,000
TOTALS	**$3,528,287**	**$933,375**	**$750,000**

Table 18. Cost of implementing Stage 2 goals (Years 6-10).

Watershed	Agricultural BMPs	Residential BMPs	Technical Assistance
Mossy Creek	$867,144	$318,885	$250,000
Long Glade Run	$1,346,952	$141,665	$250,000
Naked Creek	$973,721	$455,625	$250,000
TOTALS	**$3,187,817**	**$916,175**	**$750,000**

Timeline for Water Quality Improvements

Figures 2-5 show how the violation rate of the *E. coli* water quality standard and sediment coming in to Mossy Creek are expected to change with BMP implementation over time.

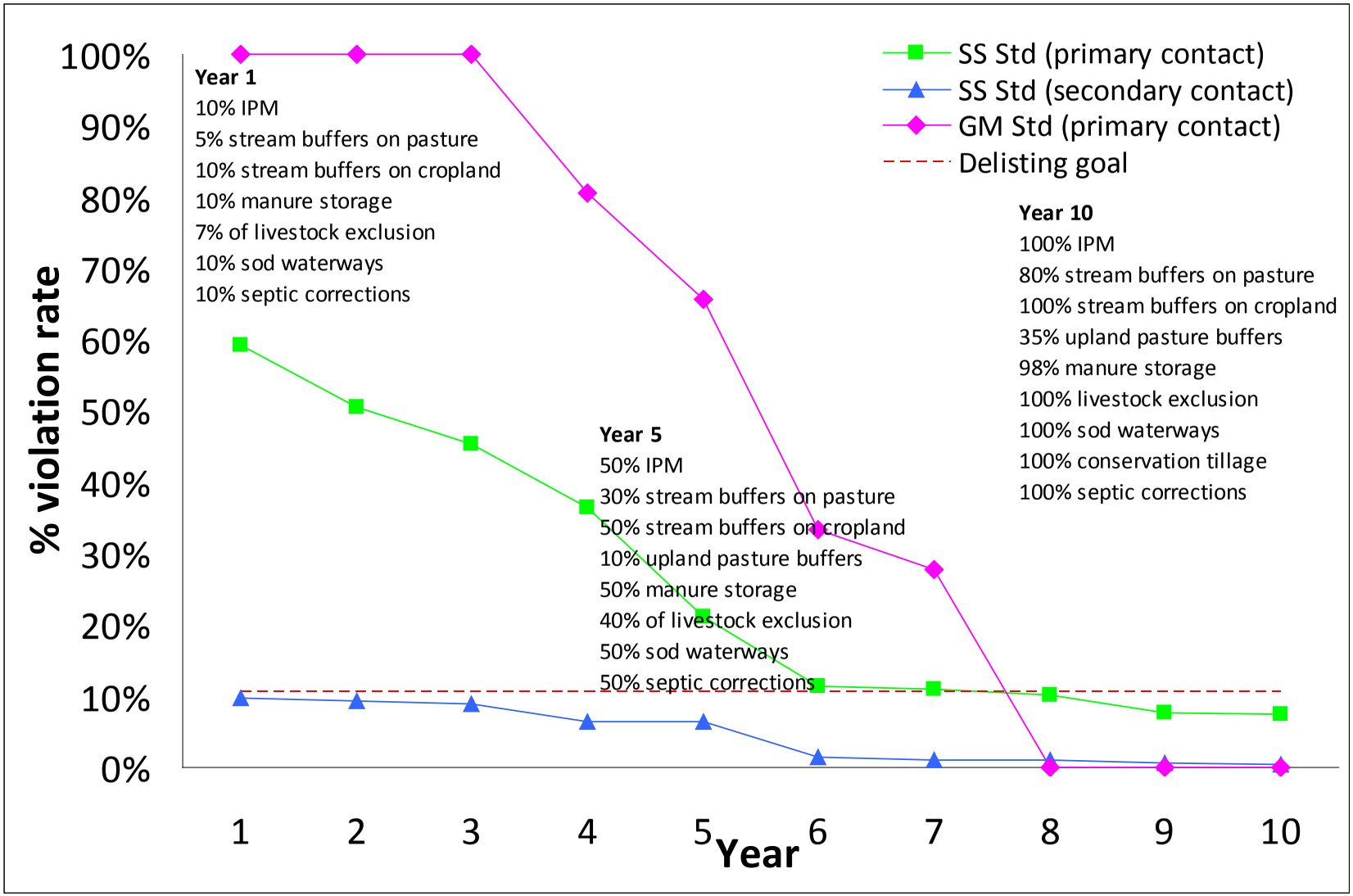

Figure 2. Bacteria water quality milestones in Mossy Creek following BMP implementation. Note: IPM=improved pasture management; SS std = single sample *E. coli* standard; GM std = geometric mean *E. coli* standard

