DRAFT

Water Quality Implementation Plan for Mill Creek, Montgomery County (Fecal Coliform TMDL)

Submitted to
The Stakeholders of
The Mill Creek Watershed

Prepared by:

Virginia Department of Conservation and Recreation and MapTech, Inc.
in cooperation with the Virginia Department of Environmental Quality

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Also Available for this project:
A Total Maximum Daily Load Implementation Plan for Mill Creek and Dodd Creek, Technical Report*

MapTech, Inc. developed the Technical Report in cooperation with VADCR

1. Introduction

The Virginia Department of Environmental Quality (VADEQ) monitors waterways throughout the state to determine if they meet water quality standards and support their designated uses. If monitoring indicates that the water body surpasses the water quality standard more than 10.5% of the time during an assessment period, the water body is placed on Virginia's List of Impaired waters (Section 303(d) List). The United States EPA through the Clean Water Act, requires that states develop a Total Maximum Daily Load (TMDL) study for any water body that is found to be impaired, or exceeding a water quality standard. The TMDL study identifies the sources of pollution and the reductions needed in each source to bring the water body into compliance with water quality standards. Virginia's 1997 Water Quality, Monitoring, Information and Restoration Act (WQMIRA) requires the development of an implementation plan (IP) following the completion of a TMDL to "achieve fully supporting status for impaired waters". A TMDL Implementation Plan provides a detailed outline of suitable best management practices (BMPs) and a strategy that may be implemented in the watershed in order to meet water quality standards. These BMP strategies are developed with input from local communities.

As a result of VADEQ monitoring, a section of Mill Creek in Montgomery County was originally listed on Virginia's Impaired Waters List in 1998 for violations of the fecal coliform bacteria water quality standard. Subsequent assessments increased the length of the impaired section to include the entire length of Mill Creek, two unnamed tributaries and Poplar Branch (Figure 1). The 2006 VADEQ water quality assessment report identifies 15.27 miles of streams in the watershed as impaired because of violations of bacteria water quality standards.

The impairment indicates that the stream is not suitable for full contact recreation, including swimming. Fecal coliform and *E. coli* bacteria are found in the digestive systems of warm-blooded animals and are used as indicators of the presence of microorganisms that cause illness in humans including Cryptosporidium, Giardia, Shigella and *E. coli O157:H7*. When introduced into water bodies, pathogens can infect humans through consumption of contaminated fish or shellfish, ingestion of water, or contact with the skin. The detrimental effects of bacteria in food and water supplies have been documented in areas throughout the United States and Canada. In May 2000 there were seven confirmed deaths with four other deaths under investigation, and over 2,000 poisonings all attributed to drinking water polluted by *E. coli* Type 0157:H7 in the town of Walkerton, Ontario (Raine, 2000; Miller, 2000). The contamination resulted in a $250 million class action lawsuit filed against the Ontario government. The source of the pollution according to the Cattleman's Association was probably runoff from a feedlot located more than 5 miles from the wells used for the town's water supply.

