Water Quality Improvement Plan

South River and Christians Creek

A plan to reduce bacteria, sediment and phosphorous in the water

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Prepared by

The Virginia Department of Conservation and Recreation

In Cooperation with

Local Stakeholders
The Virginia Department of Environmental Quality
Blue Ridge Environmental Solutions

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Introduction

The Clean Water Act (CWA) requires that all of our streams, rivers, and lakes meet the state water quality standards.

The CWA also requires that states conduct monitoring to identify polluted waters that do not meet standards. Through our monitoring program, the state of Virginia has found that many streams do not meet state water quality standards for protection of the five beneficial uses: recreation, the production of edible and marketable natural resources, aquatic life, wildlife, 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, meaning that 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 South River and Christians Creek

TMDLs were developed for Upper South River, South River and Christians Creek in 2004, 2009, and 2002 respectively after water quality monitoring showed:

1) The creeks were violating the State's water quality standard for bacteria, which was based on the concentration of fecal coliform in the water until 2003 (the fecal coliform bacteria count should not exceed a geometric mean of 200 cfu per 100 mL of water for two or more samples taken over a 30-day period, and it should not exceed 400 cfu per 100 mL at any time). In 2003, Virginia switched to an *E. coli* water quality standard after it was found that there was a more positive correlation between contact with *E. coli* and gastrointestinal illness or infection. Consequently, the TMDLs for South River were developed for *E. coli* while the TMDL for Christians Creek was developed for fecal coliform. The *E. coli* standard that became effective January 15, 2003 states that the *E. coli* bacteria count should not exceed a geometric mean of 126 cfu per 100 mL for two or more samples taken over a 30-day period, and it should not exceed 235 cfu per 100 mL at any time.

2) The creeks were violating the general (benthic) 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 these creeks were not meeting this designation. The primary stressors on the aquatic community in South River were identified as sediment and phosphorous. In Christians Creek, lack of litter fall to the first order streams in the watershed was identified as the primary stressor. Excess sedimentation from eroding streambanks was identified as a secondary stressor.

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

Creating a TMDL Implementation Plan

Once a TMDL is developed for a stream, the next step is to create a plan that identifies 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 that will 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

Springhouse at headwaters of Christians Creek

Review Of TMDL Studies

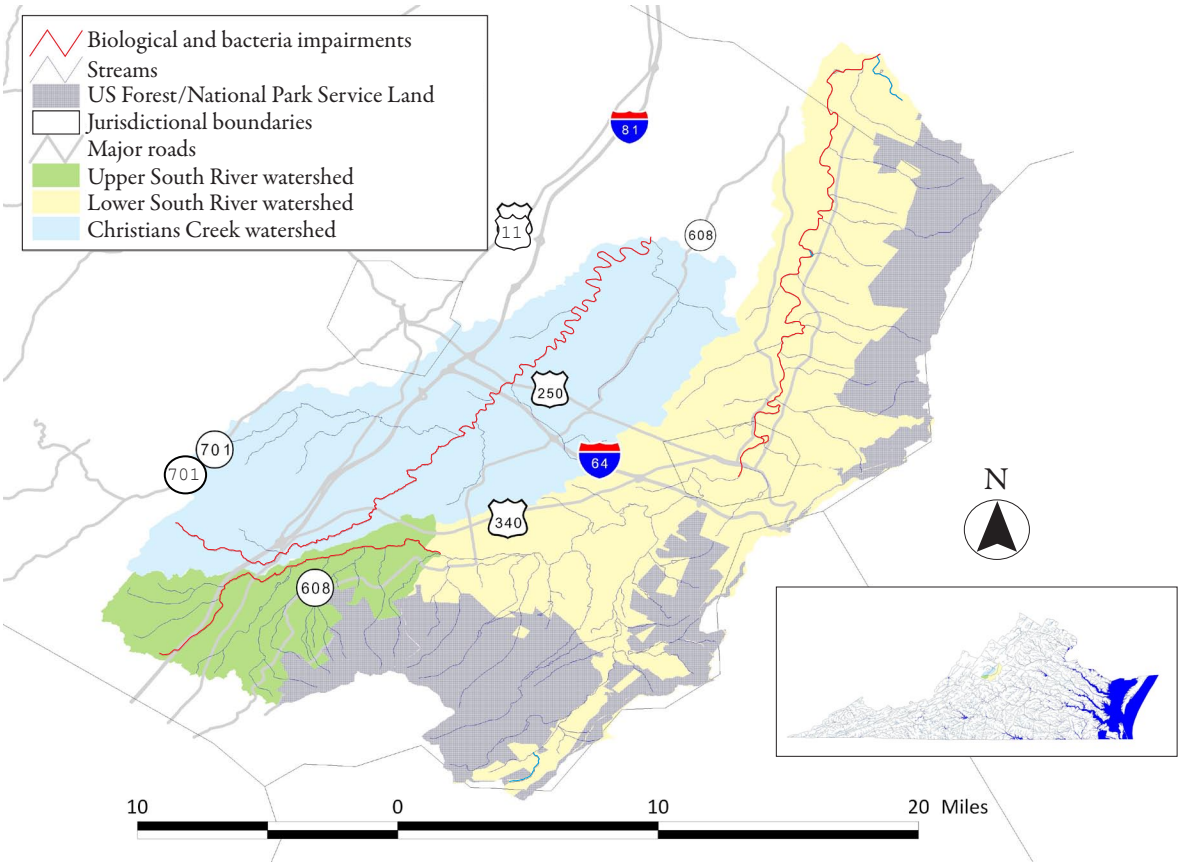

Figure 1. Location of the watersheds

Watershed Characteristics

The South River and Christians Creek are located in Augusta County Virginia in the Shenandoah River Basin. A small portion of the Lower South River extends into Rockingham County. The South River flows northeast and empties into the South Fork of the Shenandoah River, while Christians Creek flows northeast into the Middle River. Land use in the watersheds is predominantly agricultural and forest. According to the 2007 Census of Agriculture, Augusta County ranked second in the state for the total value of agricultural products sold. The County also ranked second statewide for turkey and cattle/calve inventory, which were 1.5 million and 100,808 respectively.

The segment of Christians Creek impaired by fecal coliform bacteria extends from the headwaters down to its confluence with the Middle River (31.52 miles), while the benthic impairment includes 15.71 miles. The impaired segment of the Upper South River begins at the headwaters and extends down to its confluence with Stony Run (11.79 miles). The additional fecal coliform impairment on the South River begins at Meadow Brook Bridge Road and continues 29.18 miles downstream to the river's confluence with the North River. The benthic impairment on the South River also begins at Meadow Brook Bridge Road, continuing downstream to the river's confluence with Sawmill Run (9.91 miles)

Sources of Bacteria

Agricultural runoff, direct deposition of manure in streams by livestock, and wildlife have been identified as the primary sources of bacteria in the creeks. Non-point sources of bacteria in the watersheds include failing septic systems, livestock (including manure application loads), wildlife, and domestic pets. Point sources including individual residences can contribute bacteria and sediment to streams through their permitted discharges. There are currently 12 point sources permitted to discharge fecal coliform bacteria in the South River watershed and 8 in the Christians Creek watershed.

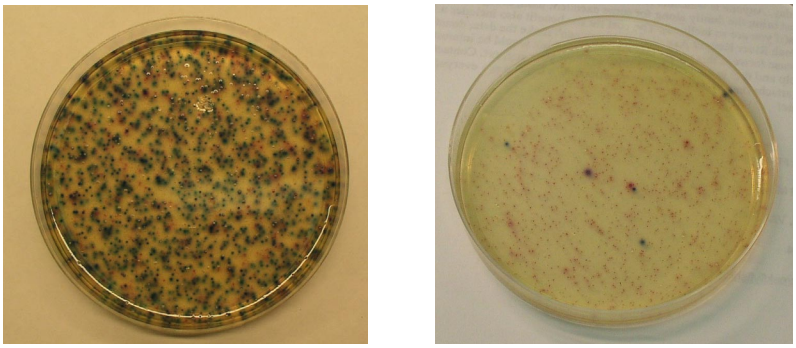

Photo shows coliscan plates, which reveal the presence and abundance of *E.coli* colonies (blue dots) and coliform bacteria colonies (red dots) in a tributary of Middle River in Augusta County where livestock have access to the stream (left) and where they have been excluded (right). Photo: Bobby Whitescarver, NRCS

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 reach the point where the creeks would 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. Note: DD=direct deposition

Watershed	Fecal Coliform Reduction from Source Category (%)						
	Cattle DD	Cropland	Pasture	Forest	Straight Pipes	Residential	Urban
Upper South	55%	99.9%	99.9%	98%	100%	99.9%	99.9%
South River	95%	95%	95%	0%	100%	95%	95%
Christians Creek	99%	94%	96%	96%	100%	99%	96%

Sources of Sediment and Phosphorous

Based on the TMDL study results, the major source of sediment in Christians Ceek is channel erosion, which is occuring due to poor bank stabilization from lack of vegetative cover in riparian areas in the watershed. In addition, there are nineteen point sources in the Christians Creek watershed that are permitted to discharge sediment to the river. In South River, excess sediment and phosphorous loads are coming predominantly from pasture and cropland. These land uses can contribute pollutants to rivers and streams through erosion and build-up/washoff processes. Agricultural lands are particularly susceptible to erosion when vegetative cover is minimal such as when pastures are overgrazed or crop fields are tilled and left uncovered. In addition, there are twelve point sources in the South River watershed that are permitted to discharge phosphorous to the river and thirty-six permitted to discharge sediment.