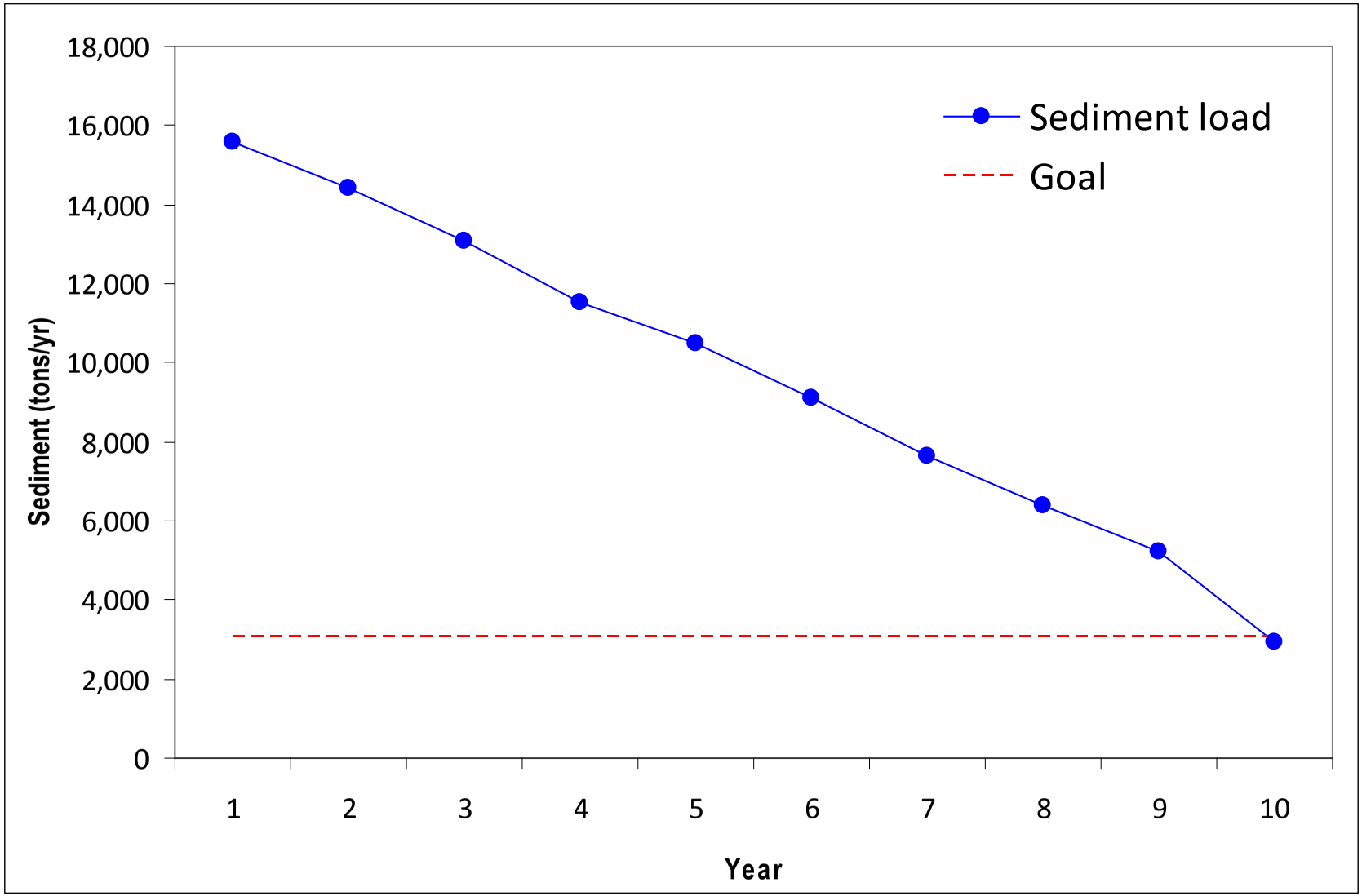

Figure 3 Sediment water quality milestones in Mossy Creek following BMP implementation. Note: BMP implementation rates are the same as those shown in Figure 1.