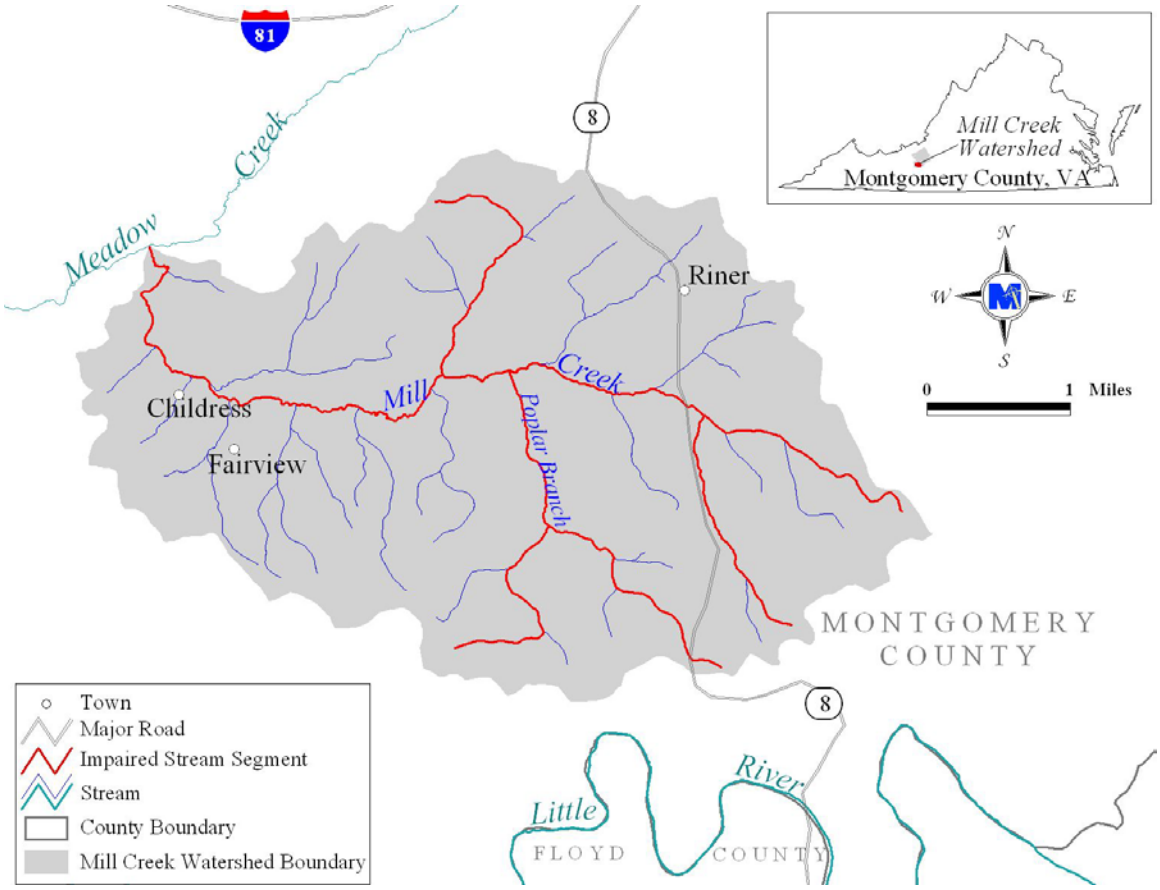

Figure 1: Location of the Mill Creek Watershed

Fecal contamination of surface and drinking waters has also impacted communities in Virginia. The Virginia Department of Health (VDH) was notified of campers and counselors at a Shenandoah Valley summer camp developing serious gastrointestinal illness in August 1994. *E. coli* 0157:H7 was confirmed as the causative agent. In Franklin County Virginia, a 1997 outbreak of illnesses involving 3 children was attributed to E. *coli* (0157:H7) in Smith Mountain Lake. The children were exposed to the bacteria while swimming in the lake and a two year old almost died as a result of the exposure (Roanoke Times, 1997). In August of 1998, 7 children and 2 adults at a daycare center in rural Floyd County were infected with *E. coli* (0157:H7). Upon investigation, two of the properties' wells tested positive for total coliform (Roanoke Times, 1998). On June 6, 2000 Virginia's second largest water source, Crystal Spring in Roanoke, was shut down by Virginia Department of Health for *E. coli* contamination (Roanoke Times, 2000).

These are not isolated cases. Throughout the U.S., the Center for Disease Control estimates at least 73,000 cases of illnesses and 61 deaths per year caused by *E. coli* 0157:H7 alone (CDC, 1995 and 2001). All known pathogens are estimated to account for 14 million illnesses, 60,000 hospitalizations, and 1,800 deaths in the United States each year (Mead, 2006). During 2001 and 2002, the Centers for Disease Control and Prevention received reports of 30 outbreaks (defined as >2 people experiencing illness) of gastroenteritis related to recreational waters, many tied directly to fecal contamination (CDC, 2004). These 30 outbreaks account for more than 1,900 confirmed cases of

illness. Whether the source of contamination is human or livestock, the threat of these pathogens appears more prevalent as both populations increase. As stakeholders, the community must assess the risk we are willing to accept and then implement measures to safeguard the public from these risks.

