Water Quality Improvement Plan

HARDWARE & NORTH FORK HARDWARE RIVER

A plan to reduce bacteria in the water

January 12, 2016

Prepared by

The Virginia Department of Environmental Quality

In Cooperation with

Local Stakeholders

Department of Biological Systems Engineering,

Virginia Tech Center for Watershed Studies

ACKNOWLEDGEMENTS

We would like to acknowledge the following organizations for their support for and participation in the development of this plan:

Friends of the Hardware River
Albemarle County Farm Bureau
Fluvanna County Farm Bureau
Albermarle County
Fluvanna County
Town of Scottsville
Thomas Jefferson Soil and Water Conservation District
USDA Natural Resources Conservation Service
North Garden Fire Hall
Walton Middle School
VA Department of Health

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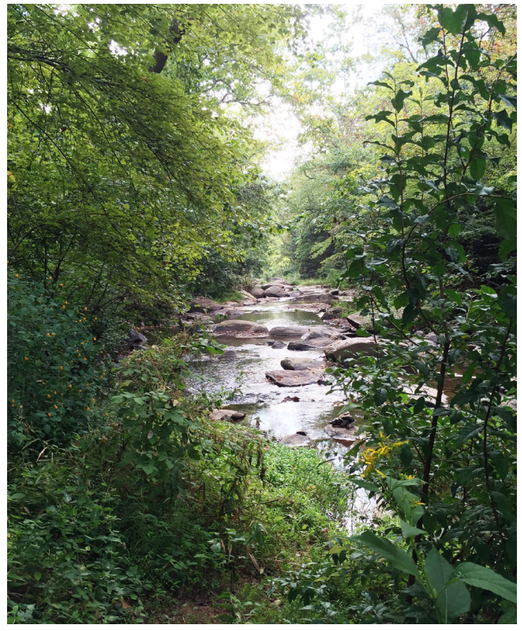
A landowner's guide to the Hardware River

The Hardware River is a beautiful river, rich in history. The river is stocked with brown and rainbow trout three times a year, offering excellent opportunities for fishing. Smallmouth bass, channel catfish, and largemouth bass are also commonly found in the waters of the Hardware. In addition, the Hardware River Wildlife Management Area is located along the banks of the river. This protected area includes over 1,000 acres of forest offering excellent opportunities for hunting, birding and hiking. Despite the fact that large portions of the land surrounding the river remain pristine, water monitoring has shown that the Hardware has high concentrations of bacteria, which means that people face an increased risk of getting sick when coming into direct contact with the water (swimming and splashing water into your eyes or mouth). As a result, the Hardware River and its North Fork are included on Virginia's list of "dirty waters."



A study of the Hardware River and the sources of bacteria in the water was completed by the VA Department of Environmental Quality in 2007. Bacteria sources include failing septic systems and straight pipes (pipes discharging untreated sewage into the stream), runoff of manure from pasture and cropland, livestock in the stream, and wildlife. This plan can act as a road map to fix these problems with the help of local landowners. The plan lists the actions needed to restore the Hardware so that it is considered safe for all types of recreation. Examples include: repairing failing septic systems, excluding livestock from streams, implementing rotational grazing systems, and planting trees and shrubs along the river. It is expected that it will take about ten years to remove the river from the dirty waters list.

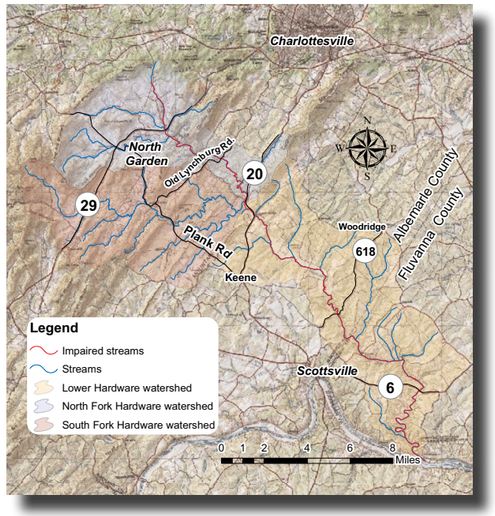
Many of the actions included in this plan can improve stream health *and* offer economic gains to landowners. These may include reduced veterinary bills for farmers with livestock, and higher property values for homeowners with functional septic systems. However, the upfront cost of some of these actions can be considerable. The estimated cost to make the river safe for swimming is about $10M. The good news is that a large portion of this money would be returned to the local economy through the use of local contractors to construct fences, install wells and repair septic systems.

In addition, there are numerous state and federal programs available to help landowners with the cost of some of these actions.

Outreach will be critical to make the community aware of the problems facing the Hardware River, the actions landowners can take to help, and the resources available to them. Outreach could include farm tours where a rotational grazing system is used, and postcard mailings reminding homeowners to have their septic tank pumped every 3-5 years. Key partners in this effort include: USDA Natural Resource Conservation Service, the Thomas Jefferson SWCD, the Health Department, Albemarle and Fluvanna Counties and local landowners.

What is needed to clean up the Hardware River?

The list of actions below is an estimate of what it would take to make the river safe for all kinds of recreation. While the list is long and the extent of work needed is large, it is important to remember that if everyone makes small changes in their daily lives, it will make a BIG difference in the river.



Residential actions:

- Septic tank pumpouts (438)
- Septic system repairs (93)
- Septic system replacements with conventional systems (234)
- Septic system replacements with alternative waste treatment systems (176)
- Streamside plantings (7 acres)
- Pet waste disposal stations (3)

Agricultural actions:

- Livestock stream exclusion fence (includes length of fence on both sides of the stream) (16.6 miles)
- Improved pasture management (8,500 acres)
- Establish vegetative cover on critical areas of pasture (highly eroded or denuded areas) (52 acres)
- Tree planting on highly erodible pasture (239 acres)
- Barnyard runoff controls (for horses) (2 acres)
- Manure storage/composting facilities (for horses) (2)
- Streamside plantings on hayland and cropland (26 acres)
- Annual cover crop plantings (51 acres/year)

To learn how you can help:

- Technical and financial assistance with agricultural practices
  Thomas Jefferson Soil and Water Conservation District
  website: http://tjswcd.org phone: (434)975-0224
- Information about septic system maintenance
  Albemarle County Health Department
  website: www.vdh.virginia.gov/LHD/ThomasJefferson/
  phone: (434)972-6200
  Fluvanna County Health Department
  www.vdh.virginia.gov/LHD/ThomasJefferson/
  (434)591-1965
- Information about water quality, citizen monitoring, and TMDL implementation
  Virginia Department of Environmental Quality
  website: www.deq.virginia.gov phone: (540)574-7850

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 from multiple sources 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 the Hardware River:

TMDLs were completed for the North Fork of the Hardware River and the Hardware River (mainstem) in 2007 after water quality monitoring showed that the rivers were violating the State's water quality standard for bacteria. This standard is based on the concentration of *E. coli* bacteria in the water, and is designed to minimize the risk of illness or infection after coming into contact with the water. The standard states that the *E. coli* bacteria count should not exceed a geometric mean of 126 cfu per 100 mL of water for two or more samples taken over a 30-day period, and that it should not exceed 235 cfu per 100 mL at any time. Table 1 shows the frequency at which the rivers are violating this standard based on monitoring by the Virginia Department of Environmental Quality (VADEQ).

Table 1. Monitoring stations in the Hardware River watershed and violation rates of the *E.coli* water quality standard. (NF: North Fork, SF: South Fork)

Station ID	Stream Name	Description	# of samples	Violation rate	Sampling period
2-HNF008.28	NF Hardware	Rt. 708 Bridge	18	50.0%	2005-2006
2-HNF005.03	NF Hardware	Rt. 708 Bridge	12	16.7%	2005-2012
2-HNF000.10	NF Hardware	Rt. 708 Bridge	12	25.0%	2005-2012
2-HAK001.34	SF Hardware	Rt. 717 Bridge	21	9.5%	2005-2012
2-HRD011.57	Hardware	Rt. 637 Bridge	78	24.4%	2003-2014
2-HRD000.36	Hardware	Rt. 646 Bridge	53	9.43%	2003-2010

Creating a Water Quality Improvement 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 water quality improvement plan (also known as 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 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 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

(VADCR & VADEQ, 2003)