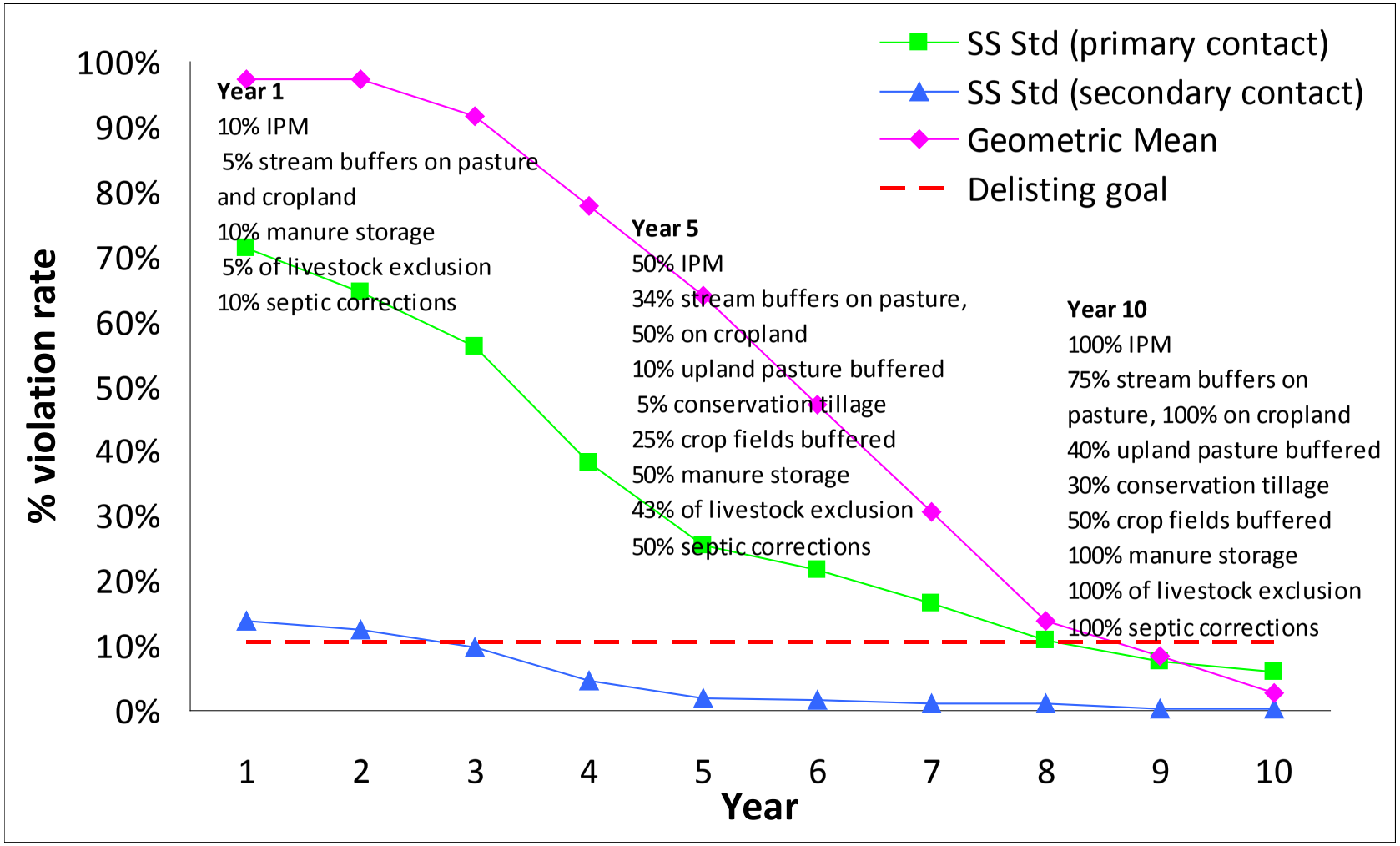

Figure 4 Bacteria water quality milestones in Long Glade Run following BMP implementation. Note: IPM=improved pasture management; SS std = single sample *E. coli* standard; GM std = geometric mean *E. coli* standard