A TMDL completed for Mill Creek in 2002 identified agricultural livestock direct deposition and runoff, failing septic systems and straight pipes (direct discharge of household sanitary waste and/or gray water into streams), pets and wildlife as significant sources of bacteria in the watershed. The resulting bacteria loads from each source needed to meet water quality standards are identified as the TMDL allocation.

This implementation plan lays out a framework to meet the TMDL allocation and reduce bacteria levels to attain water quality standards (<10.5% violations). Through the completion of the implementation plan and the subsequent establishment of an active implementation project, watershed stakeholders will be on the way to restoring the impaired waters and enhancing the value of this important resource. Additionally, development of an approved plan improves chances for obtaining funding for implementation activities.

Key components of the implementation plan are discussed in the following sections:

- Review of the TMDL Development Study
- Public Participation
- Implementation Actions
- Measurable Goals and Milestones
- Stakeholder Responsibilities

This document is an abridged version of the full *Total Maximum Daily Load Implementation Plan for Mill Creek and Dodd Creek, Technical Report*. Both versions are available by contacting the Virginia Department of Conservation and Recreation (VADCR). The plan was developed concurrently with an implementation plan for the Dodd Creek watershed in Floyd County.

2. Review of TMDL Study

The Mill Creek watershed is located in the New River Basin in Montgomery County, Virginia. Mill Creek is a tributary of Meadow Creek, which flows into the Little River. The land area of the Mill Creek watershed is approximately 9,308 acres (14.5 mi^2) and is comprised of pasture (61%), forest (22%), cropland (10%), and urban/residential (6%) land uses (Figure 2). The majority of developed areas are in and around the town of Riner with pockets of development close to Childress and Fairview in the eastern portion of the watershed.

The Louis Berger Group, Inc developed the Mill Creek TMDL study in 2002. The study used a water quality model (HSPF), land use data, bacteria source information, hydrology data, water quality monitoring data and local citizen and agency input to determine the sources of fecal coliform in the watersheds and the reductions necessary to bring the streams into compliance with water quality standards. The study showed that agricultural sources of bacteria dominate with smaller contributions from failing septic systems,

straight pipes, wildlife, and pets. The TMDLs were developed to result in 0% violations of the fecal coliform water quality standard. The TMDL outlines the following reductions in sources of bacteria necessary to meet this goal:

- Exclusion of all livestock from streams
- All straight pipes and failing septic systems need to be corrected
- A 20% reduction of land-based (runoff) bacteria loads from pasture, cropland and residential land (pets) is required
- Direct deposition of wildlife waste into streams needs to be reduced
- Implicit in the TMDLs is the requirement to keep all other bacteria sources at or below current levels