REVIEW OF TMDL STUDY

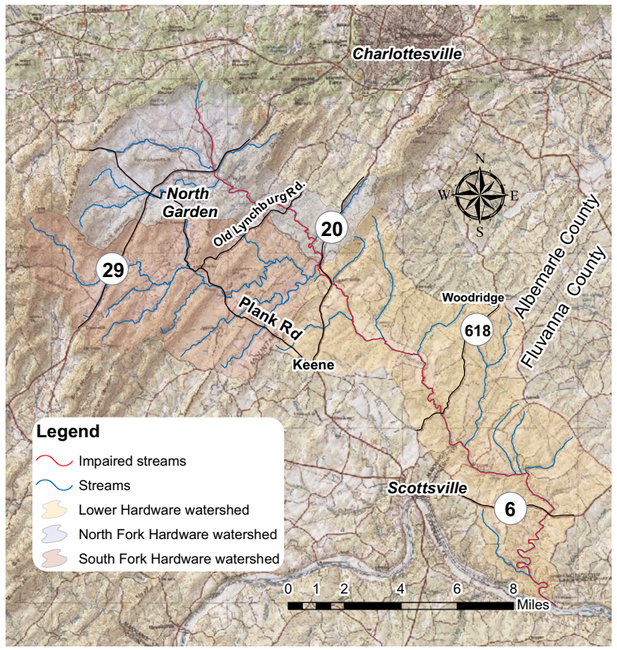


Figure 1. Location of the watersheds

Watershed Characteristics

The North and South Forks and the mainstem of the Hardware River are located primarily in Albemarle County, Virginia, with a portion of the mainstem in Fluvanna County. All three watersheds are part of the James River Basin and total approximately 88,090 acres (137 square miles). The confluence of the North and South Forks forms the beginning of the Hardware River, which empties into the James River. Forest and pasture/hay are the predominant land uses in the watershed (75% and 21% respectively). According to the 2012 Census of Agriculture, the average farm in Albemarle County is 179 acres, with over 58% of primary operators identifying their primary occupation as something other than farming. The county ranked 2nd in the state for the value of fruits, tree nuts and berries sold, and 3rd in the state for its inventory of horses and ponies. The average net cash income for a farm in Albemarle County was estimated at -$11,043 (USDA, 2012).

As shown in Figure 1, the impaired segment of the North Fork Hardware River extends 10.42 miles from the headwaters down to its confluence with the South Fork Hardware River. The impairment on the Hardware River (mainstem) extends from its confluence with the North and South Forks 23.03 miles down to its confluence with the James River (VADEQ, 2002, 2006). The South Fork Hardware River is not considered impaired. However it is grouped with the North Fork Hardware River watershed in this plan, which has been developed to address water quality problems at the watershed scale.

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 rivers. Non-point sources of bacteria in the watersheds include failing septic systems, livestock, wildlife, and domestic pets. Point sources including individual residences can contribute bacteria to streams through their permitted discharges. There are currently three point sources permitted to discharge bacteria in the watersheds, two of which are single family home permits (one in the North Fork watershed and one in the Hardware watershed). The Crossroads Village Center, located in the North Fork Hardware watershed, also has a permit to discharge bacteria (permitted *E.coli* concentration of 126 cfu/100mL, permitted *E.coli* load of 3.48 x10^{10} cfu/year).

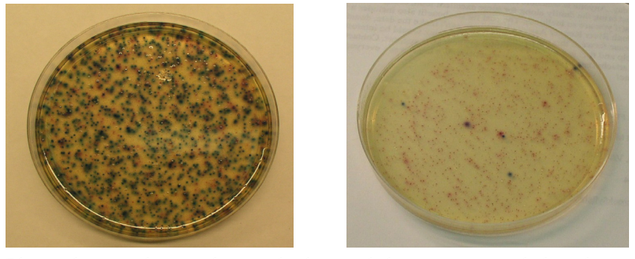


Photo shows coliscan plates, which reveal the presence and abundance of *E.coli* colonies (blue dots) and coliform bacteria colonies (red dots) in a stream where livestock have access (left) and where they have been excluded (right). Photo: Bobby Whitescarver, NRCS

Goals for Reducing Bacteria

The TMDL study completed for the rivers identified goals for reducing bacteria from the different sources in the watersheds. The goals shown in Table 1 below are based on what it would take to remove the creeks from the impaired waters list. This can occur when the single sample water quality standard for *E. coli* (235 cfu/100mL) is violated no more than 10.5% of the time. Greater reductions in non point source pollution will be needed in order to achieve a 0% violation rate, which were also identified in the TMDL. These reductions included contributions from wildlife in the North Fork Hardware River. Since even healthy streams violate the standard occasionally, and since the TMDL program does not address pollutant contributions from wildlife, the focus of planning efforts was on meeting the goals shown below. It should be noted that even these goals are considerable, particularly in the North Fork Hardware River watershed.

Table 2. Bacteria reduction goals for removal of streams from the impaired waters list (VADEQ, 2007)

Watershed	**Fecal Coliform Reduction from Source Category (%)**					**% Violation of *E.coli* standard** (Single sample standard)
	Straight Pipes & Failing Septic	Livestock stream access	Pasture runoff	Cropland runoff	Residential runoff	
NF Hardware	100%	95%	80%	10%	71%	9.9%
*Hardware	100%	40%	65%	10%	83%	10.1%

*Hardware reductions apply to the Lower and SF Hardware watersheds, which were grouped together in the TMDL study

COMMUNITY PARTICIPATION

Collecting input from the local community on conservation and outreach strategies to include in the water quality improvement plan was a critical step in this planning process.

Two public meetings were held on the evenings of March 31 and April 9, 2015 at Victory Hall in Scottsville and the North Garden Fire Hall, respectively, to kick off development of the plan. These meetings served as opportunities for local residents to learn more about the problems facing the river and work together to come up with new ideas to protect and restore water quality in their community. The meetings were publicized through notices to local media outlets, email announcements, invitations mailed to riparian landowners, and fliers posted throughout the watersheds. The meetings included a presentation by VADEQ staff on current water quality issues in the watersheds and development of the plan. This presentation was followed by break out sessions to collect local input on characteristics of the watersheds and ideas regarding what to include in the plan. Approximately 45 people attended the two meetings. In addition, an informational meeting was held with a small group of landowners and partner organizations prior to kicking off the project in order to identify suitable meeting locations, key issues, and other unique watershed characteristics that had the capacity to greatly influence the planning process. A final public meeting was held on January 12, 2016 at Walton Middle School to present the completed draft plan to the public and collect local input. Over XX people attended.

Two working groups (agricultural and residential) 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. Both working groups met twice 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 round of agricultural working group meetings, which were held as break out sessions during the first two public meetings in March and April, the groups discussed the status of farming in the region and characteristics of typical farms in the watershed. Several attendees noted that estimates of cattle and horses in the watershed that were developed in an earlier study were far too high based on land use changes in the watershed over the last 5-10 years. Participants completed a survey regarding potential BMPs to include in the plan and obstacles to livestock exclusion in the watershed. Livestock exclusion from streams and rotational grazing were ranked as the highest priority practices by participants, while forestation of crop and pasture land and equine manure storage/composting were ranked as the lowest priority. The greatest obstacles to livestock exclusion identified in the survey were giving up land for a 35-foot buffer and the cost of installation. The groups also discussed the best methods of outreach to the local agricultural community including partnering with the local Farm Bureau, and with VA Cooperative Extension. Postcard mailings and brochures were also identified as good ways to share information. A second meeting was held on June 11, 2015 at Walton Middle School. During this meeting, the group reviewed a series of BMP implementation scenarios and associated costs, and identified a time line for implementation. Participants wanted to make sure that the time line was short enough to demonstrate that the community was serious about improving water quality in the Hardware River. Participants agreed on a two-stage implementation process, with each stage lasting approximately five years. Concerns were expressed regarding how a backlog of livestock exclusion practices to be funded with 100% cost share through the VA Agricultural BMP Cost Share Program might impact the time line and availability of financial support for implementation efforts. The 100% cost share program ended on June 30, 2015; however, practices signed up prior to this date are to be honored through the state program as funds become available. Participants were concerned that this could interfere with implementation efforts in the Hardware River, but ultimately decided to plan to move directly into implementation following completion of the plan.

The primary role of the Residential Working Group was to discuss methods needed to reduce human sources of bacteria entering the creeks, recommend methods to identify and correct or replace failing septic systems and straight pipes, and provide input on the BMPs to include in the plan. At their first meeting on May 8th, the residential working group discussed the need for increased education and outreach regarding septic system maintenance. The group identified a number of strategies to reach the community with informational materials including mailings, public service announcements, and postings of informational materials at local restaurants, wineries and cideries. In addition, estimates of repairs and replacements needed were reviewed. It was noted that there are not many alternative waste treatment systems in the watersheds. A second residential working group meeting was held on June 2, 2015 at Walton Middle School. During this meeting, the group discussed the costs of septic system practices and identified a time line of ten years to accomplish BMP goals. Targeting strategies for outreach were discussed. Ultimately, participants felt that it would be best to cast a wide net with respect to outreach efforts, rather than focusing on a particular portion of the watershed. The group discussed the potential for other residential BMPs including riparian buffers and identified a small number of potential locations for projects. Participants agreed that a pet waste education program would not be very successful in the watershed due to the larger parcel sizes, but agreed that there are a few public places where people walk their dogs, which could benefit from pet waste disposal stations.