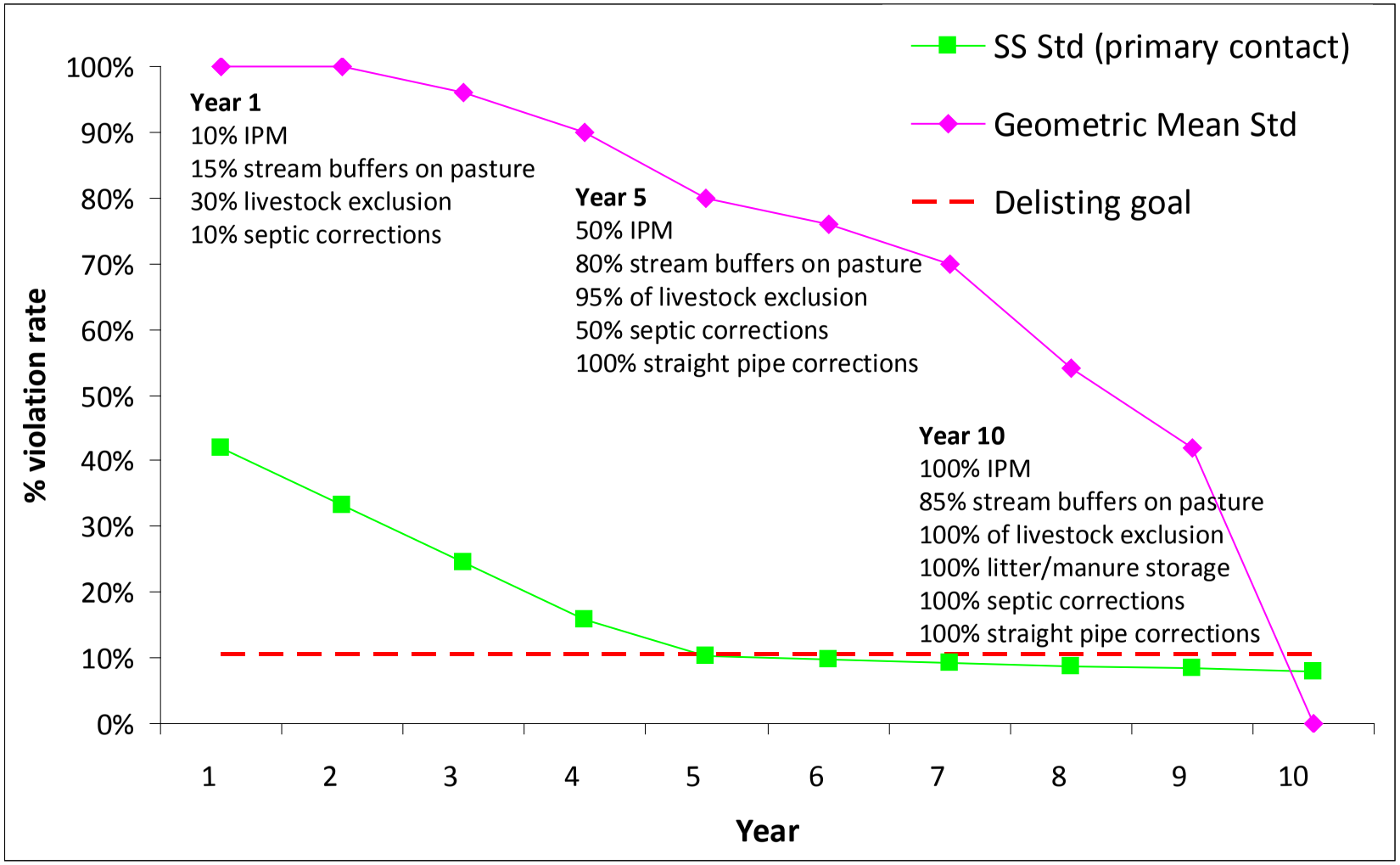

Figure 5 Bacteria water quality milestones in Naked Creek following BMP implementation. Note: IPM=improved pasture management; SS std = single sample fecal coliform standard; GM std = geometric mean fecal coliform standard

Partners And Their Role In Implementation

Voluntary Implementation Efforts

The majority of practices recommended in this plan are related to agriculture, which is the predominant land use in the watersheds. This makes participation from local farmerss a key factor to the success of this plan. Consequently, it is important to consider characteristics of farms and farmers in the watersheds that will affect the decisions farmers make when it comes to implementing conservation practices. For example, the average size of farms is an important factor to consider, since it affects how much cropland or pasture a farmer can give up for a riparian buffer. The age of a farmer, which was 57 in Virginia in 2007, may also influence their decision to implement best management practices. If a farmer is close to retirement and will be relying on the sale of their land for income during retirement, it is less likely that the farmer would be willing or able to invest in best management practices. Table 19 provides a summary of relevant characteristics of farms and producers in Augusta and Rockingham Counties from the 2007 Agricultural Census. These characteristics were considered when developing implementation scenarios, and should be utilized to develop suitable education and outreach strategies.