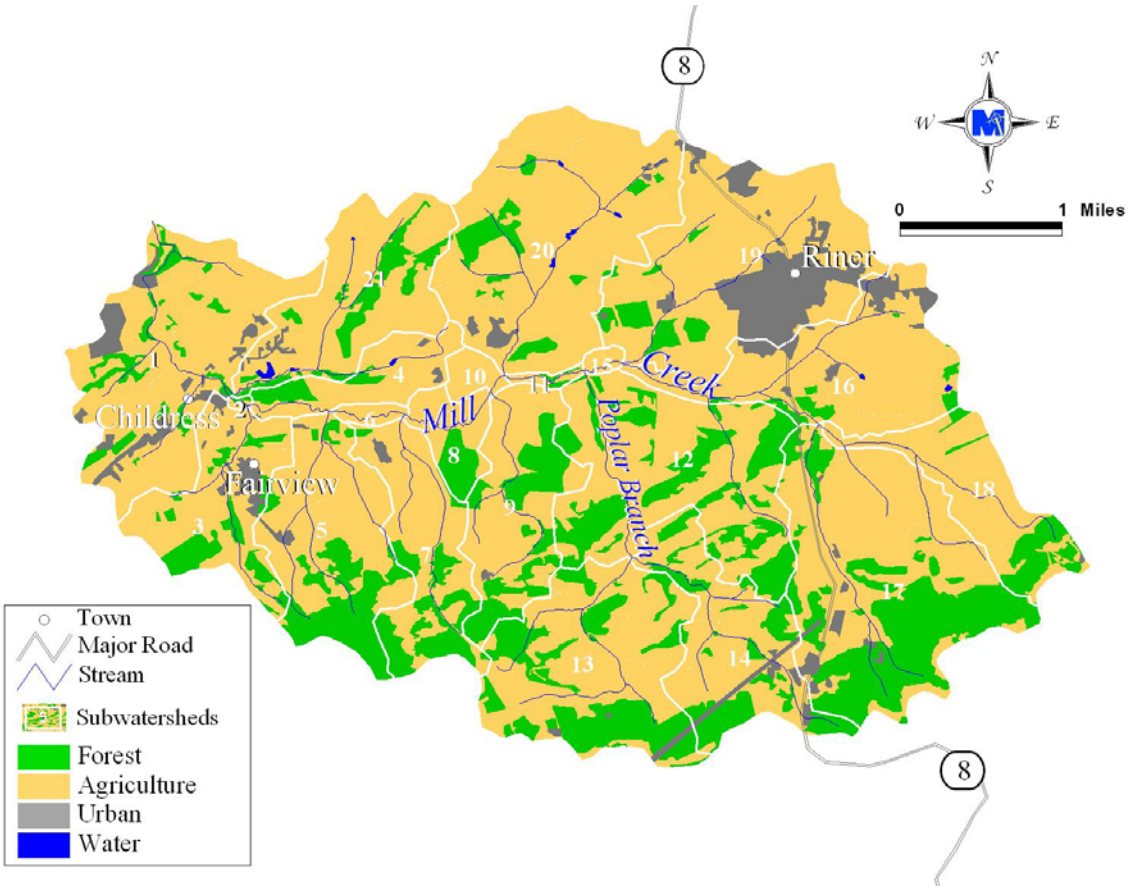

Figure 2: Distribution of land use categories in the Mill Creek watershed.

Although a reduction in wildlife direct deposition is required in the watershed to obtain 0% violations of the water quality standard, the studies showed that these streams can be removed from the impaired waters list by addressing human-induced and livestock sources only. Currently, EPA guidance allows VADEQ to remove a stream segment from the impaired waters list when the violation rate is 10.5% or less in an assessment period. Reductions of livestock, human and pet sources will result in violations below the 10.5% violation rate.

If water quality goals are not achieved after addressing human-induced and agricultural sources, a process could be initiated (*i.e.,* use attainability analysis) to change the designated use of the streams. The current designated use of the streams is full contact

recreation, which includes swimming. Virginia allows the adoption of a secondary contact designated use in the case that the human-induced and livestock sources are addressed to the maximum extent practicable and water quality goals are still not being met. The secondary contact designation indicates that the water body is appropriate for activities that have a low probability of ingestion of water or full body immersion.

3. Public Participation

The actions and commitments described in this document are drawn together from input from citizens of the watersheds, Montgomery County Government, VADCR, VADEQ, Virginia Department of Health (VDH), Virginia Cooperative Extension (VCE), Natural Resources Conservation Service (NRCS), Skyline Soil and Water Conservation District (SWCD), New River Highlands Resource Conservation and Development Area and MapTech, Inc. Every citizen and interested party in the watershed is encouraged to become involved in implementation of this plan and contribute to help restore the health of these streams.

Public participation in the plan development took place on three levels. First, two public meetings were held to inform the public about the end goals of the project and solicit participation in targeted working group meetings. Second, three working groups were formed from communities of people with common interests and concerns regarding the implementation process. The agricultural, residential and government working groups provided an arena for direct citizen and local agency input in the development of the IP. The working groups met between December 2005 and July 2006. Over 100 man-hours were devoted to participating in the working groups by individuals representing agricultural, residential and government interests. The third opportunity for public input was through the steering committee formed with representation from each working group, watershed citizens, agency representatives and local government representatives. The steering committee (held jointly with Dodd Creek) met on September 13th, 2006 with 15 members present. The purpose of the steering committee is to assimilate the recommendations of the working groups into the IP and guide the overall development of the final IP document. The final public meeting to present the draft implementation plan to the public took place on November 6, 2006 and was attended by 36 citizens and agency representatives.

Each working group discussed the type, location and cost of BMPs needed to meet the water quality goals set forth in the TMDL and how to promote those practices. The following sections summarize the findings and recommendations of each working group. The full reports from each working group are available in the technical report available from VADCR.