The Steering Committee met on November 3, 2015 at the Scottsville Public Library to discuss plans for the final public meeting and to review a draft of the implementation plan. The group provided feedback on potential speakers for the final public meeting in addition to locations and timing.

The final public meeting was held of January 12, 2016 at Walton Middle School. This meeting kicked off a 30-day public comment period during which the public could submit written comments on the draft plan. During the meeting, DEQ staff provided an overview of the process used to develop the plan and a summary of its contents. Guest speakers provided additional background information on the Hardware River watershed, and community members were invited to offer feedback and ask questions. Several partner organizations set up displays around the room and provided attendees with informational materials about their existing programs.

IMPLEMENTATION ACTIONS


Photo: Brian Walton, Thomas Jefferson SWCD

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 bacteria reductions specified in the TMDL study. 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 TMDL, a number of additional measures were needed to control bacteria coming from land-based sources. Based on the TMDL study, significant load reductions from pasture runoff are needed in order to de-list the Hardware River. After extensive review of BMPs that can be used to treat pasture runoff, and following discussions with the agricultural working group, it was determined that increasing the extent of livestock exclusion from waterways and thereby decreasing the extent of pasture BMPs needed would provide more reasonable assurance of accomplishment of water quality improvement goals. Various scenarios were developed and presented to the working groups, who reviewed both economic costs and the water quality benefits. The majority of agricultural best management practices (BMPs) in this plan are included in state and federal agricultural cost share programs that promote conservation. The final set of practices identified and the efficiencies used in this study are listed in Table 3. 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 to actions will be made as appropriate. As new technologies and innovative BMPs to address bacteria become available, these practices should also be evaluated for implementation in the watersheds.

Table 3. Bacteria reduction efficiencies for best management practices

BMP Type	Description	Bacteria Reduction	Reference
Livestock stream exclusion	Livestock exclusion from waterway	100%	1
Pasture	Streamside buffer (35-100 feet)	40%	2, 5
	Improved pasture management	50%	3, 5
	Permanent vegetative cover on critical areas	LU Change	4
	Reforestation of highly erodible pasture/cropland	LU Change	4
	Manure storage/composting (equine)	80%	3
	Barnyard runoff controls (equine)	LU Change	4
Cropland	Cover crops	20%	2,5
	Riparian buffers	40%	2, 5
Hayland	Riparian buffers	40%	2,5
Straight pipes and septic systems	Septic tank pumpout	5%	6
	Septic system repair	100%	1
	Septic system replacement	100%	1
	Alternative waste treatment system	100%	1
Residential	Pet waste disposal station	100%	1
	Riparian buffers	40%	2,5

References

1. Removal efficiency is defined by the practice
2. Bacteria efficiency assumed to be equal to sediment efficiency.
3. VADCR and VADEQ. 2003. Guidance manual for Total Maximum Daily Load Implementation Plans. Available at: www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDLImplementationPlanGuidanceManual.aspx
4. Based on differential loading rates to different land uses.
5. Chesapeake Assessment Scenario Tool - BMP effectiveness values by land use and HGMR and pollutant
6. Bacteria efficiency assumed equal to nitrogen removal efficiency - Chesapeake Assessment Scenario Tool - BMP effectiveness values by land use and HGMR and pollutant

LIVESTOCK IN THE STREAMS

An estimated total of 16.6 miles of stream exclusion fencing for livestock will be needed to de-list the Hardware River and its tributaries.

To estimate fencing needs, stream segments that flowed through or were adjacent to pasture were identified using GIS mapping. 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. Land use data from the 2014 Non Point Source Pollution Assessment (VADCR, 2014) was used in order to determine the ratio of pasture to hay land in the watersheds since these land uses are not easily differentiated using GIS mapping and aerial imagery. This ratio was used to adjust fencing estimates so that land used solely to cut hay was not included in the fencing calculations. Data on stream fencing already in place was collected from the VADCR Ag BMP Tracking database and subtracted from the estimate of total fencing needed. A total of 29.3 miles of fencing was installed in the watersheds between 1998 and 2014. Once estimates were completed, they were compared with the results of a stream survey conducted by the Thomas Jefferson SWCD in 2009. The SWCD identified properties in the watershed where livestock had direct access to the stream and collected coordinate data for those properties. The survey data was used to make several small adjustments to the fencing estimates, though overall, the two datasets matched up well.

It is expected that the majority of fencing will be accomplished through the VA Agricultural BMP Cost Share Program and federal NRCS cost share programs. In order to determine the appropriate mix of fencing practices, tax parcel data was utilized in conjunction with local data from the VADCR Agricultural BMP Database to determine typical characteristics of livestock exclusion systems in the region (e.g., streamside fencing length per practice). In addition, input was collected from the Agricultural Working Group, NRCS and the Thomas Jefferson SWCD regarding typical components of each system, associated costs, and preferred fencing setbacks. An estimated 16.6 miles of fencing (includes fencing on both sides of the stream where applicable) will be needed to remove the streams from the impaired waters list.

Table 4. Fencing needs assessment

Description	NF Hardware	SF Hardware	Hardware	TOTAL
% livestock stream exclusion needed for de-listing	95%	99%	99%	97%
Stream fencing needed (ft)	36,155	34,085	17,414	87,654

A summary of cost share programs available to farmers interested in installing fencing is provided in the funding section on pages 37-40. The codes shown in blue in the paragraph below were taken from these programs. Incentive payments vary based on the width of the streamside buffer that is installed between the fence and the stream. The portion of fencing that will be accomplished using different fencing practices was based on historical data and input from farmers and agricultural conservation professionals.

Farmers who cannot give up 35 feet or more for a streamside buffer can receive 50% cost share for the installation of fencing with a 10-foot setback, cross fencing, and an alternative water source for their livestock. It is estimated that **15%** of fencing in the watersheds will be installed using this 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 75%-85% for stream fencing, cross fencing and providing alternative water. It is estimated that **60%** of the total fencing will be installed using this practice (codes LE-1T and SL-6T). For those who are willing to install a 35 foot buffer or larger and plant trees in the buffer, USDA-NRCS's Conservation Reserve Enhancement Program (CREP) is an excellent option. This practice provides cost share and incentive payments ranging from 50% to 115% for fencing and planting materials. It is estimated that **25%** of fencing in the watersheds will be installed through CREP. The agricultural working group recommended pursuing additional funding opportunities from private funding sources and local government to supplement state and federal programs.

Table 5. Livestock exclusion BMPs (feet and number of exclusion systems)

Watershed	Fencing by Exclusion System Type (linear feet and # of practices)					
	LE-1T/SL-6T		LE-2T		CREP	
	Feet	#	Feet	#	Feet	#
NF Hardware	21,693	8	5,423	2	9,039	3
SF Hardware	19,625	5	4,906	1	8,177	2
Hardware	10,448	5	2,612	1	4,354	2

IMPLEMENTATION ACTIONS FOR PASTURE


Photo: Brian Walton, Thomas Jefferson SWCD

Runoff from pastures can carry with it bacteria from manure deposited on the land on its way to the stream.

Improved pasture management can prevent overgrazing by livestock, thereby reducing runoff, increasing filtration and vegetative uptake of pollutants, and allowing farmers to better utilize their pastures. This practice includes: maintaining minimum forage height during the growing season, application of lime and fertilizer when needed, following a nutrient management plan, controlling woody vegetation, distributing manure through managed rotational grazing, a sacrifice area for feeding during winter and summer droughts, and reseeding if necessary. Grazing land management is a similar practice, but differs in that cost share is available for establishment of cross fencing and other grazing infrastructure through the Ag BMP Cost Share Program. A flat rate incentive payment is offered through the program for the improved pasture management practice. Farmers can also utilize cost share programs to convert highly erodible pasture such as areas with steep slopes and poor vegetative cover to forest. These types of pasture typically produce lower forage yields for livestock making them less optimal for grazing or cutting hay. Table 6 shows pasture BMPs needed in order to reduce bacteria to a level at which the streams can be removed from the impaired waters list.

Table 6. Pasture BMPs

BMP	BMP (acres unless otherwise specified)		
	NF Hardware	Hardware	TOTAL
Improved pasture management	912	6,308	**7,220**
Grazing land management	161	1,113	**1,274**
Reforestation of erodible pasture	33	206	**239**
Critical area stabilization	11	41	**52**
Barnyard runoff controls (equine)	1	1	**2**
Manure storage/comosting facility (equine, system)	1	1	**2**

IMPLEMENTATION ACTIONS FOR CROPLAND


Photo: Jay Gilliam

Bacteria can run off of cropland when soils fertilized with manure are exposed to rainfall. These pollutants will make their way to the stream unless filtering practices like riparian buffers are in place to trap it.