Table 19 Characteristics of farms and farmers in Augusta and Rockingham Counties.

Characteristic	Augusta County	Rockingham County
Number of farms	1,729	1,970
Full owners of farms	1,118	1,183
Part owners of farms	652	514
Tenants	97	135
Owned land in farms (acres)	72,918	59,422
Rented land in farms (acres)	82,596	72,224
Operators identifying farming as their primary occupation	854	1,010
Operators identifying something other than farming as their primary occupation	732	780
Average size of farm (acres)	166	118
Average value of farmland ($/acre)	$4,897	$6,150
Average net cash farm income of operation ($)	$20,338	$67,892
Average farm production expenses ($)	$96,292	$209,779

In addition to local farmers, participation from homeowners is also critical to the success of this plan. Though the amount of bacteria that is coming from failing septic systems and straight pipes is minimal compared to livestock, human waste carries with it pathogens that can cause health problems above and beyond those associated with livestock waste.

Tracking Implementation

The Headwaters SWCD has been receiving funding from the VA DCR for a full time agricultural technician to work with producers in several watersheds in Augusta County including Mossy Creek, Long Glade Run and Naked Creek. Targeted cost share funding for best management practices has also been provided to the Headwaters SWCD for agricultural BMPs in these watersheds. These funds have been available since Summer 2006. VA DCR staff will continue to work with Headwaters Soil and Water Conservation District and other partners in tracking implementation efforts and evaluating progress. The following sections in this chapter describe the responsibilities and expectations for the various components of implementation.

Monitoring Water Quality

Improvements in water quality will be determined by monitoring conducted by the VA Department of Environmental Quality's (DEQ) ambient and biological monitoring programs. These programs use a variety of parameters to determine overall water quality status, but will focus on bacteria as the primary impairment of Mossy Creek, Long Glade Run and Naked Creek. Each stream will have one sampling site at a publicly accessible location which will be visited once a month by DEQ monitors. DEQ will also continue to monitor the biological health of Mossy Creek by sampling the benthic community in the Fall or Spring once a year. Table 20 provides a summary of the DEQ stations and their locations.

Other groups are also monitoring the streams. Friends of the Shenandoah River (FOSR) has a strong presence in the entire Shenandoah River Basin, including Augusta County. Their monitors collect water samples every other week which are tested for water column toxics, including metals and temperature, and then reported to DEQ. DEQ is able to use this data for listing and delisting streams as impaired in their biannual report to EPA. Thus far, all FOSR data in the three watersheds have shown the water quality to be fully supporting of aquatic life. Figure 6 shows the location of all monitoring stations in the watersheds.

Table 20. DEQ Monitoring Stations in the Mossy Creek, Long Glade Run and Naked Creek

Stream Name	Station ID	Location	Frequency	Type of Sampling
Mossy Creek	1BMSS001.35	Rt. 747 Bridge (Rock. Co.)	Monthly	Bacteria and Water Quality Parameters
Long Glade Run	1BLGC000.96	Rt. 727 Bridge	Monthly	Bacteria and Water Quality Parameters
Naked Creek	1BNKD000.80	Rt. 994 Bridge	Monthly	Bacteria and Water Quality Parameters
Mossy Creek	1BMSS003.01	Rt. 747 Bridge (Aug. Co.)	Fall/Spring	Biological Monitoring