Goals for Reducing Sediment and Phosphorous

Sediment and phosphorous were identified as the primary pollutants stressing the benthic community (aquatic insects that live at the bottom of the stream) in South River. Sediment and lack of riparian vegetation were identified as the primary stressors in Christians Creek. 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. Excess phosphorous loading into streams can accelerate algal growth, which consumes large amounts of oxygen in the water when it dies off and decomposes. This too is harmful to aquatic organisms, since they need that oxygen in the water to survive. In order to correct these problems, sediment and phosphorous reduction goals were developed for the streams (Tables 2&3).

Table 2. Goals for sediment reductions in South River and Christians Creek

Sediment Reduction by Source Category (%)					
Watershed	**Pasture**	**Cropland**	**Residential**	**Open urban grass**	**Channel erosion**
South River	48%	48%	48%	48%	48%
Christians Creek	50%	50%	0%	0%	27.5%

Table 3. Goals for phosphorous reductions in South River

Phosphorous Reduction by Source Category (%)						
Pasture	**Cropland**	**Residential**	**Open urban grass**	**Transitional**	**Ground-water**	**Septic systems**
70%	70%	70%	70%	70%	70%	70%

Public Participation

Collecting input from the local community on conservation and outreach strategies to include in the TMDL Implementation Plan was a critical step in this planning process.

A public meeting was held on the evening of June 11, 2009 at the Waynesboro City Council Chambers to conclude the development of the South River benthic and bacteria TMDL and to kick off the development of this implementation plan. A final public meeting was held at the __on September __ to 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.

Three working groups (agricultural, residential and urban) were formed in order to discuss implementation and outreach strategies suitable for different land uses in the watersheds. Each working group was made up of stakeholders who were familiar with land use management issues specific to their particular working group focus area. The groups met 1-2 times during the development of this plan.

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 March 3rd, the group discussed existing obstacles to livestock exclusion including maintenance and cost issues. The group discussed different fencing options and agreed that some portions of the watershed would be easier to fence than others. The Lower South River was noted as a more difficult section to fence due to

significant bank erosion and instability. Cropland management practices were also discussed, and the group agreed that the majority of farmers in the watershed are utilizing some form of conservation tillage, though fewer have implemented continuous no till. A second agricultural working group meeting was held at Riverheads High School on May 13, 2010. The group reviewed summaries of the extent of BMP implementation that would be needed to remove the bacteria impairment and the associated phosphorous and sediment reductions that would be expected with this level of implementation. The cost of these BMPs was also discussed along with a potential timeline for implementation. The group estimated that it would take 20 years to reach the bacteria de-listing goal. It was generally agreed that the livestock exclusion and pasture management goals would be the hardest to reach, and several participants suggested increasing the cost share rate for livestock exclusion practices to increase participation. Targeting and outreach strategies were also reviewed at this meeting, with several participants suggesting to focus on the largest landowners first, and/or the landowners who live directly on the creek.

The first Urban Working Group meeting was held in the Waynesboro City Council Chambers on March 15, 2010. The group discussed existing programs to address sediment and phosphorous runoff from impervious and developing areas in Augusta County and the City of Waynesboro. Erosion and sediment control and stormwater management programs were discussed, along with urban BMP mapping and maintenance needs. Existing efforts to extend public sewer and correct failing septic systems were also mentioned, along with the wastewater treatment plant upgrade in Waynesboro that is nearly complete. The group discussed urban BMPs that could be included in the plan such as manufactured BMPs like Filterra units, and BMP retrofits to existing stormwater management BMPs that do not address water quality (only quantity). The second urban working group meeting was held in the Waynesboro City Council Chambers on June 30, 2010. During the meeting, the group reviewed BMP implementation scenarios along with associated costs and BMP reduction efficiencies for bacteria, sediment and phosphorous. A timeline for implementation of urban BMPs was discussed and targeting strategies were reviewed. The group recommended working at a smaller subwatershed scale in order to demonstrate clear progress through water quality monitoring. Specific subwatersheds and potential urban BMP projects were also discussed for inclusion in the plan.

The primary role of the Residential Working Group was to discuss methods needed to reduce human and pet sources of bacteria entering the creeks. The residential working group met on May 26, 2010 in the Waynesboro City Council Chambers. VA Health Department staff provided feedback on septic system repair and replacement costs, while staff from the Augusta County Service Authority provided information on average costs to connect to public sewer in Augusta County. The group also discussed estimates of the number of straight pipes in the watersheds. It was agreed upon that the estimate developed for the Lower South River was too high, and should be reduced significantly. The group talked about the large number of geese in the watersheds, particularly in the lower South River, and discussed ways to reduce the population including a guard dog service and habitat modifications.

The Steering Committee met on September 1, 2010 to discuss the agenda for the final public meeting and to review the draft public document outlining the implementation plan. The group reviewed summaries of each of the working group discussions and provided comments on the draft public document.

Implementation Actions


Photo: Mike Phillips, NRCS

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 were identified for implementation, estimates of the number of each action that would be needed in order to meet water quality goals were developed.

Management Actions Selected through Stakeholder Review

While management actions such as livestock exclusion and correction of failing septic systems were directly prescribed by the TMDLs, a number of additional measures were needed to control bacteria, sediment and phosphorous from land-based sources. Various scenarios were developed and presented to the working groups, who reviewed 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 4. It should be noted that an adaptive management strategy will be utilized in the implementation of this plan. BMPs that are easiest to implement, provide the greatest water quality benefits, and offer the greatest economic return to landowners will be implemented first. The effectiveness of these practices will be continually evaluated, and adjustments of actions will be madeas appropriate. As new technologies and innovative BMPs to address bacteria, sediment and phosphorous become available, these practices should also be evaluated for implementation in the South River and Christians Creek watersheds.

Table 4. BMP bacteria, sediment and phosphorous reduction efficiencies

BMP Type	Description	Bacteria Reduction	Sediment Reduction	Phosphorous Reduction	Reference
Direct deposit	Livestock exclusion with riparian buffer	50(100)%[1]	50(97)%[2]	50(97)%[2]	1,2,10
Pasture	Prescribed grazing	50%	LU Conv.	LU Conv.	2,12
	Sediment retention, erosion or water control structure	75%	75%	60%	6,14
	Constructed wetlands	30%	80%	50%	2,11
Cropland	Poultry litter storage	99%	N/A	N/A	2
	Dry manure storage	80%	N/A	N/A	2
	Continuous no-till	70%[3]	70%	70%[3]	11
	Conservation tillage	N/A	LU Conv.	LU Conv.	12
	Sod waterway	50%	LU Conv.+50%	LU Conv.+50%	12
	Small grain cover crop	20%	20%	20%	11
	Nutrient management plan	N/A	22%	22%	11
	Contour farming	N/A	41%	41%[3]	16
Residential	Pet waste digester	50%	N/A	0%	1
	Pet waste education program	50%	N/A	0%	3
Straight pipes and septic systems	Septic tank pumpout	5%	N/A	0%	2
	Septic system repair	100%	N/A	100%	1
	Septic system replacement	100%	N/A	100%	1
	Alternative waste treatment system	100%	N/A	100%	1
	Connection to public sewer	100%	N/A	100%	1
Ag/Urban	Streambank stabilization	N/A	2.55 lbs/ft/y	0.0035 lb/ft/y	11
Urban	Vegetated buffers	50%	50%	50%	2
	Grassed swales	0%	90%	70%	11
	Bioretention filters	90%	90%	65%	5,6
	Manufactured BMPs	80%	80%	75%	6,8
	Porous pavement	N/A	N/A	65%	6
	Increased SW BMP management (clean out stormwater drains)	65%[3]	65%	65%	7
	Retention pond with aquatic bench	75%	75%	60%	6, 14
	Stormwater control structure retrofits (sediment forebays, pre-filtering strips)	75%	75%	60%	6
	Extended detention basin, enhanced	60%[3]	60%	20%	11
	Street sweeping	5.50E+08 col./curb mile/yr	0.171 tons/curb mile/yr	163.4 lb/curb mile/yr	4,13,15
	BMPs for disturbed sites: flocculation in sediment basins	N/A	91%	95%	9

1-Direct load reduction efficiency in parentheses; 2-Streambank reduction utilized in Christians Creek; 3-Based on sediment reductions

References: Table 4

1. Removal efficiency is defined by the practice.

2. VADCR. 2003. Guidance manual for Total Maximum Daily Load Implementation Plans.

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. Curtis, M. (Department of Environmental Protection, Montgomery County Maryland). 2002. Street Sweeping for Pollutant Removal.

5. United States Environmental Protection Agency. 1999. Storm Water Technology Fact Sheet: Bioretention. Publication Number: EPA 832-F-99-012.

6. Virginia Department of Conservation and Recreation: Division of Soil and Water Conservation. 2005. Engineers' Toolkit Virginia Stormwater Management Program (VSMP) Permit Regulations Effective January 29, 2005.

7. Ferguson, T., R. Gignac, M. Stoffan, A. Ibrahim, and H. Aldrich. 1997. Rouge River National Wet Weather Demonstration Project Cost Estimating Guidelines: Best Management Practices and Engineered Controls. Rouge River National Wet Weather Demonstration Project, Wayne County, MI. (Referenced in US EPA Storm Drain System Cleaning Factsheet).

8. United States Environmental Protection Agency. 1999. Storm Water Technology Fact Sheet: Hydrodynamic Separators. Publication Number: EPA 832-F-99-017.

9. Jurries, D. 1999. Flocculation of Construction Site Runoff in Oregon. Accessed June 30, 2010.

10. Zaimes, G., et. al. 2005. Stream Bank Erosion Under Different Riparian Land-use Practices in Northeast Iowa. AFTA 2005 Conference Proceedings.

11. Nonpoint Source BMPS approved for Phase 5.0 of the Chesapeake Bay Program Watershed Revised 1/18/06.

12. Effectiveness quantified through land use change in Generalized Watershed Loading Function (GWLF) model simulations.

13. VADCR and VADEQ, 2006. Water Quality Implementation Plan for Blacks Run and Cooks Creek (Fecal Coliform and Aquatic Life TMDLs).