Cropland is a relatively small source of bacteria in the Hardware River watershed since most farmers typically apply commercial fertilizer rather than manure. However, there are still opportunities to reduce the bacteria load to the river from cropland. Cover crops are an effective way of limiting runoff of manure. By keeping the soil covered throughout the year, the soil and manure applied to it are more likely to stay put. Many farmers in Albemarle and Fluvanna Counties are already planting cover crops on an annual basis. Consequently, this plan includes a modest amount of cover crops since the practice is already commonly used in the region. Riparian buffers are another effective practice for filtering polluted runoff. There are limited opportunities for cropland buffers in the watersheds since most of the agricultural land next to the streams is currently in pasture or hay. Table 7 shows the estimated extent of cropland BMPs needed in order to remove the streams from the impaired waters list. Opportunities for riparian buffers on hay land were also identified in the planning process. Opportunities for a total of 3.6 acres of riparian buffers (50% forested, 50% grass) were identified for hay land in the North Fork Hardware watershed, and 3.3 acres in the Hardware River watershed (South Fork and Lower).

Table 7. Cropland BMPs needed

BMP	BMP Acres		
	NF Hardware	Hardware	TOTAL
Cover crops	11	40	**51**
Riparian buffers (forest)	0.84	9	**9.84**
Riparian buffers (grass)	0.85	9	**9.85**

STRAIGHT PIPES AND FAILING SEPTIC SYSTEMS

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

Estimates of the percentages of households with failing septic systems and straight pipes (pipes directly discharging untreated sewage into the stream) in the watersheds are shown in Table 8. These estimates were developed as part of the TMDL study. 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 region. Based on existing conditions in the watersheds, it was estimated that approximately 33% of septic system replacements would be done with alternative waste treatment systems while the remaining 57% could be done using conventional septic systems. No opportunities for connection to public sewer were identified in the watersheds. A septic tank pumpout program could be utilized to help educate homeowners in the watersheds about septic system maintenance and to locate and correct failing septic systems. This program could be implemented on a limited basis, targeting homes closest to streams. The estimates shown in Table 8 are based on pumping out septic tanks for 25% of households.

Table 8. Residential wastewater treatment BMPs

Watershed	Failing septic systems	Straight pipes	Septic system repair	Alternative waste treatment system	Septic system replacement (conventional)	Septic system replacement with pump	Septic tank pumpout
NF Hardware	114	11	23	44	36	22	114
Hardware	349	29	70	132	109	67	354
TOTALS	**463**	**40**	**116**	**167**	**145**	**75**	**468**

RESIDENTIAL IMPLEMENTATION ACTIONS

In order to treat bacteria running off of developed land, BMPs to reduce and filter residential runoff will be necessary.

Due to the largely agricultural land base of the watersheds, opportunities for residential stormwater and pet waste BMPs are relatively limited. However, several opportunities were identified for pet waste disposal stations in the watershed including Walnut Creek Reservoir, Red Hill Elementary School and Walker Middle School. In addition, a small amount of residential property next to the river was identified for potential riparian buffer installations. These buffers could be designed and planted as attractive landscape features by selecting the right plants. Partners in this effort could include groups like Virginia Master Gardeners and Master Naturalists, who could work with landowners to design a buffer that blends in with their existing landscaping.

Table 9. Residential/pet waste BMPs

BMP	Units	Extent	
		NF Hardware	Hardware
Riparian buffers	acres	6.9	0
Pet waste station	stations	1	2

EDUCATION AND OUTREACH

In order to get landowners involved in implementation, education and outreach and assistance with the design and installation of best management practices will be needed.

In order to get landowners involved in implementation, it will be necessary to initiate education and outreach strategies and provide technical assistance with the design and installation of various best management practices. There must be a proactive approach to contact farmers and residents to identify the practices that will help meet the goal of improved water quality while also meeting their needs as private landowners. Economic costs and benefits must be considered in this process. The working groups recommended several education/outreach techniques, which will be utilized during implementation.

The following additional education and outreach strategies were identified:

Agricultural Programs

- Make contact with landowners in the watersheds to make them aware of 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).
- Give presentations at local Farm Bureau events including annual membership meetings, August and October field days (Fluvanna County) and regular board meetings. Provide information for distribution with semi annual newsletters.
- Organize educational programs for farmers including farm tours in partnership with VA Cooperative Extension and Farm Bureau. Reach out to new landowners so that they can learn more about how agricultural BMPs actually work.
- Conduct mailings to agricultural landowners. Include contact information for organizations that provide assistance with BMP implementation (technical and financial).
- Partner with the local Master Gardeners chapter to distribute informational materials. Develop a brochure that could be placed in the display racks that the group has set up at local plant nurseries, Lowes Garden Center and Southern States.
- Partner with a local landowner who recently established an instructional farm in the watershed for the purposes of demonstrating regenerative agricultural practices such as rotational grazing, and hosting other educational workshops with guest speakers.

Residential Programs

- Identify straight-pipes and failing septic systems (e.g., contact landowners through mailings)
- Develop and distribute educational materials (e.g., septic system maintenance guide). Potential locations identified included the VA Cooperative Extension Office, local libraries, local pizza places, wineries and cideries. Conduct mass mailings to distribute materials to homeowners.
- Hold a "septic social" in the watershed to share maintenance information with property owners
- Develop public service announcements to run on local radio stations such as "The Corner"
- Establish signs along horse trails encouraging proper disposal of manure
- Set up a display at Batesville Day. While Batesville is not located within the watershed, it is typically attended by property owners throughout the surrounding area.
- Reach out to local kennels in the watershed to share information on pet waste management
- Consider development of a local ordinance that requires a homeowner to pumpout their septic tank before transferring ownership of a property
- Form partnerships with local realtors, building inspectors, and community groups such as the Ruritans to distribute educational information on septic system maintenance to homeowners.

Staffing Needed for Outreach and Technical Assistance

A critical component in the successful implementation of this plan is the availability of knowledgeable staff to work with landowners on implementing conservation practices. While this plan provides a general list of practices that can be implemented in the watershed, property owners face unique management challenges to implementation of practices. Consequently, technical assistance is a key component to successful BMP implementation. Technical assistance includes helping landowners identify suitable BMPs for their property, designing BMPs and locating funding.

The staffing level needed to implement this plan was estimated based on discussions with stakeholders and the staffing levels used in similar projects including the Rockfish River TMDL implementation project in Nelson County. It was determined that 1 position would be needed for agricultural and residential implementation. The Thomas Jefferson Soil and Water Conservation District currently houses one position that is focused on TMDL implementation. Should funding become available, the SWCD would be well suited to administer both the agricultural and residential BMP programs.

IMPLEMENTATION COSTS

Costs: Agricultural BMPs

The costs of agricultural best management practices included in the implementation plan were estimated based on data for Albemarle and Fluvanna Counties from the VADCR Agricultural BMP Database, the NRCS and Thomas Jefferson SWCD BMP component cost lists, input from SWCD and NRCS staff, and input from the agricultural working group (Table 10).

The total cost of livestock exclusion systems includes not only the costs associated with streamside fence installation and maintenance, but also the cost of developing alternative water sources for livestock and installing rotational grazing systems. It should be noted that CREP does not pay for cross fencing for rotational grazing; however, this program is commonly combined with state programs that can cover these costs. The agricultural working group discussed concerns about maintenance of exclusion fencing and agreed that associated expenses could be an obstacle to participation in BMP programs for livestock exclusion. Consequently, fence maintenance was included in BMP cost estimates. It was estimated that approximately 10% of fencing would need to be replaced over a 15 year contract (e.g. CREP) and 6.5% over a 10 year contract (SL-6T/LE-1T/LE-2T).

The majority of agricultural practices recommended in this plan are included in state and federal cost share programs. These programs offer financial assistance with implementing the practices and may also provide landowners with an incentive payment to encourage participation. However, it should be noted that these programs typically cover 75% of the cost of a BMP and require that the landowner cover the full cost of the practice up front and then receive reimbursement. Reimbursements are usually issued quickly and there is a low interest loan program available through VADEQ; however, this may still be an obstacle for some landowners interested in participating.

Table 10. Estimated agricultural BMP costs to achieve de-listing goal for the North Fork Hardware and Hardware River.

Practice	Cost share code	Units	Unit cost	Cost by watershed		TOTAL
				North Fork Hardware	Hardware	
Livestock exclusion with riparian buffers (35 ft)	LE-1T/SL-6T	system	$37,533	$292,799	$390,265	$683,064
Livestock exclusion with riparian buffers (100 ft)	CRSL-6	system	$41,051	$131,648	$177,287	$308,935
Livestock exclusion with reduced setback	LE-2T	system	$36,797	$71,844	$95,623	$167,467
Livestock exclusion fence maintenance (10 years)	N/A	feet	$3.50	$9,335	$13,374	$22,708
Improved pasture management	EQIP (529, 512), SL-10T	acres	$100	$91,200	$630,800	$722,000
Grazing land management	SL-9	acres	$225	$36,225	$250,425	$286,650
Reforestation of erodible pasture	FR-1	acres	$200	$6,105	$38,110	$44,215
Critical area stabilization	SL-11	acres	$2,440	$26,840	$100,040	$126,880
Manure storage facility (equine)	N/A	facility	$15,000	$15,000	$15,000	$30,000
Barnyard runoff controls (equine)	N/A	acres	$20,000	$20,000	$20,000	$40,000
Riparian buffers on hayland (forested)	FR-3	acres	$350	$5,385	$4,935	$10,320
Riparian buffers on cropland (grass)	WQ-1	acres	$165	$140	$1,490	$1,630
Riparian buffers on cropland (forested)	FR-3	acres	$350	$1,260	$13,545	$14,805
Small grain cover crops	SL-8B	acres	$30	$601	$2,200	$2,801
TOTAL ESTIMATED COST				$708,381	$1,753,093	$2,461,475

Costs: Residential BMPs

The costs of recommended residential BMPs (septic systems and pet waste) shown in Table 10 were estimated using input from the Albemarle County Health Department and the residential working group.