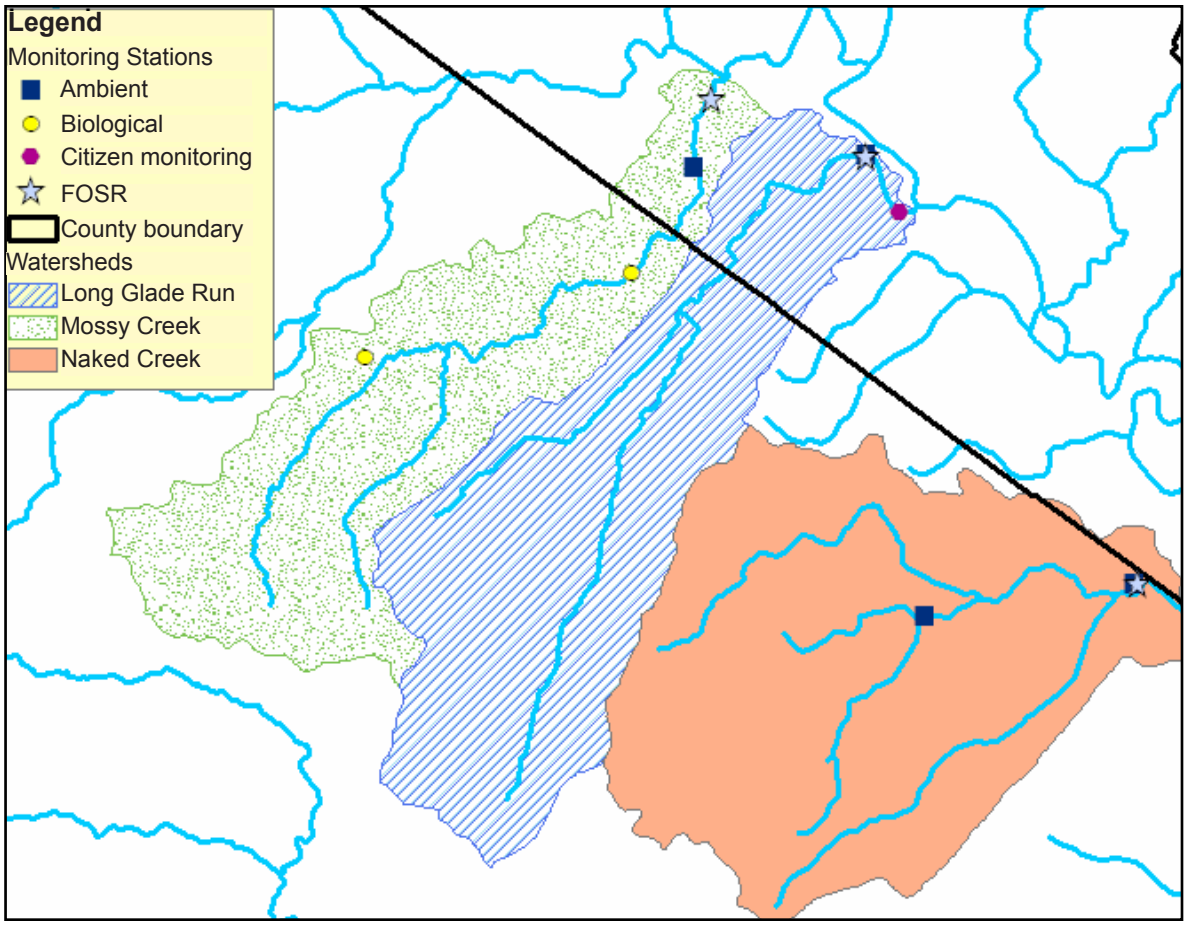

Figure 6. Mossy Creek, Long Glade Run and Naked Creek monitoring stations. Note: FOSR=Friends of the Shenandoah River

FOSR recently partnered with another citizen monitoring organization, Friends of the North Fork Shenandoah River in a proposal for a monitoring project in the Shenandoah Valley. This project began in April 2009, and includes 8 bacteria monitoring sites and 2 benthic sites in the Naked Creek watershed. Monitoring sites were selected above and below recently installed agricultural best management practices. The objective of project is to assess the effectiveness of different best management practices in reducing the amount of bacteria and improving the abundance and diversity of aquatic life in the stream.

In addition to surface water monitoring, it has been recommended that additional monitoring be conducted on sediment loading from the Mount Solon Spring. Sediment contributions from Freemason Run during storm events could be significant; however, sufficient data has not been collected to draw clear conclusions. During the spring study that took place in Mossy Creek in 2007, a model of the relationship between total suspended solids and water clarity rated using a turbidity tube was developed. This model will allow future research to be conducted at a very low cost. With assistance from the DCR Karst Program, it is possible that additional monitoring could be conducted.