14. Technical Memorandum: The Runoff Reduction Method Center for Watershed Protection & Chesapeake Stormwater Network April 18, 2008

15. United States Environmental Protection Agency. 2010. National Pollution Discharge Elimination System (NPDES) Street Sweeping Factsheet

16. Borisova, T., D'Souza, G., Khandelwal, N., Benham, B., and M.L. Wolfe. 2008. Analysis of sediment reduction strategies for Abrams Creek Benthic TMDL using PredICT software.

Livestock Direct Deposition

The TMDL studies specify a 55-99% reduction in the direct deposit of waste into the stream by livestock, making some form of stream fencing necessary.

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. The VADCR Agricultural BMP Database was utilized in conjunction with input from SWCD and NRCS staff to determine typical characteristics (e.g., average length of fencing installed per fencing project) of the different livestock exclusion systems offered through the state and federal agricultural cost share programs 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.

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 series of available fencing practices was 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 6% of total fencing in the Lower South River and Christians Creek watersheds and 15% of fencing in the Upper South River watershed 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 35% of the total fencing in the Lower South River and Christians Creek watersheds and 19% of fencing in the Upper South River watershed 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 1% of fencing in all of the watersheds will be installed using this practice. In addition, it is expected that the Conservation Reserve Program (CRP) 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 Program (CREP) is an excellent option. This practice provides cost share and incentive payments ranging from 50% to 115% for fencing, planting materials, and alternative water source development. It is estimated that 57% of fencing in the Upper South River watershed and 50% of fencing in the South River and Christians Creek watersheds will be installed through this program (Table 5).

Table 5. Livestock exclusion BMPs

Exclusion system	Linear Feet of Livestock Exclusion		
	Upper South	Lower South	Christians Creek
LE-1T	19,571	75,317	88,478
LE-2T	15,451	12,911	15,168
WP-2T	1,030	2,152	2,528
CRP	8,240	17,251	20,224
CREP	58,712	107,596	126,398
TOTAL	103,004	215,227	252,796

Implementation Actions for Pasture

Runoff from pastures can carry with it bacteria from manure on the pasture, and can also pick up sediment and phosphorous on its way to the stream.

One pasture practice that will help water quality is prescribed grazing 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 filters, trapping bacteria, sediment and phosphorous before it runs into the stream. Wetlands restoration was recommended as a BMP for several subwatersheds in the South River where existing soils, vegetation and hydrology indicate that a wetland was present in the area at an earlier point in time. The South River Science Team (described on page 37) would like to work with project partners in selecting wetlands for restoration or construction, preferably above the 5-year flood inundation area. This would allow for optimal retention of nutrients, sediment, bacteria and bioavailable mercury, which is of additional concern in the Lower South River watershed. It was necessary to include water control structures as a BMP to treat runoff from upland pasture areas in Christians Creek in order to meet the bacteria reductions called for in the TMDL study. It is recognized that it is unlikely that the extent of water control structures listed in Table 6 will be implemented, but this implementation scenario demonstrates what would be needed to meet the TMDL established for bacteria.

Table 6. Pasture BMPs

BMP		BMP Acres		
		Upper South	Lower South	Christians Creek
Riparian buffer	35 ft width	65	150	177
	20 ft width	4	8	9
	10 ft width	4	3	3
Prescribed grazing		3,720	10,321	23,794
Constructed/restored wetlands		10	10	0
Sediment retention, erosion or water control structure (ac. treated)		0	0	200

Implementation Actions for Cropland


Photo: Jeff Vanuga, NRCS (2002)

Sediment and phosphorous can run off of cropland when soils are exposed to rainfall, and will make their way to the stream unless filtering practices like riparian buffers are in place to trap them.

In addition, bacteria from the spreading of manure on cropland can end up in a stream unless the appropriate management practices are in place. 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 and decrease soil disturbance, or provide filtering benefits (Table 7).

Table 7. Cropland BMPs needed

BMP	Units	Upper South	Lower South	Christians Creek
Poultry litter storage	system	1	1	1
Beef manure storage	system	3	7	5
Cropland buffers	acres	4	57	29
Sod waterways	acres	10	45	49
Conservation tillage	acres	346	1,524	102
Cover crops	acres	226	993	269
Continuous no-till	acres	511	1,490	48
Nutrient management plan	plan*	6	17	0
Contour farming	acres	0	1,625	0

*Estimate based on an average nutrient management plan covering 166 acres

Implementation Actions for Residential Areas

In order to address runoff of bacteria from domestic pets into the streams, some form of pet waste management will be necessary.

A pet waste education program will help pet owners better understand the importance of picking up after their pets, whether it be in their own backyard, their neighborhood, or in public parks. The City of Waynesboro currently has pet waste disposal stations at all of their public parks, though the residential working group thought an additional station could be added at Ridgeview Park due to its size.

In addition to a pet waste education program, the installation of pet waste digesters by private homeowners will assist in meeting bacteria reduction goals. A pet waste digester is a compact unit that can be installed in a backyard by digging a small hole, which the unit is then fitted into. Pet waste is collected and added to the digester along with water and an enzyme that aids in the digestion of bacteria found in the waste. It is recognized that these digesters will work best in more compact residential developments such as Waynesboro, Stuarts Draft, the Village of Greenville, Vesper View, and a neighborhood in Grottoes.

The large number of geese found in residential neighborhoods in the watershed, particularly in Waynesboro, was discussed by the residential working group. Several suggestions were made as to how to reduce the population including: 1) the use of a service that provides border collies to chase away geese periodically 2) modifying habitat around water features to deter year round colonization by geese. Habitat modifications could include not mowing all the way down to the creek or pond edge, planting taller native grasses and managing them appropriately, and eliminating artificial water features that bring in large populations of geese.

Table 8. Residential BMPs

BMP	Upper South	Lower South	Christians Creek	TOTAL
Pet waste education program		1		1
Pet waste digester	20	200	100	325
Goose management program	0	1	0	1

Straight Pipes and Failing Septic Systems

Since state law requires that failing septic systems and straight pipes be corrected once identified, a 100% reduction in bacteria from these sources is needed.

Estimates of the percentages of households served by failing septic systems and straight pipes (pipes directly discharging untreated sewage into the stream) in the watersheds are shown in Table 9. These estimates were developed as part of the TMDL studies. They are based on the age of homes in the watershed, and in the case of straight pipes, the proximity of homes to the stream. Estimates of needed repairs and replacements of failing systems with conventional and alternative systems were based on input from the Health Department and observations from septic system maintenance projects in the area. Potential opportunities to connect to public sewer were identified by neighborhood as well (Table 10).

Table 9. Residential wastewater treatment BMPs

Watershed	Failing septic systems	Straight pipes	Septic system replacement	Alternative waste treatment system	Septic system repair	Septic tank pumpout
Upper South	289	9	57	64	145	66
Lower South	878	20	85	312	438	202
Christians Creek	443	4	107	108	222	102

Table 10. Potential connections to public sewer for failing septic systems/straight pipes

Watershed	Neighborhood	Estimated # of connections	Status
Upper South	Village of Greenville	32	Project planning underway
Lower South	Harriston	9	Connections possible
	Vesper View	9	Connections possible
	Oak Hill	45	Project underway
Christians Creek	Annex	10	Requires running sewer main

Implementation Actions for Urban Areas

Currently, the City of Waynesboro and Augusta County are implementing programs to control urban stormwater runoff from impervious surfaces, and erosion from disturbed sites under construction. However, based on the TMDL studies, considerable treatment of runoff from existing urban development is still needed. In reviewing opportunities for urban stormwater management in the watersheds, it was determined that one of the more cost effective strategies would be to retrofit or upgrade existing stormwater BMPs including detention basins and retention ponds.

In addition to retrofitting existing stormwater facilities to better address water quality, the urban working group identified significant opportunities to improve existing maintenance of stormwater BMPs. Specifically, the group discussed the need to clean out storm drains and stormwater pipes. Based on discussions with the urban working group, the accumulation of sediment within the storm drain system could be addressed with the purchase of appropriate equipment for flush trucks.

Table 11. Urban BMPs

BMP	Units	Upper South	Lower South	Christians Creek
Streambank stabilization	linear ft	250	10,000	1,000
Vegetated buffers (35 ft width)	acres	0.5	8	1
Urban nutrient management	acres	50	300	0
Grassed swales	ac treated	20	0	40
Bioretention filters	ac treated	92	50	50
Pourous pavement	acres	0	2	0
Street sweeping	curb miles	0	2,800	0
Manufactured BMPs	ac treated	90	25	25
Increased stormwater BMP management	ac treated	1,655	5,452	125
Extended detention basin	ac treated	0	700	0
Retention ponds with liner	ac treated	0	410	0
Existing detention basin retrofits	ac treated	1,300	2,100	300
Flocculation in sediment basins	ac treated	9.4	24	0

Pilot Projects: Agricultural BMPs


Photo: Bobby Whitescarver, NRCS

The agricultural working group identified a series of pilot projects to be implemented in the watersheds.

These projects will not only reduce bacteria, sediment and phosphorous loading into the streams, they will also address existing obstacles to implementation of agricultural BMPs and serve as demonstration projects that can be publicized through field days and farm tours.

Table 12. Pilot agricultural BMPs

Project description	Units	Upper South	Lower South	Christians Creek
Streambank stabilization: includes grading back stream banks and revegetating to reduce erosion. May include rock vanes and other in-stream structures to re-direct flow when needed	Linear ft	500	3,000	2,500
Fencing/buffer maintenance program: assist farmers in rebuilding washed out fencing after flooding events and removing invasive species from riparian buffers to prevent them from spreading into upland pastures.	# of fencing projects maintained	5	5	5
Portable shade structures: employ as a strategy to reduce the amount of time livestock spent near or in the stream. Funding for portable shade structures is available through EQIP; however, typically a farmer would need to have livestock excluded from the stream in order to qualify for these funds. Additional funding will need to be pursued in order to install the shade structures.	# of structures	3	3	3

Pilot Projects: Residential BMPs

Connection to public sewer is one of the most effective ways to correct a failing septic system.