Table 10. Estimated residential BMP costs to achieve de-listing goal for the North Fork Hardware and Hardware Rivers.

Practice	Cost share code	Units	Unit cost	Cost by watershed		
				North Fork Hardware	Hardware	TOTAL
Septic tank pumpout	RB-1	pumpout	$325	$36,888	$115,050	**$151,938**
Septic system repair	RB-3	repair	$3,000	$68,400	$209,400	**$277,800**
Conventional septic system replacement	RB-4	system	$8,000	$286,800	$872,400	**$1,159,200**
Conventional septic system replacement w/pump	RB-4P	system	$10,000	$221,700	$671,700	**$893,400**
Alternative waste treatment system	RB-5	system	$25,000	$1,104,500	$3,299,500	**$4,404,000**
Pet waste stations	N/A	station	$150	$150	$300	**$450**
Riparian buffers	N/A	acres	$3,500	$24,255	$0	**$24,255**
TOTAL ESTIMATED COST				$1,742,693	$5,168,350	**$6,911,043**

Table 12 Total estimated costs of BMP implementation to achieve de-listing goals.

BMP Type	North Fork Hardware	Hardware River	TOTAL
Agricultural	$708,381	$1,753,093	$2,461,475
Residential	$1,742,693	$5,168,350	$6,911,043
TOTAL	$2,451,074	$6,921,443	$9,372,517

Costs: Technical Assistance

Technical assistance costs were estimated for 1 position using a cost of $60,000/per year. This figure is based on the existing staffing costs included in the Virginia Department of Environmental Quality's grant agreement with the Thomas Jefferson Soil and Water Conservation District for the Rockfish River implementation project in Nelson County. Based on the ten year timeline for achieving de-listing goals (described in great detail in the Implementation Timeline section of this plan), this would make the total cost of technical assistance approximately $600,000. When factored in to the cost estimate for BMP implementation shown in Table 12, this would make the total cost of implementation approximately $9.97M.

Photo: Brian Walton, Thomas Jefferson SWCD

IMPLEMENTATION BENEFITS

The primary benefit of implementing this plan will be cleaner water in the Hardware River and its tributaries. This may lead to enhanced quality of life for the local community as well as potential economic benefits.

Specifically, *E. coli* contamination in the creeks will be reduced to meet water quality standards. 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 within the Hardware River watershed community. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians, and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide economic benefits to the community, as well as numerous environmental benefits. By implementing BMPs such as installation of alternative (clean) water sources, exclusion of cattle from streams, and rotational grazing, agricultural producers can experience significant economic gains through improved forage production and herd health. Residential property owners can increase their property value through proper septic system maintenance as well. Additionally, money spent by landowners and other stakeholders in the process of implementing this plan will stimulate the local economy.

Benefits: Agricultural Practices

It is recognized that every farmer faces unique management challenges that may make implementation of some BMPs more cost effective than others. Consequently, costs and benefits of the BMPs recommended in this plan must be weighed on an individual basis. The benefits highlighted in this section are based on general research findings.

Restricting livestock access to streams and providing them with a 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 13 shows an example of how this can translate into economic gains for producers. In addition, keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VCE (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 forage harvested with equipment and fed to the animal. According to the 2012 Census of Agriculture, farmers across the state spent over $1 billion purchasing feed for livestock, far exceeding any other reported operational expenditure (USDA, 2012). Consequently, improving forage production through improved pasture management and rotational grazing could offer producers considerable economic benefits.

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

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

Note: Table from 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 ($325 per pumpout) in comparison to repairing or replacing a system ($3,000 to $25,000).

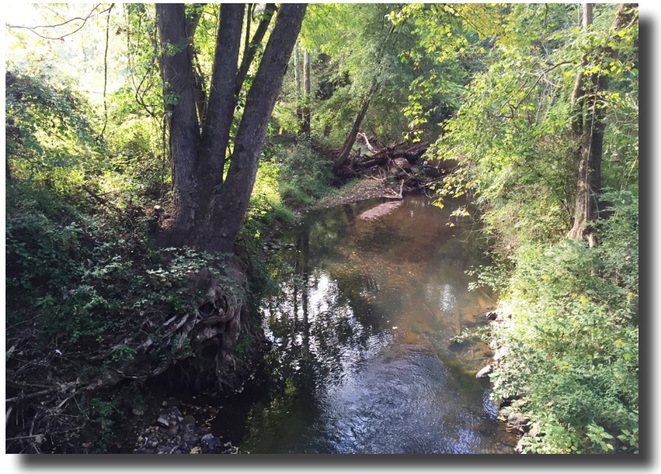
In addition to the benefits to individual landowners, the local economy will be stimulated through expenditures made during implementation, and the infusion of dollars from funding sources outside of the watersheds. Building contractors and material suppliers who deal with septic system pump-outs, private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

Benefits: Watershed Health

Focusing on reducing bacteria in the Hardware River and its tributaries will not only make the river safer for swimming, it will improve the overall health of the watershed. Reductions in streambank erosion, excessive nutrient runoff, and water temperature are additional benefits associated with streamside buffer plantings and livestock stream exclusion. In turn, reduced nutrient loading and erosion and cooler water temperatures improves habitat for fisheries, which provides benefits to anglers and the local economy.

Riparian buffers can also improve habitat for wildlife such as ground-nesting quail and other sensitive species. Data collected from Breeding Bird Surveys in Virginia indicate that the quail population declined 4.2% annually between 1966 and 2007. Habitat loss has been cited as the primary cause of this decline. As a result, Virginia has experienced significant reductions in economic input to rural communities from quail hunting. The direct economic contribution of quail hunters to the Virginia economy was estimated at nearly $26 million in 1991, with the total economic impact approaching $50 million. Between 1991 and 2004, the total loss to the Virginia economy was more than $23 million from declining quail hunter expenditures (VDGIF, 2009).

GOALS AND MILESTONES



The end goal of implementation is restored water quality in the North Fork Hardware and Hardware Rivers. It is expected that this will occur over a 10-year period.

Two types of milestones will be used to evaluate progress over the implementation 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.

Following the idea of a staged implementation approach, resources and finances will be concentrated on the most cost-efficient control measures and areas of highest interest first. For instance, the TMDL study indicated that runoff from pasture is the source of approximately 96% of total bacteria in the Hardware River watershed. Concentrating on implementing pasture management practices within the first several years may provide the highest return on water quality improvement with less cost to landowners.

While the focus of this plan is to remove these streams from the impaired waters list, full achievement of the TMDL must also be considered. This means that the BMPs needed to accomplish a 0% violation rate of the bacteria standard must be explored, along with associated costs and a time line. The TMDL for the North Fork Hardware River calls for a 20% reduction in bacteria from wildlife in the stream in order to reach a 0% violation rate. Since this plan is focused on addressing sources of bacteria that can be attributed to humans either directly or through land management, a 0% violation rate could not be accomplished for the North Fork Hardware River. In the Hardware River watershed, considerable reductions in bacteria would be needed from all human sources to reach a 0% violation

rate. In order to accomplish these significant reductions (e.g. 99% reduction in bacteria from pasture runoff), BMPs such as water control structures on pasture land and considerable conversion of pasture to forest would be needed. Based on input from the agricultural working group, widespread implementation of these practices is highly unlikely. Therefore, it was decided that a 0% violation rate would not be demonstrated for the Hardware River watershed since reasonable assurance of implementation could not be provided. It should be noted that estimates of the impact of the BMPs included in this plan on water quality are conservative, meaning that continued monitoring following implementation could demonstrate accomplishment of water quality goals at lower than expected levels of BMP implementation. BMP goals and associated water quality milestones will be evaluated throughout the project time line allowing for adjustments to goals and milestones as needed.