Agricultural and Residential Education Programs

The Headwaters Soil and Water Conservation District (SWCD) will be in charge of initiating contact with farmers to encourage the installation of BMPs. This one-on-one contact will facilitate communication of the water quality problems, the types of practices that could improve water quality, and the economic benefits of implementing these practices on the farm. District staff will also conduct outreach activities in the watershed to encourage participation in conservation programs. Such activities include mailing out newsletters and organizing field days. The staff will work with other conservation organizations such as VA Cooperative Extension in these efforts.

A residential education program consisting of educational materials about pet waste and a pet waste digester program could be run through a partnership between the Headwaters SWCD, the Augusta County Service Authority and the Augusta County SPCA. These organizations could assist in the distribution of information on the importance of picking up after your pet including the potential for contamination of drinking water for homeowners with wells. The SPCA could provide new pet owners with information upon adopting a pet from the shelter, and provide pet waste digesters to customers if grant funding to purchase them was available.

Integration with Other Watershed Plans

Each watershed in the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographic boundaries and goals. These include but are not limited to TMDLs, Roundtables, Water Quality Management Plans, erosion and sediment control regulations, stormwater management, Source Water Protection Program, and local comprehensive plans. Coordination of the implementation project with these existing programs could result in additional resources and increased participation. Consequently, local governments serve as important partners in this effort. Not only do local governments oversee such activities as the development of local comprehensive plans, they can also work with state partners to develop ordinances involving pollution prevention measures.

Funding for Implementation

A list of potential funding sources available for implementation has been developed. Detailed descriptions can be obtained from the Soil and Water Conservation Districts (SWCDs), VADCR, Natural Resources Conservation Service (NRCS), and Virginia Cooperative Extension (VCE). While funding is being provided to the Headwaters SWCD for agricultural BMPs and technical assistance for farmers, an additional funding commitment is needed for the residential program. While the Headwaters SWCD is currently working with the Augusta County Service Authority to conduct septic system repairs and replacement, this project and associated funding comes to an end in 2009.

Virginia Agricultural Best Management Practices Cost-Share Program
The cost-share program is funded with state and federal monies through local SWCDs. SWCDs administer the program to encourage farmers and landowners to use BMPs on their land to better control transportation of pollutants into our waters due to excessive surface flow, erosion, leaching, and inadequate animal waste management. Program participants are recruited by SWCDs based upon those factors, which have a great impact on water quality. Cost-share is typically 75% of the actual cost, not to exceed the local maximum.

Virginia Agricultural Best Management Practices Tax Credit Program
For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, is allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. This program can be used independently or in conjunction with other cost-share programs on the stakeholder's portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing.

Virginia Agricultural Best Management Practices Loan Program
Loan requests are accepted through VADEQ. The interest rate is 3% per year and the term of the loan coincides with the life span of the practice. To be eligible for the loan, the BMP must be included in a conservation plan approved by the local SWCD Board. The minimum loan amount is $5,000; there is no maximum limit. Eligible BMPs include 23 structural practices such as animal waste control facilities, and grazing land protection systems. The loans are administered through participating lending institutions.

Virginia Small Business Environmental Assistance Fund Loan Program
The Fund, administered through VADEQ, is used to make loans or to guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, equipment to implement voluntary pollution prevention measures, or equipment and structures to

implement agricultural BMPs. The loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with favorable repayment terms based on the borrower's ability to repay and the useful life of the equipment being purchased or the life of the BMP being implemented. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

Virginia Water Quality Improvement Fund

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants for point sources are administered through VADEQ and grants for nonpoint sources are administered through VADCR.

Conservation Reserve Program (CRP)

Through this program, cost-share assistance is available to establish cover of trees or herbaceous vegetation on cropland. To be eligible for consideration, the following criteria must be met: 1) cropland was planted or considered planted in an agricultural commodity for two of the five most recent crop years, and 2) cropland is classified as "highly-erodible" by NRCS. The payment to the participant is up to 50% of the cost for establishing ground cover.