Both Augusta County and the City of Waynesboro are working to extend public sewer lines to service two communities with malfunctioning septic systems, privies, and straight pipes: the Village of Greenville and the Oak Hill subdivision, respectively. It is expected that approximately 50 homes in the Oak Hill subdivision currently have, or will have a failing septic system within the next three years. An additional 32 homes in the 1790s Village of Greenville currently have failing septic systems, grey water systems without treatment, privies, or no indoor plumbing at all. The City of Waynesboro began Phases 1 and 2 of construction on the Oak Hill sewer line project in 2007, Phase 3 is expected to be completed within the next 3-5 years. Augusta County is still working to complete plans for the sewer line extension in Greenville that will address the septic issues while not encouraging sprawling development in the area. Providing cost share to homeowners for connection fees in both of these neighborhoods would greatly increase the number of homes that could be connected to the new sewer lines. The connection fee in the Village of Greenville is estimated at $6,900, while the fee in the Oak Hill subdivision is estimated at $5,900.

Pilot Projects: Urban BMPs

In an effort to prioritize urban implementation projects, staff from the City of Waynesboro and Augusta County identified a series of urban projects to be designated as high priority.

Figure 2. Detention basin retrofit sites in Wayne Hills/Eastern Pelham subwatershed

Table 13. High priority urban projects: The City of Waynesboro (Lower South River watershed)

Project description	Subwatershed
Identify and map critical wetlands and riparian buffers for protection/enhancement	Pratts Run
Develop and implement an urban nutrient management plan for the Waynesboro Country Club's golf course.	
Implement residential nutrient management outreach program	Wayne Hills/ Eastern Pelham Subwatershed
Retrofit a chain of city-maintained stormwater basins including the Randolph Ave. pond, Charleston Park pond, Pelham East pond, and Nottingham Estates pond.	
Enhance maintenance of city drainage structures collecting large amounts of sediment	
Implement a streambank stabilization project along a 600-foot segment of the South River that runs through a pocket park and a section of DuPont's property. Install a riparian buffer along this section of river, with a minimum 35 foot width, educational signage and limited fishing access points.	South River mainstem
Ridgeview Park Project • Install a bioretention filter and replace a concrete flume that conveys runoff directly to the South River with a reinforced vegetated spillway. • Remove 500 ft of parking lot asphalt and replace with pervious pavers. • Install a riparian buffer along 100 linear feet of river with limited access points for fishing and educational signage.	

Table 14. High priority urban projects: Augusta County

Project description	Subwatershed
Install a series of urban BMPs at Riverheads High School	Christians Creek, Subwatershed 1
Retrofit detention basin in Fishersville at Augusata Health (30 acre drainage area)	Christians Creek, Subwatershed 4
Retrofit Forest Spring detention basin in Stuarts Draft (265 acre drainage area)	Lower South River, Subwatershed 1
Retrofit detention basin in Stuarts Draft next to to Food Lion (29 acre drainage area)	
Retrofit detention basin in Stuarts Draft near Broadmoor (29 acre drainage area)	

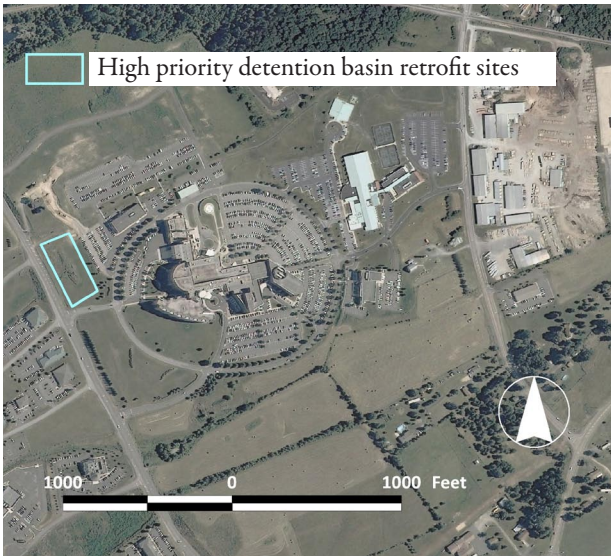

Figure 3. Augusta Health detention basin

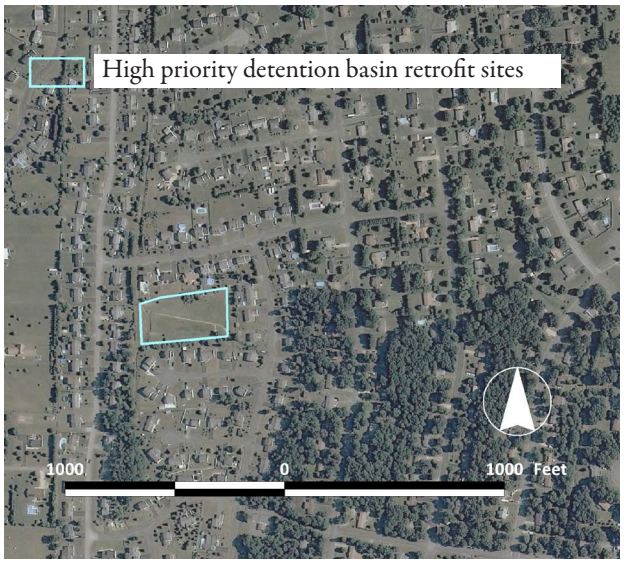

Figure 4. Forest Springs detention basin

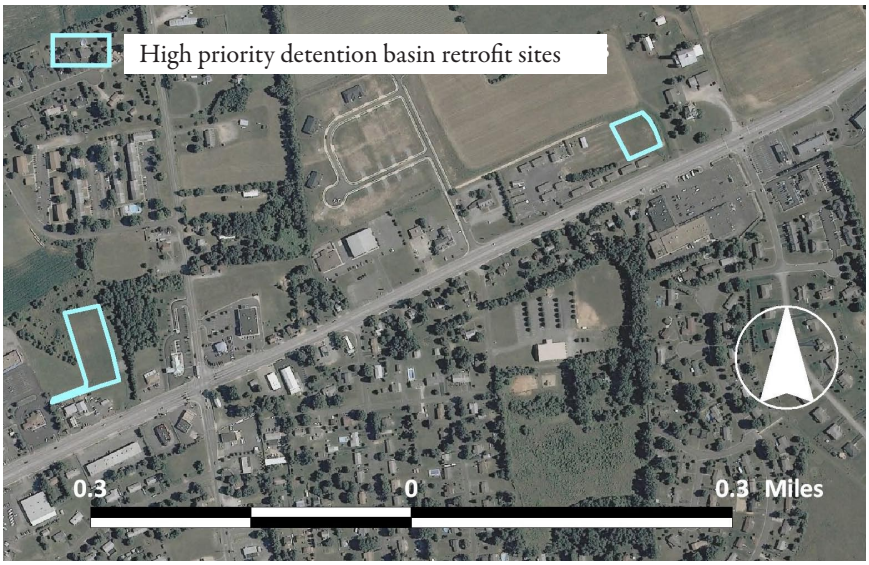

Figure 5. Food Lion (left) and Broadmoor (right) detention basins

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 strategies and provide assistance with the design and installation of best management practices.

There must be a proactive approach to contact farmers and residents to articulate exactly what the TMDL means to them and what practices will help meet the goal of improved water quality. 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. Presentations at local Ruritan and Rotary clubs were mentioned as a good way to reach farmers as well. The Sweet Dreams event hosted in Stuarts Draft was identified as a good opportunity for outreach about septic system maintenance along with Waynesboro Riverfest. A septic system maintenance booth could be set up at either of these events. In addition, local Farmer's Markets, Staunton Earth Day and Waynesboro Public Works Day were identified as good opportunities for outreach. The "Living South River Display" at Grand Caverns is an excellent outreach tool already in place in the watershed.

The following tasks associated with outreach programs were identified:

Agricultural Programs

- Make contact with landowners in the watersheds to make them aware of implementation goals, cost-share assistance, and voluntary options that are available to agricultural producers interested in conservation
- Provide technical assistance for agricultural programs (e.g., survey, design, layout).
- Develop and distribute educational materials
- Organize educational programs (e.g., County Fair, presentations at VCE events or club events)

- Handle and track cost-share
- Assess and track progress toward BMP implementation goals
- Coordinate use of existing agricultural programs and suggest modifications

Residential Programs

- Identify straight-pipes and failing septic systems (e.g., contact landowners in older homes, septic pump-out program)
- Handle and track cost-share
- Develop /organize educational materials & programs (e.g., septic pump-outs, pet waste control)
- Develop a downspout disconnection program for homeowners; offer rain barrels as an incentive
- Distribute educational materials (e.g., informational pamphlets on TMDL IP and on-site sewage disposal systems).
- Assess progress toward implementation goals

Urban Programs

- Develop educational materials and programs. Ideas include:
    - Hold workshops for contractors and developers on existing erosion and sediment control and stormwater management regulations.
    - Distribute information to homeowners who have stormwater management features on their property.
    - Work with property owners and property owner associations to obtain grants and de velop a cost share program to properly maintain and/or retrofit smaller stormwater facilities to better address water quality
    - Hold a rain barrel workshop in partnership with Little Debbie (have 250 gallon barrels)
- Inventory existing stormwater BMPs, storm drains and pipes; refine existing spatial data
- Develop a robust maintenance program for stormwater BMPs and infrastructure
- Provide technical assistance in designing and installing stormwater BMPs
- Work with contractors in the watersheds to make them aware of implementation goals and ensure compliance with existing erosion and sediment control and stormwater regulations
- Work with the City of Waynesboro and Augusta County to track urban BMP implementation
- Identify funding opportunities for pilot BMP projects
- Assess progress towards implementation goals

Technical Assistance Needed for Outreach

The staffing level needed to implement the agricultural, residential and urban components of the plan was 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 2 FTEs would be needed to provide the technical assistance needed for agricultural and residential implementation. Based on existing staffing levels for urban BMP maintenance and implementation needs, it was estimated that a minimum of 3 FTEs would be needed to reach implementation goals within a reasonable timeline. If engineering assistance was provided with respect to BMP design, it is possible that this number could be reduced to 1 FTE.