Based on input from the working groups regarding BMP adoption rates, it is estimated that it would take a total of 10 years to implement the BMPs needed to remove these streams from Virginia's impaired waters list. The overall time line for implementation has been divided into three stages: 2016–2020, 2021–2025, and 2025-2026. Implementation of practices included in Stage 1 is expected to result in removal of the North Fork Hardware River from the impaired waters list, while Stage 2 goals demonstrate what it would take to remove the Hardware River from the impaired waters list. Stage 3 includes several additional agricultural practices for the North Fork Hardware in order to come closer to meeting the TMDL goal of a 0% violation rate for the bacteria water quality standard. This final stage of implementation could also serve as an opportunity to re-visit BMP goals and water quality milestones for the Hardware River to determine if more could be done to improve water quality.

Table 14 shows the cost of BMP implementation in each watershed at each stage while tables 15 and 16 show implementation and water quality improvement goals for each watershed in each implementation stage.

Table 14. BMP implementation costs by stage

Stage	NF Hardware	Hardware	TOTAL
Stage 1 (Years 1-5)	$2,105,013	$5,476,908	$7,581,922
Stage 2 (Years 6-10)	$343,658	$1,425,186	$1,768,843
Stage 3 (Years 11-12)	$56,255	$0	$56,255

Table 15. Timeline for implementation in the North Fork Hardware River watershed

BMP Type	BMP	Units	Stage 1		Stage 2		Stage 3	
			Extent	% Land use treated	Extent	% Land use treated	Extent	% Land use treated
Livestock stream exclusion	Livestock exclusion w/riparian buffers (100 feet)	feet/systems	9,039/3	24%	0	0%	381/0.2	1.25%
	Livestock exclusion w/riparian buffers (35 feet)	feet/systems	21,693/8	57%	0	0%	913/0.4	3%
	Livestock exclusion w/reduced setback	feet/systems	5,423/2	14%	0	0%	228/0.1	0.75%
Pasture	Improved pasture management	acres	912	24%	0	0%	243	30%
	Grazing land management	acres	161	4%	0	0%	43	5%
	Reforestation of erodible pasture	acres	33	0.75%	0	0%	0	0%
	Critical area stabilization	acres	11	0.25%	0	0%	0	0%
	Barnyard runoff controls (equine)	acres	1	0.1%	0	0%	0	0%
	Manure storage/composting (equine)	systems	1	0.1%	0	0%	0	0%
Hayland	Riparian buffers (grass and forest)	acres	3.6	0.06%	0	0%	0	0%
Cropland	Cover crops	acres	11	50%	0	0%	0	0%
	Riparian buffers (grass and forest)	acres	1.7	0.4	0	0%	0	0%
Residential*	Septic tank pumpout	pumpout	91	20%	23	5%	0	0%
	Septic system repair	repair	18	14%	5	4%	0	0%
	Conventional septic system	system	29	23%	7	6%	0	0%
	Conventional septic system w/pump	system	18	14%	4	4%	0	0%
	Alternative waste treatment	system	35	28%	9	7%	0	0%
	Pet waste station	station	1	<0.01%	0	0%	0	0%
	Riparian buffers (grass and forest)	acres	6.93	0.02%	0	0%	0	0%
Average annual *E.coli* load (cfu/yr)			2.02×10^{13}		1.98×10^{13}		1.26×10^{13}	
% Violation of Single Sample *E. coli* standard (235 cfu/100mL)			4.9%		4.6%		1.7%	
% Violation of Geometric mean *E. coli* standard (126 cfu/100mL)			0.0%		0.0%		0.0%	

*For all septic system practices, percent land use treated: percent calculation based on total number of failing septic systems and straight pipes with exception of septic tank pumpouts (based on the total number of dwellings with septic systems)

Table 15. Timeline for implementation in the Hardware River watershed. ***Note:*** The timeline for the Hardware River does not include a Stage 3 as seen in the North Fork. Additional agricultural BMPs could be considered following completion of Stage 2 goals based on water quality monitoring.

BMP Type	BMP	Units	Stage 1		Stage 2	
			Extent	% Land use treated	Extent	% Land use treated
Livestock stream exclusion	Livestock exclusion w/riparian buffers (100 feet)	feet/systems	12,355/4	24%	602/0.5	1%
	Livestock exclusion w/riparian buffers (35 feet)	feet/systems	29,651/9	57%	1,445/1	3%
	Livestock exclusion w/reduced setback	feet/systems	7,413/2	14%	361/0.3	1%
Pasture	Improved pasture management	acres	4150	50%	2158	77%
	Grazing land management	acres	732	9%	381	14%
	Reforestation of erodible pasture	acres	206	2.5%	0	0%
	Critical area stabilization	acres	41	0.5%	0	0%
	Barnyard runoff controls (equine)	acres	0	0%	1	0.1%
	Manure storage/composting(equine)	systems	0	0%	1	0.1%
Hayland Cropland	Riparian buffers (grass and forest)	acres	3.29	0.12%	0	0%
	Cover crops	acres	40	4$	0	0%
	Riparian buffers (grass and forest)	acres	18	50%	0	0
Residential*	Septic tank pumpout	pumpout	283	20%	71	5%
	Septic system repair	repair	56	14%	14	4%
	Conventional septic system	system	87	23%	22	6%
	Conventional septic system w/pump	system	54	14%	13	4%
	Alternative waste treatment	system	106	28%	26	7%
	Pet waste station	station	2		0	0%
Average annual *E.coli* load (cfu/yr)			2.63×10^{14}		1.82×10^{14}	
% Violation of Single Sample *E. coli* standard (235 cfu/100mL)			15.2%		10.5%	
% Violation of Geometric mean *E. coli* standard (126 cfu/100mL)			2.8%		0%	

Water Quality Monitoring

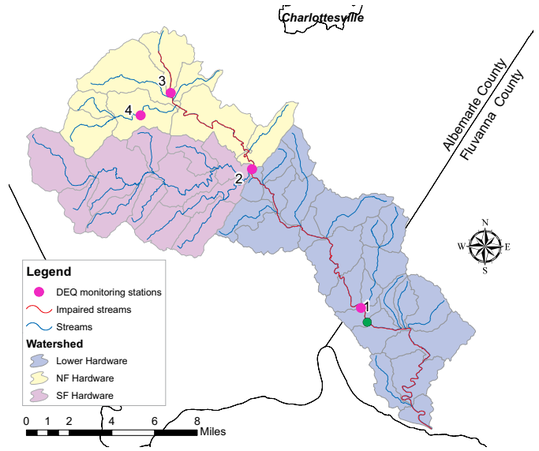


Figure 2. VADEQ monitoring stations. See Table 21 for station location descriptions.

Improvements in water quality will be evaluated through water quality monitoring conducted at the VADEQ monitoring stations shown in Figure 2. The map shows stations that are part of VADEQ's Ambient Monitoring Program, wherein bi-monthly watershed monitoring takes place on a rotating basis for two consecutive years. Monitoring will begin no sooner than the second odd numbered calendar year following the initiation of TMDL implementation efforts in the watersheds. This will help ensure that sufficient time has passed for BMPs to have become functional and improvements in water quality are detectable. Since targeted TMDL implementation began in 2010 when the TJSWCD received a grant for livestock exclusion practices in the Hardware River watershed, implementation monitoring will begin at the stations shown in Figure 2 in January 2016. At a minimum, the frequency of sample collections will be every other month for two years. After two years of bi-monthly monitoring an assessment will be made to determine if the segments are no longer impaired. Once full restoration has been achieved, monitoring will be suspended.

There is the potential for additional monitoring at a subset of stations in the watersheds where continual VADEQ monitoring is conducted on a bi-monthly basis beginning on the next odd number calendar year after the initiation of implementation. This will require additional funding and can only be accomplished with sufficient resources to support needs of the data users, and only if watershed conditions and stakeholder support are suitable to this strategy. These monitoring stations will be located in the watersheds based on TMDL implementation funds, either state, federal, or other sources, becoming available. Citizen monitoring is another very useful tool for measuring improvements in water quality. The TJSWCD launched an extensive Coliscan monitoring program to detect *E.coli* in the watershed in July 2009. Samples were collected on a monthly basis at twelve sites in the watershed through August 2012. These stations could be re-visited through a citizen monitoring initiative to evaluate water quality improvements following additional BMP implementation in the watersheds.