Conservation Reserve Enhancement Program (CREP)

This program is an "enhancement" of the existing USDA CRP Continuous Sign-up. It has been "enhanced" by increasing the cost-share rates from 50% to 75% and 100%, increasing the rental rates, and offering a flat rate incentive payment to place a permanent "riparian easement" on the enrolled area. Pasture and cropland adjacent to streams, seeps, springs, ponds and sinkholes are eligible to be enrolled. Buffers consisting of native, warm-season grasses on cropland, and mixed hardwood trees on pasture, must be established in widths ranging from the minimum of 30% of the floodplain or 35 feet, whichever is greater, to a maximum average of 300 feet. Cost-sharing (75% - 100%) is available to help pay for fencing to exclude livestock from the riparian buffer, watering facilities, hardwood tree planting, filter strip establishment, and wetland restoration. The State of Virginia will make an additional payment to place a perpetual easement on the enrolled area.

Environmental Quality Incentives Program (EQIP)

Approximately 65% of the EQIP funding for the state of Virginia is directed toward "Priority Areas." These areas are selected from proposals submitted by a locally led conservation work group. The remaining 35% of the funds are directed toward statewide priority concerns of environmental needs. EQIP offers 5 to 10-year contracts to landowners and farmers to provide 75% cost-share assistance, 25% tax credit, and/or incentive payments to implement conservation practices and address the priority concerns statewide or in the priority area. Eligibility is limited to persons who are engaged in livestock or agricultural production.

Wildlife Habitat Incentive Program (WHIP)
WHIP is a voluntary program for landowners who want to develop or improve wildlife habitat on private agricultural lands. Participants work with NRCS to prepare a wildlife habitat development plan. This plan describes the landowner's goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A 10-year contract provides cost-share and technical assistance to carry out the plan. Cost-share assistance of up to 75% of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Types of practices include: disking, prescribed burning, mowing, planting habitat, converting fescue to warm season grasses, establishing riparian buffers, creating habitat for waterfowl, and installing filter strips, field borders and hedgerows.

Wetland Reserve Program (WRP)
This program is a voluntary program to restore and protect wetlands on private property. Landowners who choose to participate in WRP may receive payments for a conservation easement or cost-share assistance for a wetland restoration agreement. The landowner will retain ownership but voluntarily limits future use of the land. To be eligible for WRP, land must be suitable for restoration (formerly wetland and drained) or connect to adjacent wetlands. A landowner continues to control access to the land and may lease the land for hunting, fishing, or other undeveloped recreational activities.

Southeast Rural Community Assistance Project (SE/R-CAP)
The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. Staff members of other community organizations complement the SE/R-CAP staff across the region. They can provide (at no cost): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Financial assistance includes $1,500 toward repair/replacement/ installation of a septic system and $2,000 toward repair/replacement/installation of an alternative waste treatment system. Funding is only available for families making less than 125% of the federal poverty level.

National Fish and Wildlife Foundation
Grant proposals for this funding are accepted throughout the year and processed during fixed sign up periods. There are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. Grants generally range between $10,000 and $150,000. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the NFWF website (http://www.nfwf.org). If the project does not fall into the criteria of any special grant programs, a proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife and habitat conservation, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated.

Clean Water State Revolving Fund

EPA awards grants to states to capitalize their Clean Water State Revolving Funds (CWSRFs). The states, through the CWSRF, make loans for high-priority water quality activities. As loan recipients make payments back into the fund, money is available for new loans to be issued to other recipients. Eligible projects include point source, nonpoint source and estuary protection projects. Point source projects typically include building wastewater treatment facilities, combined sewer overflow and sanitary sewer overflow correction, urban stormwater control, and water quality aspects of landfill projects. Nonpoint source projects include agricultural, silvicultural, rural, and some urban runoff control; on-site wastewater disposal systems (septic tanks); land conservation and riparian buffers; leaking underground storage tank remediation, etc.

Wetland and Stream Mitigation Banking

Mitigation banks are sites where aquatic resources (wetlands, streams, and associated buffers) are restored, created, enhanced, or in exceptional circumstances, preserved expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. Mitigation banking is a commercial venture which provides compensation for aquatic resources in financially and environmentally preferable ways. Not every site or property is suitable for mitigation banking. Wetlands and streams are complex systems, and their restoration, creation, enhancement, or preservation often requires specialized ecological and engineering knowledge. Likewise, the mitigation banking process requires experience to efficiently navigate. Mitigation banks are required to be protected in perpetuity, to provide financial assurances, and long term stewardship. The mitigation banking processes is overseen by the Inter-Agency Review Team (IRT) consisting of several state and federal agencies and chaired by DEQ and Army Corps of Engineers. For more information, contact the Army Corps of Engineers or VADEQ's Virginia Water Protection Program.

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