Implementation Costs



Costs: Agricultural BMPs

The costs of agricultural best management practices included in the implementation plan were estimated based on data for Augusta County from the VADCR Agricultural BMP Database and considerable input from Headwaters SWCD and NRCS staff. When sufficient data were available, the search of the agricultural database for best management practices and their associated costs was limited to 2000 through 2008 so that estimates were as current as possible.

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 for LE-1T, LE-2T, CREP and CRP practices and installing hardened crossings for WP-2T practices. 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, and an up front incentive payment on $0.50 per linear foot to maintain stream fencing as part of the WP-2T practice. Typically the average cost of fence maintenance is significantly higher. In developing the cost estimates for fence maintenance, a figure of $3.50/linear foot of fence was used. It was estimated that approximately 10% of fencing would need to be replaced over the timeline of this plan.

The majority of agricultural practices recommended in the implementation plan are included in state and federal cost share programs. These programs offer financial assistance in implementing the practices and may also provide landowners with an incentive payment to encourage participation. For example, the CP-33 practice (Creation of Upland Bird Habitat) offers farmers an incentive payment of $100/acre and covers up to 90% of the costs of implementing the practice. Consequently, when assessing costs it is important to consider both the potential cost to the landowner as well as the cost to state and federal programs. Table 15 shows total agricultural BMP costs by watershed.

Table 15. Estimated agricultural BMP costs by watershed.

Practice	Cost share code	Units	Unit cost	Cost by watershed		
				Upper South	Lower South	Christians Creek
Livestock exclusion with riparian buffers	CREP	system	$25,460	$560,120	$ 1,018,400	$1,196,600
	CRP	system	$23,500	$141,000	$ 305,500	$376,000
	LE-1T	system	$23,500	$282,000	$ 1,104,500	$1,292,500
	WP-2T	system	$5,084	$5,084	$10,168	$10,168
Livestock exclusion with reduced setback	LE-2T	system	$15,000	$180,000	$ 150,000	$180,000
Livestock exclusion fence maintenance (20 yrs)	N/A	feet	$3.50	$72,102	$150,633	$176,957
Streambank stabilization	WP-2A	feet	$100	$50,000	$300,000	$250,000
Prescribed grazing	EQIP (529, 512)	acres	$100	$372,000	$1,023,100	$2,379,400
Constructed wetlands	N/A	acres	$90,000	$900,000	$900,000	$0
Portable shade structure	EQIP	structure	$1,940	$5,820	$5,820	$5,820
Sediment retention, erosion or water control structure	WP-1	acres treated	$2,000	$0	$0	$400,000
Cropland buffers	CP-33,WQ-1	acres	$258*	$1,032	$14,706	$7,482
Cover crops	SL-8B	acres	$30	$6,780	$29,790	$8,070
Sod waterways	WP-3	acres	$1,600	$16,000	$72,000	$78,400
Continuous no-till	SL-15A	acres	$100	$51,100	$149,000	$4,800
Contour farming	N/A	acres	$40	$0	$65,000	$0
Nutrient management plan	NM-1	plan	$400	$2,400	$6,800	$0
Poultry litter storage	WP-4,EQIP	facility	$38,000	$38,000	$38,000	$38,000
Dry manure storage	WP-4,EQIP	facility	$58,000	$174,000	$406,000	$290,000
TOTAL ESTIMATED COST				$2,857,436	$5,749,417	$6,694,217

*CP-33 and WQ-1 practice cost average (50:50)

Costs: Residential BMPs

The costs of recommended residential BMPs were estimated using:

1) Cost data from other watersheds in Augusta, Rockingham and Shenandoah Counties where residential septic system maintenance programs have been implemented in the past 10 years.
2) Cost data from the Shenandoah Valley Soil and Water Conservation District, who completed a grant to distribute pet waste digesters to Rockingham County residents in 2008.
3) Input from the Augusta County Health Department and Residential Working Group.

These costs are shown for each watershed in Table 16.

Table 16. Estimated residential BMP costs by watershed.

Practice	Cost share code	Units	Unit cost	Cost by watershed		
				Upper South	Lower South	Christians Creek
Septic tank pumpout	RB-1	pumpout	$250	$16,500	$50,500	$25,500
Connection to public sewer	RB-2	connection	$6,400*	$220,800	$371,700	$59,000
Septic system repair	RB-3	repair	$3,000	$435,000	$1,314,000	$666,000
Conventional septic system	RB-4	system	$6,000	$342,000	$510,000	$642,000
Alternative waste treatment system	RB-5	system	$18,000	$1,152,000	$5,616,000	$1,944,000
Pet waste education program	N/A	program	$3,750	$1,875	$3,750	$1,875
Pet waste digester	N/A	digester	$60	$1,200	$12,000	$6,000
Goose management program	N/A	program	$5,000	$0	$5,000	$0
TOTAL ESTIMATED COST				$2,167,875	$7,881,450	$3,343,625

*$6,900 in Upper South River watershed, $5,900 in Lower South River and Christians Creek watersheds

Costs: Urban BMPs

Table 17. Estimated urban BMP costs by watershed.

BMP	Units	Unit cost	Upper South	Lower South	Christians Creek
Streambank stabilization	linear ft	$200	$50,000	$2,000,000	$200,000
Vegetated buffers (35 ft width)	acres	$400	$200	$3,200	$400
Grassed swales	ac treated	$50	$1,000	$0	$2,000
Bioretention filters	ac treated	$15,000	$1,380,000	$750,000	$750,000
Porous pavement	acres	$62,500	$0	$125,000	$0
Street sweeping	curb miles	$333	$0	$932,400	$0
Manufactured BMPs	ac treated	$15,000	$1,350,000	$375,000	$375,000
Urban nutrient management	acres	$15	$750	$4,500	$0
Increased stormwater BMP management	ac treated	$160	$264,800	$872,320	$20,000
Extended detention basin	ac treated	$2,000	$0	$1,400,000	$0
Retention ponds with liner	ac treated	$2,500	$0	$1,025,000	$0
Existing detention basin retrofits	ac treated	$2,000	$2,600,000	$4,200,000	$600,000
Flocculation in sediment basins	ac treated	$2,140	$20,116	$51,360	$0
TOTAL ESTIMATED COST			$5,666,866	$11,738,780	$1,947,400

Table 18. Total estimated costs of full BMP implementation

Watershed	Agricultual BMPs	Residential BMPs	Urban BMPs
Upper South	$2,857,436	$2,167,875	$5,666,866
Lower South	$5,749,417	$7,881,450	$11,738,780
Christians Creek	$6,694,217	$3,343,625	$1,947,400
TOTAL	$15,301,070	$13,392,950	$19,353,046

Costs: Technical Assistance

Technical assistance costs were estimated for 3 full time positions using a cost of $50,000 per position per year. This figure is based on the existing staffing costs included in the Virginia Department of Conservation and Recreation's grant agreement with the Headwaters Soil and Water Conservation District to provide technical assistance to landowners in TMDL implementation watersheds. Based on the 20 year timeline of this plan (described in great detail in the Implementation Timeline section of this plan), this would make the total cost of technical assistance approximately $3M. When factored into the cost estimate for BMP implementation shown in Table 13, this would make the total cost of implementation approximately $51 million.

Implementation Benefits

The primary benefit of implementing this plan will be cleaner water in the South River and Christians Creek. Specifically, *E. coli* contamination in the creeks will be reduced to meet water quality standards, and sediment and phosphorous loading 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, the incidence of infection from *E. coli* sources through contact with surface waters should be reduced considerably following the implementation of the measures outlined in this plan.

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, urban 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, prescribed grazing, and private sewage system maintenance will each provide economic benefits to land owners. Additionally, money spent by landowners and other stakeholders in the process of implementing this plan will stimulate the local economy.

Benefits: Agricultural Practices

Restricting livestock access to streams and providing them with clean water source has been shown to improve weight gain and milk production in cattle (Zeckoski et al., 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 19 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 (1998) 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 a prescribed grazing management strategy in conjunction with a providing livestock with a clean water source will also provide economic benefits for the producer. Standing forage utilized directly by the grazing animal is less costly and of higher quality than the same forage harvested with equipment and fed to the animal.

Table 19. 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 Zeckoski et al. (2007)

Benefits: Residential Practices

The residential program will play an important role in improving water quality since human waste can carry human viruses in addition to 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, 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 ($250 per pumpout) 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.

Benefits: Urban Practices

The primary benefits of urban stormwater management practices to private property owners include flood mitigation and improved water quality. A 2004 study assessing the economic benefits of stormwater management showed that these services can be valued at 0-5% of the market value of a home (Braden and Johnston, 2004). In addition, urban BMPs have a number of economic benefits to localities. Increased retention of stormwater on site can lower peak discharges, thereby reducing the drainage infrastructure needed to prevent flooding. This can result in cost savings to local governments through reduced engineering and land acquisition costs, and reduced materials and installation costs for stormwater culverts and streambank armoring to prevent scour. Lastly, implementation of urban BMPs greatly reduces soil erosion and sediment transport to our rivers, streams and lakes. A 1993 study of the economic cost of erosion-related pollution showed that national off-site damages from urban sediment sources cost between $192 million and $2.2 billion per year in 1990 dollar values (Paterson et al, 1993). This cost range would be far greater today if adjusted for inflation.