Table 17. DEQ station location descriptions

Station #	Stream	River mile	Description
1	Hardware	11.57	Rt. 637 Bridge at Gaging Station
2	NF Hardware	0.10	Rt. 708 Bridge
3	NF Hardware	8.28	Rt. 708 Bridge
4	South Branch of NF Hardware	2.40	Rt. 712 Bridge

Targeting Implementation:
Livestock exclusion

Implicit in the process of a staged implementation is targeting of best management practices. Targeting ensures optimal utilization of limited technical and financial resources. Excluding livestock from streams can be very resource intensive with varying results with respect to water quality depending on characteristics of the site where livestock are excluded. This makes targeting of outreach and financial resources very important when addressing livestock access to streams. In 2009, the TJSWCD conducted a stream assessment of the Hardware River in order to identify properties to target with outreach regarding livestock exclusion. Through this effort, and through additional analyses conducted during the watershed planning process, approximately 30 properties have been identified in the watersheds where livestock have access to the stream. Tax parcel data was used to identify property owners and develop a mailing list for outreach regarding technical and financial assistance available for livestock stream exclusion. In addition, segments of the creeks were further prioritized for livestock exclusion fencing based on potential water quality improvements resulting from stream fencing. Through this process, each watershed was divided up into a series of smaller subwatersheds, and an analysis of the water quality benefits of livestock exclusion was performed for each subwatershed based on 1) the extent of pasture next to the stream 2) the number of livestock in the watershed and 3) the proximity of the stream segment to the headwaters. The subwatersheds were then ranked in ascending order based on the ratio of bacteria loading per fence length (constituted 70% of ranking), and proximity to the headwaters (constituted 30% of ranking) (Figure 3). This additional prioritization may prove useful should the demand for technical and financial assistance with livestock exclusion in the watersheds exceed the capacity of local conservation partners to assist landowners.

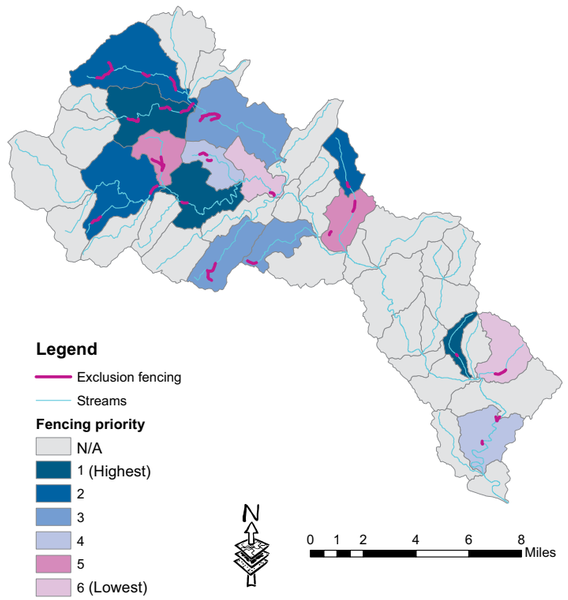


Figure 3. Livestock stream exclusion prioritization

Targeting Implementation:
Septic system maintenance

Outreach to encourage landowners to properly maintain septic systems is frequently conducted through mailings to homeowners including postcards and brochures. Experience with outreach and cost share programs in surrounding counties has shown that often times, landowners must be contacted 2-4 times before they follow up on opportunities for technical and financial assistance with septic system maintenance. This can prove costly when conducting mailings in large watersheds including the Hardware River where there are approximately 1,900 households. Identifying areas in the watershed with older homes and aging septic systems to target with outreach materials can be helpful in maximizing response rates from homeowners and corrections of failing septic systems. In order to prioritize subwatersheds for septic system maintenance outreach, subwatersheds were ranked based on the estimated percentage of failing septic systems and straight pipes (Figure 4). This information was taken from the Hardware River TMDL study, which used the age of homes to predict septic system failure rates. The rankings shown in Figure 4 could be used for follow up outreach after a large watershed mailing if funds were not available for repeated watershed-wide mailings.

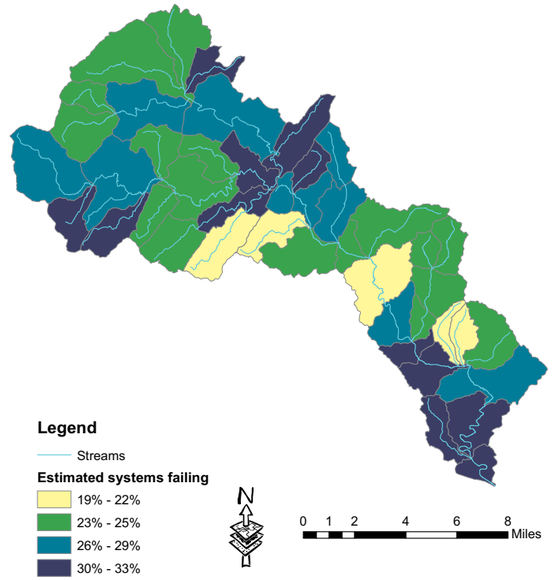


Figure 4. Septic system BMP prioritization

PARTNERS AND THEIR ROLE IN IMPLEMENTATION

Agricultural and Residential Landowners

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 18 provides a summary of relevant characteristics of farms and producers in Albemarle and Fluvanna Counties from the 2012 Agricultural Census. These characteristics were considered when developing implementation scenarios, and should be utilized to develop suitable education and outreach strategies.

Table 18. Characteristics of farms and farmers in Albemarle and Fluvanna Counties, VA (USDA, 2012)

Characteristic		Albemarle	Fluvanna
Number of farms		946	303
Land in farms (acres): full owners		86,207	25,572
Land in farms (acres): part owners	Rented land in farms	36,394	9,987
	Owned land in farms	34,514	8,223
Operators identifying farming as their primary occupation		392	131
Operators identifying something other than farming as their primary occupation		554	172
Average age of primary operator		62	60
Average size of farm (acres)		179	155
Average market value of farmland and buildings ($/acre)		$8,756	$5,097
Average net cash farm income of operation ($)		-$11,043	-$3,214
Average farm production expenses ($)		$50,230	$23,344
Farms with internet access		702	231

In addition to local farmers, participation from homeowners, local government staff and elected officials is critical to the success of this plan. Elected officials make important decisions with respect to land use and development that are likely to affect water quality. It is critical that the goals of this plan are considered as these decisions are evaluated. Residential property owners will need to ensure that their septic systems are regularly pumped and inspected (every 3-5 years). Though the amount of bacteria coming from failing septic systems and straight pipes is minimal compared to livestock, human waste carries with it pathogens that can cause considerable health problems

Thomas Jefferson Soil and Water Conservation District and USDA Natural Resource Conservation Service

Both the SWCD and NRCS are continually reaching out to farmers in the watersheds and providing them technical assistance with conservation practices. Currently, dedicated staff is not available to work solely in the three subwatersheds that are covered in this plan, meaning that agricultural BMP implementation goals cannot be met without additional resources. SWCD and NRCS staff responsibilities include promoting available funding and the benefits of BMPs, and providing assistance in the design and layout of agricultural BMPs. SWCD and NRCS staff can assist with conducting outreach activities in the watersheds to encourage participation in conservation programs; however, staff time for very targeted outreach is limited. Such activities include mailing out newsletters and organizing field days. Should funding for additional staff become available for targeted outreach in these watersheds, the Thomas Jefferson SWCD would be well suited to administer an agricultural BMP program.

Dedicated staff is currently not available to lead efforts to correct failing septic systems and straight pipes as well. The Thomas Jefferson SWCD is currently implementing a residential septic program in the nearby Rockfish and Tye River watersheds in Nelson County. Since they have trained and experienced staff, they could take the lead in administering a residential cost share program as well should funding become available.

Albemarle and Fluvanna Counties

Decisions made by local government staff and elected officials regarding land use and zoning will play an important role in the implementation of this plan. This makes the Albemarle and Fluvanna County Boards of Supervisors and the Planning Commissions key partners in long term implementation efforts. Currently, both counties have zoning and land use policies in place that support the preservation of agricultural land and encourage good stewardship of natural resources. Both counties administer conservation easement programs, which have helped to encourage land conservation across the counties. Based on feedback from the agricultural working group, suburban encroachment is a significant issue in the watershed, with the number of working farms in the area significantly declining over the last 20 years. Local government support of land conservation will become increasingly important as greater numbers of conservation measures are implemented across the watersheds. Ensuring that land remains in agriculture and forest will allow the practices installed to continue to benefit water quality.

Virginia Department of Environmental Quality

The Virginia Department of Environmental Quality has a lead role in the development of TMDL implementation plans. VADEQ also provides available grant funding and technical support for TMDL implementation. VADEQ will work closely with project partners including the Thomas Jefferson Soil and Water Conservation District to track implementation progress for best management practices. In addition, VADEQ will work with interested partners on grant proposals to generate funds for projects included in the implementation plan. When needed, VADEQ will facilitate additional meetings of the

steering committee to discuss implementation progress and make necessary adjustments to the implementation plan.

VADEQ is also responsible for monitoring state waters to determine compliance with water quality standards. VADEQ will continue monitoring water quality in the Hardware River and its tributaries in order to assess water quality and determine when restoration has been achieved and the streams can be removed from Virginia's impaired waters list.