Agricultural Working Group

The agricultural working group consisted predominately of beef producers and agency personnel (19 members). The primary task of the Agricultural Working Group is to address bacteria sources attributed to agricultural operations, identify any obstacles to implementation of agricultural BMPs and recommend practical solutions to those obstacles. The group discussed the specifications of livestock exclusion, pasture management and animal waste BMPs that are typically promoted in implementation

areas. Key topics and recommendations discussed at the two working group meetings include:

- Currently cost-share is available for alternative livestock watering systems only when part of a grazing land protection (SL-6) or loafing lot management system (WP-4B). The group recommends offering some amount of cost-share beyond the existing tax credit for an alternative watering source alone. The rationale behind this suggestion is that it will reduce the livestock access to the stream if properly placed.
- Grazing land protection (SL-6) and stream protection (WP-2T) BMPs will be implemented to reduce direct livestock deposition. The group recommends pursuing cost-share assistance for shade structures associated with these livestock exclusion systems. The group also recommends that installation of BMPs would increase if a reduced rate of cost-share were eligible (i.e., 25-50%) for exclusion systems installed with less than the required 35-ft buffer.
- The group discussed possible outreach and educational tools to promote agricultural BMPs as a viable option for farmers. Individual farm contacts and providing individual solutions will be key to successfully promoting BMPs. The group recommends an added incentive (i.e., increased cost-share) for farmers who are willing to install agricultural BMPs during the first 1-2 years of the implementation project as a way to get the implementation project started quickly. Grazing land/forage workshops are also suggested as potentially effective outreach methods.
- The group recommends that the implementation project take the increasing development in the watershed into account as implementation progresses.

Residential Working Group

The primary tasks of the residential working group are to find ways to identify and eliminate straight pipes and failing septic systems, address difficulties faced by landowners in correcting these problems, and recommend educational and outreach tools that will help promote the implementation of residential BMPs. The group consists of 12 citizens and agency representatives. Key topics and recommendations discussed at the two working group meetings include:

- Residential implementation estimated in the Mill Creek watershed will be based on replacing failing septic systems and straight pipes in the watershed because a land load (runoff) reduction is required to meet the bacteria reductions in the TMDL.
- The group recommends septic tank pump-outs, connection of a malfunctioning septic system to public sewer, septic system repairs, installation of a conventional septic system, the installation of an alternative waste treatment system and a pet waste education program as effective control measures to address residential sources of bacteria.
- The group suggests that pursuing a septic tank pump-out ordinance is an option in Montgomery County.
- The group recommends providing cost-share for the installation of an observation port and sludge filter in association with septic system pump-outs and repairs as a way to promote septic systems awareness and maintenance.

- The group recommends these specific education and outreach tools: working with local community organizations such as Rotary and Garden Clubs to promote residential BMPs, offering a well testing program to homeowners, yard signs provided to participants who complete pump-outs, and a pet waste education program.

Government Working Group

The primary tasks of the government working group are to identify resources presently available to support implementation, identify regulatory controls that relate to the plan's water quality goals, and recommend the most efficient delivery of implementation. The group consists of 15 representatives from local, state and federal agencies. Key topics and recommendations resulting from the working group include:

- The Skyline Soil & Water Conservation District is interested in administering the implementation project following the completion of the implementation plan. DCR has funds set aside from an EPA grant to provide staffing through the District to provide technical assistance to farmers and homeowners for the implementation of both agricultural and residential BMPs. The Virginia Department of Health will provide support services for the residential program including referring customers to the district and permit writing. The Natural Resources Conservation Service provides BMP design support along with providing financial and technical services to farmers through existing federal conservation programs. The group discussed the role Virginia Cooperative Extension can play in educational and outreach activities including participating in activities to address pet waste in the watershed.
- Regulatory controls identified as relating to implementation include Virginia Sewage Handling and Disposal Regulations and the Virginia Agricultural Stewardship Act. DCR stressed the fact that the intent of the implementation project is not make agricultural stewardship act complaints.
- Implementation progress will be evaluated through water quality monitoring conducted by DEQ. DEQ will monitor 4 stations in the Mill Creek watershed for through the life of the implementation project. Each station will be sampled bi-monthly (beginning in January 2007) for a suite of parameters including *E. coli*.
- The working group recommends that the implementation plan and the implementation project recognize the increasing development in the Mill Creek watershed by incorporating the goals in the Montgomery County and Village of Riner comprehensive plans that relate to water quality.