Establishment of Coldwater Trout Fishery

The Shenandoah Valley Chapter of Trout Unlimited is currently working with the Department of Game and Inland Fisheries, James Madison University and other partners to explore opportunities for the restoration of several segments of the South River and its tributaries in support of the creation of a coldwater trout fishery. These efforts are part of a larger Interstate 81 Coldwater Area Restoration Initiative that is being led by Trout Unlimited and the Department of Game and Inland Fisheries. The South River is a specific focus of Trout Unlimited's Shenandoah Headwaters Home Rivers Initiative. The goals established in this implementation plan will directly support this effort through the creation of riparian and in-stream habitat and water quality conditions necessary to support a viable trout population in the South River.

The anticipated economic benefits of these efforts are substantial. According to a 2010 U.S. Fish and Wildlife Service Study of trout fishing in the United States, there were approximately 138,000 trout anglers (16 years or older) in Virginia in 2006, each of whom spent an average of 5 days a year fishing. This translated into considerable retail sales and state and federal tax revenues. Nationally, trout anglers spent an estimated $1.06 billion in 2006 on food and lodging for fish trips. In addition, anglers spent $32,362,000 and $18,654,000 on public and private land use fees respectively for fishing in 2006. Trout fishing related expenses generated $965,201,922 in federal tax revenues in 2006 and $807,005,252 in state and local tax revenues across the county (U.S. Fish and Wildlife Service, 2010). Consequently, it is expected that the creation of a viable trout fishery on the South River would result in considerable economic benefits to state and local governments, private landowners and business owners in Augusta County and the City of Waynesboro.

Implementation Timeline

The end goal of implementation is restored water quality in the South River and Christians Creek. It is expected that this will occur over a 20-year period of implementation. Two types of milestones will be used to evaluate progress over the 20 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 five stages with each stage spanning a period of four years. Resources will be concentrated on the most cost-efficient best management practices first. Table 20 shows the cost of BMP implementation in each watershed at each stage while tables 21-23 show implementation and water quality improvement goals for each watershed in each implementation stage. In order to be removed from the impaired waters list, a stream cannot violate the *E. coli* standard more than 10.5% of the time. A violation rate below this cut-off was achieved for the South River watersheds by the final stage of implementation. Achieving this goal in the Christians Creek watershed was very difficult and could not be done without including a significant number of water control structures to treat pasture runoff. In turn, this resulted in extremely high costs for the final stage of implementation. It is recognized that it is highly unlikely that this level of funding will be available through cost share programs or through private sources. Following achievement of implementation goals, it is recommended that water quality improvements and remaining bacteria reductions needed for de-listing be re-evaluated for Christians Creek. It is possible that the shortfalls in bacteria reductions are within the margin of error for the TMDL in which case the de-listing goal could be reached.

The phosphorous reduction goals established in the South River TMDL also proved very challenging to meet. Consequently, the recommended final stage of implementation in the Upper and Lower South River falls short of meeting the phosphorous goal of the TMDL (70% reduction) by 14% and 12%, respectively. It was determined that the costs of achieving these final reductions prevented reasonable assurance that the TMDL goals could be met. In addition, it is possible that the shortfalls in phosphorous reductions are within the margin of error for the TMDL in which case the water quality goals would still be met.

Table 20. BMP implementation costs by stage

Stage	Upper South	Lower South	Christians Creek
Stage 1 (Years 1-4)	$1,368,824	$6,178,135	$3,319,653
Stage 2 (Years 5-8)	$1,609,895	$6,905,271	$4,145,424
Stage 3 (Years 9-12)	$1,330,653	$5,918,336	$3,323,444
Stage 4 (Years 13-16)	$2,881,635	$3,630,893	$829,332
Stage 5 (Years 17-20)	$3,501,170	$2,737,013	$367,389
Total	$10,692,177	$25,369,647	$11,985,242

Table 21. Timeline for implementation in the Upper South River watershed

BMP Type	BMP	Units	Stage				
			1	2	3	4	5
Direct deposition	Livestock exclusion with riparian buffers	system	14	15	12	0	0
	Livestock exclusion with reduced setback	system	4	4	4	0	0
Pasture/Crop	Streambank stabilization	feet	125	0	375	0	0
Pasture	Prescribed grazing	acres	148	148	148	1,228	2,048
	Constructed wetlands	acres	0	0	0	0	10
	Portable shade structure	structure	0	1	1	1	0
Cropland	Cropland buffers	acres	1	2	1	0	0
	Cover crops	acres	68	90	68	0	0
	Sod waterways	acres	3	4	3	0	0
	Continuous no-till	acres	102	102	103	102	102
	Nutrient management plan	plan	0	2	2	1	1
	Poultry litter storage	facility	0	0	1	0	0
	Dry manure storage	facility	0	1	0	1	1
Residential	Pet waste education prgm.	program	1	0	0	0	0
	Pet waste digester	digester	6	8	6	0	0
Septic	Septic tank pumpout	pumpout	22	22	22	0	0
	Connection to sewer	connection	10	12	10	0	0
	Septic system repair	repair	44	58	43	0	0
	Conventional septic system	system	17	24	16	0	0
	Alternative waste treatment	system	20	26	18	0	0
Urban	Streambank stabilization	linear ft	63	62	125	0	0
	Vegetated buffers	acres	.10	.10	.10	.10	.10
	Grassed swales	ac treated	2	2	2	10	4
	Bioretention filters	ac treated	10	10	10	43	19
	Urban nutrient management	acres	5	5	5	25	10
	Manufactured BMPs	ac treated	0	0	0	45	45
	Increased stormwater mgmt.	ac treated	331	331	331	331	331
	Existing basin retrofits	ac treated	0	0	0	650	650
	Flocculation in sediment basins	ac treated	9.4	0	0	0	0
% Violation of Instantaneous E. coli standard			**13**	**12**	**12**	**11**	**10**
% Violation of Geometric mean E. coli standard			**25**	**20**	**20**	**17**	**15**
Cumulative Phosphorous Reduction (%) *(TMDL goal=70%)*			**17**	**29**	**37**	**45**	**56**
Cumulative Sediment Reduction (%) *(TMDL goal=48%)*			**21**	**31**	**40**	**46**	**54**

Table 22. Timeline for implementation in the Lower South River watershed

BMP Type	BMP	Units	Stage				
			1	2	3	4	5
Direct deposition	Livestock exclusion w/riparian buffers	system	41	41	20	0	0
	Livestock exclusion w/reduced setback	system	4	4	2	0	0
Pasture/Crop	Streambank stabilization	feet	500	500	500	500	1,000
Pasture	Prescribed grazing	acres	1,024	1,279	1,790	2,046	4,092
	Constructed wetlands	acres	0	0	0	0	10
	Portable shade structure	structure	0	1	1	1	0
Cropland	Cropland buffers	acres	17	23	17	0	0
	Cover crops	acres	298	397	298	0	0
	Sod waterways	acres	14	18	13	0	0
	Continuous no-till	acres	298	298	298	298	0
	Contour farming	acres	325	325	324	325	326
	Nutrient management plan	plan	3	6	4	4	0
	Poultry litter storage	facility	0	1	0	0	0
	Dry manure storage	facility	1	2	2	2	0
Residential	Pet waste education program	program	1	0	0	0	0
	Pet waste digester	digester	15	20	15	75	75
Septic	Septic tank pumpout	pumpout	67	67	68	0	0
	Connection to sewer	connection	21	25	17	0	0
	Septic system repair	repair	131	175	132	0	0
	Conventional septic system	system	25	35	25	0	0
	Alternative waste treatment	system	94	125	93	0	0
Urban	Streambank stabilization	linear ft	2,500	2,500	2,500	2,500	0
	Vegetated buffers	acres	1	1	1	2	3
	Urban nutrient management	acres	0	75	75	75	75
	Bioretention filters	ac treated	5	5	5	25	10
	Manufactured BMPs	ac treated	0	0	0	10	15
	Porous pavement	acres	2	0	0	0	0
	Street sweeping	curb miles	560	560	560	720	400
	Increased stormwater mgmt.	ac treated	1,090	1,091	1,090	1,229	952
	Existing basin retrofits	ac treated	420	420	525	535	200
	Extended detention basin	ac treated	140	140	182	188	50
	Retention pond	ac treated	82	82	103	108	35
	Flocculation in sediment basins	ac treated	24	0	0	0	0
% Violation of Instantaneous E. coli standard			**13**	**8**	**8**	7	6
% Violation of Geometric mean E. coli standard			**17**	**3**	**0**	**0**	0
Cumulative Phosphorous Reduction (%) *(TMDL goal=70%)*			**20**	37	47	**52**	58
Cumulative Sediment Reduction (%) *(TMDL goal=48%)*			**26**	**43**	**57**	**67**	75