Virginia Department of Conservation and Recreation

The Virginia Department of Conservation and Recreation (VADCR) administers the Virginia Agricultural Cost Share Program, working closely with Soil and Water Conservation Districts to provide cost share and operating grants needed to deliver this program at the local level and track implementation. In addition, VADCR administers the state's Nutrient Management Program, which provides technical assistance to producers in appropriate manure storage and manure and commercial fertilizer

Virginia Department of Health

The Virginia Department of Health (VDH) is responsible for adopting and implementing regulations for onsite wastewater treatment and disposal. The Sewage Handling and Disposal Regulations require homeowners to secure permits for handling and disposal of sewage (e.g. repairing a failing septic system or installing a new treatment system). VDH staff provide technical assistance to homeowners with septic system maintenance and installation, and respond to complaints regarding failing septic systems and straight pipes.

Other Potential Local Partners

There are numerous additional opportunities for future partnerships in the implementation of this plan. Additional potential partners in implementation include:

- VA Cooperative Extension (VCE)
- Chesapeake Bay Funders Network
- Master Well Owner Network (through VCE)
- Friends of the Hardware River
- Rivanna Water and Sewer Authority
- VA Master Naturalists (Rivanna and Fluvanna Chapters)
- James River Association
- Fluvanna & Albemarle County Farm Bureaus
- Chesapeake Bay Foundation
- Nature Conservancy
- Middle James Roundtable
- Chesapeake Conservancy
- VA Master Gardeners (Piedmont and Fluvanna Chapters)
- Southeastern Rural Community Asst. Prgm.

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 implementation efforts with these programs could make additional resources available and increase participation by local landowners.

Albemarle County Water Resource Management Program

Albemarle County's Water Resource Management Program includes a number of initiatives designed to protect the County's water resources. The Water Protection Ordinance requires that vegetated buffers be preserved or established along most County streams and limits activities that can occur within those areas including building, grading and other development activities. Generally, the ordinance requires a 100 foot buffer along streams, ponds and wetlands. Agricultural activities such as grazing are exempt from this requirement. In addition, the County is a member of the Rivanna Stormwater Education Partnership, which has developed numerous educational materials encouraging landowners to implement BMPs and pick up after their pets. The County has an "A-Mail list" for Natural Resources that the community can sign up for in order to receive regular updates on natural resource management in the region. This is an effective tool in keeping the public informed about local water quality issues and how they can get involved. Albemarle County has also established a Water Resources Funding Advisory Committee that has met monthly since September 2014. The primary objective of this committee is to identify funding mechanisms to support the County's Water Resources Program. The ordinances, education and outreach, and funding programs in place in the County may all serve as important tools in moving the implementation of this plan forward, and should be integrated into implementation efforts in the future.

Albemarle and Fluvanna County Conservation Easement and Ag Forestal District Programs

Both Albemarle and Fluvanna Counties have developed programs and policies to support the preservation of agricultural and forested lands within their jurisdictions by providing tax incentives to landowners. Conservation easement programs allow the counties to co-hold easements that protect

agricultural and forested lands in perpetuity. In addition, both counties offer programs that allow landowners to establish Ag Forestal Districts. These rural conservation areas are protected from development for a limited period of time and in return, landowners can take advantage of property tax incentives. The preservation of agricultural land in the Hardware River watershed will help to extend the life span of agricultural BMPs installed by landowners, while protection of forest land will provide numerous water quality benefits including the filtration of pollutants from adjacent developed lands.

Albemarle and Fluvanna County Comprehensive Plans

Both Albemarle and Fluvanna Counties have Comprehensive Plans that are intended to guide development and natural resource management within their jurisdictions. Both plans stress the importance of the preservation of rural areas, and encourage development in development core areas. Green infrastructure concepts are featured throughout both plans, which will work to protect water quality from future development impacts. In addition, both plans encourage the development of recreational opportunities for the local community that will increase awareness of the value of water resources including blueways and greenways. Increasing local awareness and appreciation of the Hardware River and its tributaries will in turn increase local support for the implementation of conservation practices designed to improve water quality.

Virginia's Phase II Chesapeake Bay Watershed Implementation Plan

Virginia's Watershed Implementation Plan (WIP) outlines a series of BMPs, programs and regulations that will be implemented across the state in order to meet nitrogen, phosphorous, and sediment loading reductions called for in the Chesapeake Bay TMDL, completed in December 2010. The TMDL is designed to ensure that all pollution control measures needed to fully restore the Bay are in place by 2025, with at least 60 percent of the actions completed by 2017. A number of the BMPs included in this implementation plan are also found in Virginia's WIP. Consequently, Albermarle and Fluvanna Counties will be able to track and receive credit for progress in meeting Phase II WIP goals while also working towards implementation goals established in this plan to improve local water quality. For more information about Virginia's Phase II WIP, please visit VADEQ's Bay TMDL webpage: http://www.deq.virginia.gov/Programs/Water/ChesapeakeBay.aspx

FUNDING FOR IMPLEMENTATION

A list of potential funding sources available for implementation has been developed. Detailed descriptions can be obtained from the Thomas Jefferson SWCD, VADCR, Natural Resources Conservation Service, and Virginia Cooperative Extension. While funding is being provided to the Thomas Jefferson SWCD for agricultural BMPs and technical assistance for farmers, an additional funding commitment is needed to fully implement the agricultural, residential and urban practices included in the plan.

Virginia Agricultural Best Management Practices Cost-Share Program

This program is funded with state and federal monies through local SWCDs. SWCDs administer the program to encourage 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 local caps.

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 the Code of Virginia equaling 25% of the first $70,000 expended for agricultural BMPs 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 in conjunction with other cost-share programs on the landowner'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 with no maximum limit. Eligible BMPs include structural practices such as animal waste control facilities, and grazing land protection systems. Loans are administered through participating lending institutions.

Virginia Small Business Environmental Assistance Fund Loan Program

The Fund, administered through VADEQ, is used to make or guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, or equipment and structures to implement agricultural BMPs. Loans are available up to $50,000 and will carry an interest rate of 3%, with repayment terms based on the borrower's ability to repay and the life of the equipment or BMP. 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 and nonpoint sources are administered through VADEQ.

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 Farm Service Agency (FSA) CRP Continuous Sign-up. It has been "enhanced" by increasing the rental rates, and offering incentive payments to place the enrolled area under a 10-15 year contract. The average cost share payment in this program is 75%; however, additional incentives are available to raise this rate if a landowner is willing to install addtional control measures. 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. Federal cost-sharing (50%) 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 Thomas Jefferson SWCD also provides a cost share payment. The State of Virginia will make an additional payment to landowners who elect 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 up to 10-year contracts to landowners and farmers to provide financial assistance, 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 agricultural production.

EPA Section 319 Grant Project Funds

Through Section 319 of the Federal Clean Water Act, Virginia is awarded grant funds to implement NPS programs. The VADEQ administers the money annually on a competitive grant basis to fund TMDL implementation projects, outreach and educational activities, water quality monitoring, and technical assistance for staff of local sponsor(s) coordinating implementation. In order to meet eligibility criteria established for 319 funding, all proposed project activities must be included in the TMDL implementation plan covering the project area. In addition, this plan must include the nine key elements of a watershed based plan identified by EPA (see Guidance Manual for TMDL Implementation Plans, VA Departments of Conservation and Recreation and Environmental Quality, July 2003).

Regional Conservation Partnership Program (RCPP)

RCPP was authorized through the 2014 Farm Bill. This 5-year program promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. The RCPP competitively awards funds to conservation projects designed by local partners specifically for their region. Partners such as SWCD's and non profit organizations can then work with interested landowners to utilize these funds for BMP implementation. The Chesapeake Bay watershed is one of eight "Critical Conservation Areas" identified in this program. These areas receive 35% of program funding.

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: prescribed burning, converting fescue to warm season grasses, creating habitat for waterfowl, and installing field borders.

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 (SER-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 (NFWF)

NFWF administers the Chesapeake Bay Stewardship Fund, which is dedicated to the protection and restoration of the Chesapeake Bay. The Stewardship Fun is supported through partnerships with government agencies and private corporations, and typically awards $8 million to $12 million per year through two competative grant programs (Innovative Nutrient and Sediment Reduction Grants and Small Watershed Grants) and a technical assistance program. A request for proposals is typically issued in the spring and awards are made in the fall.

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.

Clean Water State Revolving Fund

EPA awards grants to states to support their Clean Water State Revolving Funds (CWSRFs). The states then make loans for priority water quality activities. As recipients make payments, 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.

Chesapeake Bay Funders Network

The Funders Network is a collaborative of funding organizations that provides opportunities for funders to pool resources and work together on shared interests in the Chesapeake Bay watershed. The funders make collaborative decisions on funding initivatives and specials projects (unsolicited proposals are not excepted. Implementation of a "Flexible Fencing Program" in the watersheds using private funding was identified as a way to increase interest in livestock stream exclusion. The program that has been implemented in the Shenandoah Valley with support from the Chesapeake Bay Funders Network was identified as a good model. Typically a 5-year contract is required, and farmers are offered more flexibility with the materials that they use and where the fence is placed. Should funding become available, some of the fencing goals established in this plan would be met using this program.

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 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. 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 state and federal agencies and chaired by VADEQ and the Army Corps of Engineers.

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