Table 23. Timeline for implementation in the Christians Creek watershed

BMP Type	BMP	Units	Stage				
			1	2	3	4	5
Direct deposition	Livestock exclusion w/riparian buffers	system	47	47	26	0	0
	Livestock exclusion w/reduced setback	system	4	4	4	0	0
Pasture/Crop	Streambank stabilization	feet	500	1,000	1,000	0	0
Pasture	Prescribed grazing	acres	4,758	7,138	7,138	2,380	2,380
	Sediment retention, erosion or water control structure	ac treated	0	0	0	200	0
	Portable shade structure	structure	0	1	1	1	0
Cropland	Cropland buffers	acres	9	11	9	0	0
	Cover crops	acres	81	107	81	0	0
	Sod waterways	acres	15	19	15	0	0
	Continuous no-till	acres	15	19	14	0	0
	Poultry litter storage	facility	1	0	0	0	0
	Dry manure storage	facility	2	2	1	0	0
Residential	Pet waste education program	program	1	0	0	0	0
	Pet waste digester	digester	30	40	30	0	0
Septic	Septic tank pumpout	pumpout	34	34	34	0	0
	Connection to sewer	connection	3	4	3	0	0
	Septic system repair	repair	67	89	66	0	0
	Conventional septic system	system	32	43	32	0	0
	Alternative waste treatment	system	32	43	33	0	0
Urban	Streambank stabilization	linear ft	300	400	300	0	0
	Vegetated buffers	acres	0.3	0.7	0	0	0
	Bioretention filters	ac treated	15	20	15	0	0
	Grassed swales	ac treated	12	16	12	0	0
	Manufactured BMPs	ac treated	3	6	10	4	2
	Increased stormwater mgmt.	ac treated	25	25	25	25	25
	Existing basin retrofits	ac treated	30	75	120	45	30
% Violation of Instantaneous E. coli standard			**35**	**28**	**21**	**20**	**19**
% Violation of Geometric mean E. coli standard			**85**	**57**	**35**	**30**	**28**
Cumulative Sediment Reduction (%)			**18**	**25**	**29**	**TMDL met, not assessed**	

Targeting Implementation

Implicit in the process of a staged implementation is targeting of best management practices. Targeting ensures optimum utilization of limited technical and financial resources. In order to determine where outreach efforts should be focused in the early stages of implementation, subwatersheds were ranked with respect to implementation priority for agricultural and urban BMPs. While several high priority areas were identified for potential connection to public sewer, a specific targeting strategy for residential BMPs was not identified. However, it should be noted that repairs and replacements to failing septic systems that are within close proximity to a stream will have the greatest water quality benefits.

Targeting Agricultural BMPs

The Upper South River was identified as a high priority for agricultural BMP implementation by members of the Virginia Chapter of Trout Unlimited and the Department of Game and Inland Fisheries based on the potential for creation of a viable trout fishery in this area. This portion of the watershed also ranked highly for livestock exclusion from streams. Targeting of critical areas for livestock fencing was accomplished through analysis of the amount of bacteria livestock are contributing through direct deposition of manure into the stream, and the length of fencing needed. Each watershed was divided up into a series of smaller subwatersheds, which were then ranked in descending order based on the ratio of bacteria loading per fence length and proximity to the headwaters of the creeks. Likelihood of flooding was also considered in prioritizing fencing since maintenance costs were identified as a major deterrent to fencing by the agricultural working group. If possible, effort should be made to prioritize resources for livestock exclusion in the following order of subwatersheds shown in Figure 6. Streambank stabilization projects to address downstream mercury concerns should also be considered in prioritizing fencing projects in the Lower South River.

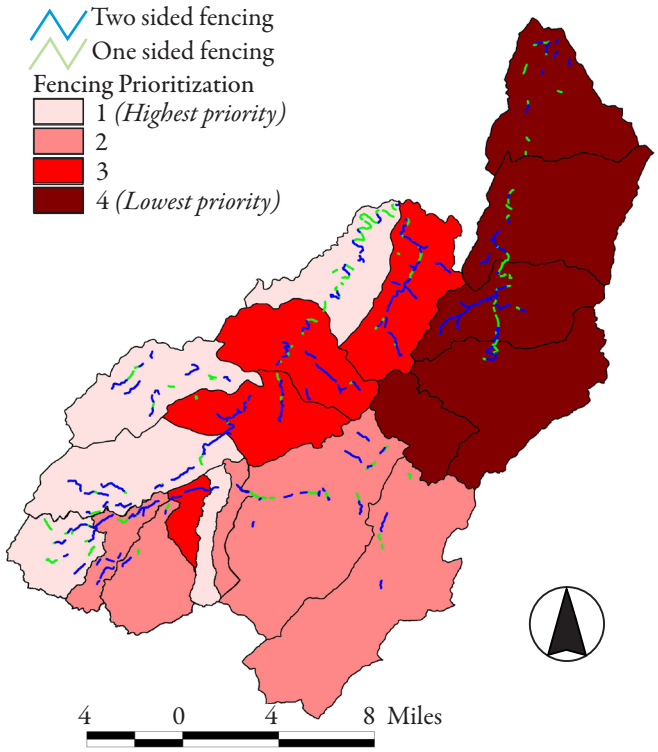

Figure 6. Livestock exclusion prioritization.

Targeting Urban BMPs

The urban working group recommended that urban implementation be focused in a series of small subwatersheds with significant urban land use acreage and the foundation for measurable water quality improvements through the implementation of urban BMPs. The City of Waynesboro provided a list of high

priority subwatersheds for targeted implementation and associated project ideas based on factors such as natural resource protection, high visibility and opportunities for retrofitting existing urban BMPs (Table 24). The Pratt's Run watershed was identified as the top priority for urban BMPs by city staff. Augusta County identified the Stuarts Draft area as a high priority for urban BMP implementation along with the series of retrofits to existing BMPs described in Table 14.

Table 24. Targeted urban BMP project ideas by subwatershed: City of Waynesboro

Subwatershed	Subwatershed description	Targeted project description
Pratt's Run/ Coyner Springs Run	Experienced significant commercial and residential growth in recent years, though it still includes some wetlands and riparian buffers.	Work with City GIS to identify and map critical wetlands and riparian buffers for protection/enhancement. Work with Waynesboro Country Club to develop and implement an urban nutrient management plan for the golf course.
Wayne Hills/ Eastern Pelham	The Wayne Hills area is mainly residential as is the eastern part of Pelham Knolls (drains through several subdivisions including Pelham East, Charleston Park, Hopeman Station, Jefferson Park, and Jefferson Park Estates)	Implement residential nutrient management outreach program, include education on the negative impacts of pet waste on water quality. Retrofit a chain of city-maintained stormwater basins. Enhance maintenance of city drainage structures known to collect large amounts of sediment. Replave the impervious parking lot at the Public Works Administration Building with pervious pavement/concrete.
Rockfish Run	Comprised of the Eastern Corridor to the City, which is created by US Route 250	Implement streambank restoration project following Kirby Avenue bridge replacement. Implement a series of streambank restoration and buffer projects during redevelopment within the Route 250 corridor on city-owned right of ways platted to the edge of stream. This would also heighten the aesthetics of the corridor from an economic development standpoint and make the practices highly visible.
Steele's Run	Large drainage area extending outside of the City limits, includes residential, commercial and industrial land uses. Several City Right-of-Ways cross Steele's Run, including Winchester Avenue	The possibility may exist for a public/ private partnership on property that is in lies between Steele's Run and the South River, and is primarily in the floodplain. Implement a series of streambank restoration projects in city right of ways.
District Home Creek	Least developed of the targeted subwatersheds, but has the potential to see significant growth, especially residential development.	Plant riparian buffers in common areas in newly constructed subdivision such as Ana Marie Estates and Claybrook. Also implement passive methods to reduce goose populations such as alternative landscape maintenance programs. Convert Kate Collins conventional stormwater basin into a bio-basin.

Partners And Their Role In Implementation

Agricultural and Residential Landowners

Headwaters SWCD and NRCS conservation staff often 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 may also influence their decision to implement best management practices. Table 25 provides a summary of relevant characteristics of farms and producers in Augusta County 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 25. Characteristics of farms and farmers in Augusta County.

Characteristic	#
Number of farms	1,729
Full owners of farms	1,118
Part owners of farms	652
Tenants	97
Owned land in farms (acres)	72,918
Rented land in farms (acres)	82,596
Operators identifying farming as their primary occupation	854
Operators identifying something other than farming as their primary occupation	732
Average size of farm (acres)	166
Average value of farmland ($/acre)	$4,897
Average net cash farm income of operation ($)	$20,338
Average farm production expenses ($)	$96,292

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.

DuPont and the South River Science Team

In addition to bacteria, sediment and phosphorous impairments, the Lower South River also has a mercury impairment from legacy contamination from the DuPont Plant in the City of Waynesboro. DuPont has been working with the South River Science Team, which is made up of technical experts from universities, state and federal agencies, to determine

where the mercury is stored in the watershed and to explore how the contamination can be remediated. Planning efforts for remediation of this mercury are currently underway, and it is anticipated that there will be some overlap between what is needed to address the mercury impairment and the bacteria, sediment and phosphorous impairments. Consequently, opportunities to collaborate with DuPont on projects such as streambank restoration, riparian buffers plantings and livestock exclusion should be explored. DuPont plans to complete a series of streambank restoration projects in the Lower South River watershed over the next several years. A 500-ft stablilization project was completed at the Invista Plant site in 2010, and DuPont expects to begin their next project in 2012. While the Lower South River watershed was assigned a lower ranking for livestock exclusion, including streambank restoration work in conjunction with livestock exclusion projects will make the establishment of stream fencing more practical for a number of farmers who expressed concerns about stream channel migration and unstable banks in the Lower South River watershed during the agricultural working group meetings.

Augusta County and the City of Waynesboro

In order to implement a number of the urban BMPs included in this plan, partnerships with the City of Waynesboro and Augusta County will be critical. Retrofitting existing stormwater facilities in the watersheds will need to be done in cooperation with the city and the county, and any efforts to increase/improve maintenance of stormwater infrastructure will largely be on the part of city and county staff. Representatives from both localities expressed concerns about the staffing levels that will be needed in order to complete the urban BMPs prescribed in the plan including enhanced maintenance of existing facilities. Concerns about the cost of contracting with engineers to design a number of these practices were expressed by both city and county staff. Additional funding for local government staff including engineering assistance will be needed to complete these actions. It is expected that partners will explore collaborative funding opportunities for both funding for staff and urban BMP implementation.

Headwaters SWCD and Natural Resource Conservation Service

During the implementation project, the Headwaters SWCD and NRCS will continue to reach out to farmers in the South River and Christians Creek watersheds and provide them with technical and financial assistance with conservation practices. Their responsibilities include promoting available funding and the benefits of BMPs and providing assistance in the survey, design, and layout of agricultural BMPs. The SWCD and NRCS staff will 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, Waynesboro Parks and Recreation, 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.

Virginia Department of Environmental Quality

Improvements in water quality and implementation progress will be determined through monitoring conducted by the VA Department of Environmental Quality's ambient and biological monitoring programs. Each stream will be visited once a month by DEQ monitors (Figure 7). DEQ will also continue to monitor the biological health of the South River and Christians Creek by sampling the benthic community in the Fall or Spring once a year. The results of this monitoring will be used to determine how effective implementation efforts to reduce sediment loading to the creeks has been. 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 and then reported to DEQ. DEQ is able to use this data for listing and de-listing streams as impaired in their biannual report to EPA.

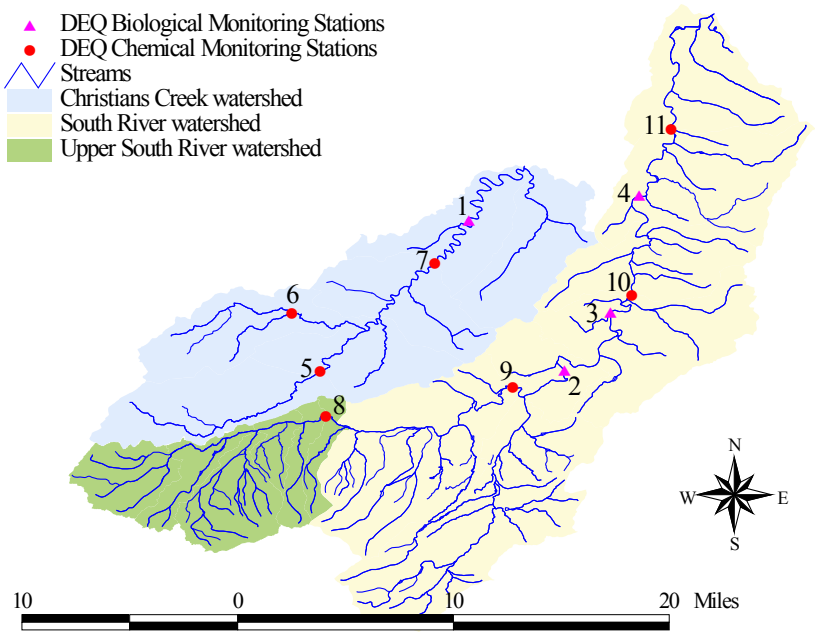

Figure 7. Virginia DEQ water quality monitoring stations in the South River and Christians Creek

Integration with Other Watershed Plans

Each watershed in the state is under the jurisdiction of a multitude of water quality programs and activities, many of which have specific geographic boundaries and goals. Coordination of the implementation project with these existing programs could make additional resources available and increase participation by local landowners.

Augusta County Comprehensive Plan

The Natural Resources Section of the Augusta County Comprehensive Plan prioritizes natural resource conservation by watershed. The Comprehensive Plan identifies Agricultural Conservation Areas (ACA) based on where the greatest amount of active farming is occurring in the county. A large por-

tion of the Upper South River watershed is classified as an ACA, further supporting the decision that it should receive a high priority ranking for agricultural implementation since these areas are least likely to be targeted by the county for future development. Most future growth in the county will be targeted to the Urban Service Areas (80% of growth in next 20 years). The county has identified these watersheds as potential target areas for advanced stormwater management, riparian buffer management, and development principles that protect water quality, such as low-impact development in an effort to protect stream health. "Priority Watersheds for Development Impacts" were designated as those that have the highest existing impervious cover within the county and that have high percentages of land in the Urban Service and Community Development Areas. A large portion of the Christians Creek watershed falls within this designation. This should be considered following completion of Stage 3 implementation goals before significant funds are invested to install stormwater management structures on pasture.

The City of Waynesboro Comprehensive Plan and Land Use Guide

The Waynesboro Land Use Guide, completed in 2008, was created to ensure that future land use decisions support the city's development goals and strategically manage growth. This guide balances growth pressure with preservation, identifies appropriate areas for development and preservation, and addresses infrastructure improvements needed to support growth and meet current regulations. The guide also addresses land use decisions that will affect the natural environment including flooding in certain parts of the city. In the Summary of Environmental and Natural Resources Issues and Opportunities section of the guide, the following key points are made:

- Flooding is an issue due to natural flooding of the South River.
- There is an opportunity to address stormwater issues.
- Accurate mapping of wetlands is an issue to understanding which areas to preserve.
- The city's Urban Trout Fishery is an asset to be expanded and improved.

This guide will serve as a useful tool for planning and prioritizing urban BMP implementation including riparian buffers along the proposed South River Greenway that is featured in the plan.

Augusta County Agricultural Task Force

In 2005, an Agricultural Task Force was formed in order to provide the County with a review of existing ordinances and policies with respect to their support of agriculture in the region. Several of the recommendations provided in this report should be integrated into implementation efforts including:

- Establishment of a mentorship program for younger producers – principles of conservation based farming could be included in this program
- Establish a Purchase of Development Rights Program – agricultural conservation efforts should be targeted in agricultural zones and protected lands
- In addition, the report includes a list of significant agricultural events in the area. This list should be used to identify opportunities to distribute information to farmers about the best management practices included in this plan:
    - Virginia Cattleman's Convention
    - Virginia State Dairyman's Convention
    - Virginia Farm Show
    - Virginia Beef Expo
    - Virginia Agricultural Expo
    - Breeders shows

Funding for Implementation

A list of potential funding sources available for implementation has been developed. Detailed descriptions can be obtained from the Headwaters SWCD, 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 to implement the residential and urban practices included in the plan.

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 and rental rates, and offering a flat rate incentive payment to place a permanent "riparian easement" on the enrolled area. Additional federal incentives can bring the effective cost share rate up to 115% of eligible expenses. 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.

Chesapeake Bay Watershed Initiative

This initiative was authorized in the 2008 Farm Bill for 2009-2012. It provides technical and financial assistance to producers to implement practices that reduce sediment and nutrients to help protect and restore the Chesapeake Bay. Prioirity has been given to the Shenandoah and Potomac River Basins and selected watersheds that have impaired streams due to high levels of nutrients and sediment. Producers who live in an NRCS high priority Cheasapeake Bay watershed receive additional consideration in the funding ranking process.

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. 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.

Virginia Natural Resources Commitment Fund

This fund was established in the Virginia Code as a subfund of the Water Quality Improvement Fund in 2008. Monies placed in the fund are to be used solely for the Virginia Agricultural BMP Cost Share Program as well as agricultural needs for targeted TMDL implementation areas. Watershed addressed in this water quality improvement plan are eligible for these funds, which are appropriated by DCR to Headwaters SWCD.

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 such as wetlands, streams, and streamside 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.

References

Augusta County. 2007. Augusta County Comprehensive Plan Update 2007-2027. April 25, 2007. Commonwealth of Virginia. 2005.

Braden, J. and Johnston, D. 2004. Downstream economic benefits from storm-water management. Journal of Water Resources Planning and Management, 130(6), 498-505.

Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy.

City of Waynesboro. 2008. City of Waynesboro Comprehensive Plan: Land Use Guide.

Engineering Concepts, Inc. 2009. Bacteria and Benthic Total Maximum Daily Load Development for South River. Prepared for the Virginia Department of Environmental Quality. June 2009.

Landefeld, M., and J. Bettinger. 2002. Water effects on livestock performance. Ohio State University Agriculture and Natural Resources. Report ANR-13-02. Columbus, Ohio.

MapTech Inc. 2001. Fecal coliform and NO3 TMDL Implementation Plan for Dry River, Muddy Creek, Pleasant Run and Mill Creek, Virginia. Prepared for the Virginia Department of Conservation and Recreation and the Virginia Department of Environmental Quality. July 15, 2001.

MapTech Inc. 2004 Fecal bacteria and general standard TMDL development for impaired streams in the Middle River and Upper South River watersheds, Augusta County, Virginia. Prepared for the Virginia Department of Conservation and Recreation. April 28, 2004.

Map Tech Inc. 2006. Water Quality Implementation Plan for Blacks Run and Cooks Creek (Fecal coliform and Aquatic Life TMDLs). Prepared in coordination with the Virginia Department of Environmental Quality. May 25, 2006.

Paterson, R.G. et al. 1993. Costs and benefits of urban erosion and sediment control: The North Carolina Experience. Environmental Management, 17(2), 167-178.

Surber, G.K., K. Williams, and M. Manoukian. 2005. Drinking water quality for beef cattle: an environmentally friendly and production enhancement technique. Animal and Range Sciences, Extension Service, Montana State University.

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.

US Department of Agriculture, National Agricultural Statistics Service. 2007. US Census of Agriculture, 2007.

US Fish and Wildlife Service. 2010. Trout Fishing in 2006: A Demographic Description and Economic Analysis. April 2010.

US Geological Survey. 2003. Use of the Hydrological Simulation Program-FORTRAN and bacterial source tracking for development of the fecal coliform TMDL for Christians Creek, Augusta County Virginia. Water-Resources Investigations Report 03-4162. Prepared in cooperation with the Virginia Department of Conservation and Recreation. Richmond, VA 2003.

VADEQ. 1998. 303(d) Total Maximum Daily Load Priority List and Report.

VADEQ and VADCR. 2003. Guidance Manual for TMDL Implementation Plans.

VCE. 1998. Mastitis cost? by Gerald M. (Jerry) Jones, Extension Dairy Scientist, Milk Quality and Milking Management, Virginia Tech. Dairy Pipeline. December 1998.

Zeckoski, R., Benham, B., Lunsford, C. 2007. Streamside livestock exclusion: A tool for increasing farm income and improving water quality. Biolocial Systems Engineering, Virginia Tech. Publication Number 442-766. September 2007.