4. Implementation Actions

The bacteria sources in the Mill Creek watershed that need to be addressed in this implementation plan include livestock access to streams, failing septic systems and straight pipes, agricultural and residential runoff, and pet waste. The quantity and type of BMPs required to address these sources were determined through spatial analyses of land use, stream-network data, U.S. Census data, the USDA Common Land Unit Layer (CLU), data archived in the VADCR Agricultural BMP Database and data from the TMDL development document. The map layers and archived data were combined to establish estimates of bacteria sources and the corrective actions required to address these sources (Table 1). Additionally, input from local agency representatives and the working

groups were used to modify the analyses. Further descriptions of each BMP identified in this section are included in Appendix A.

Agricultural Implementation Needs

Agricultural implementation focuses on excluding livestock from perennial streams because the TMDLs identified low flow (dry) conditions as critical periods of fecal coliform violations. This indicates that direct sources of bacteria (i.e., livestock depositing waste in streams) as opposed to runoff sources dominate water quality violations. In addition, some reductions are required in the amount of bacteria that reaches streams through rainwater runoff from pasture. Estimates of livestock exclusion fencing needs are based on a 100% reduction of livestock direct deposition in the Mill Creek watershed as identified in the TMDL. The method used to estimate necessary reductions assumes that exclusion fencing is needed on pastureland, loafing areas and adjacent forestland that border a perennial or intermittent stream. In the case that a stream is bordered on both sides by pasture, it is assumed that fencing is needed on both sides along with a hardened crossing for livestock to move between pastures.

There are approximately 25 miles of perennial streams and 14 miles of intermittent streams in the Mill Creek watershed. After accounting for the 6,300 feet of known existing streamside fencing, the total length of livestock exclusion fencing required is approximately 10.2 miles (Figure 3). Based on data archived in the DCR Agricultural Database and the TMDL Implementation Tracking Program, associated with the streamside fencing will be 34 grazing land protection systems (SL-6), 3 stream protection systems (WP-2T) and 1 loafing lot management system (WP-4B). The estimate of 1 loafing lot management system is based on discussions with Skyline SWCD and the agricultural working group. Currently there are 3 dairies operating in the watershed and the Skyline SWCD estimates that only 1 of the dairies may need a loafing lot management system. In addition, it was estimated that 7.5% of installed fencing would need to be replaced during the implementation project as a result of flooding and other damage. Funding for fencing replacement would be through a WP-2T practice, with an average cost of $3.50 per foot of fencing replaced.

The grazing land protection system (SL-6) includes streamside fencing with a 35-foot stream buffer, cross-fencing for pasture management, hardened crossings and a livestock watering system. Through a state program, cost-share is provided for 75% of the system cost. An additional state tax credit of 25% of the operator's contribution is available. The stream protection practice (WP-2T) provides cost-share for stream exclusion fencing and hardened access areas along with a $0.50 per linear foot of fencing maintenance

payment to account for damaged and destroyed fencing. The loafing lot management system (WP-4B) provides cost-share and state tax credit for development of loafing paddocks, hardened walkways and stream exclusion fencing in areas of heavy livestock use.

Bacteria in runoff from agricultural areas will be addressed through stream buffers associated with stream exclusion fencing, an animal waste storage lagoon (WP-4) and improved pasture management. The stream buffers required through the livestock exclusion practices will serve to filter bacteria and nutrients from pasture along with controlling streambank erosion. The agricultural working group estimated that 1 animal waste storage lagoon (WP-4) is needed in the watershed. The improved pasture management BMP is considered an enhancement of a grazing land management system. Currently, improved pasture management is not a BMP available through the Virginia Agricultural BMP Cost-Share program. Along with the infrastructure provided by a grazing land management system, improve pasture management includes:

- Maintenance of an adequate forage height (suggested 3-inch minimum grass height) during growing season.
- Application of lime and fertilizer according to soil test results.
- Mowing of pastures to control woody vegetation.
- Distribution of manure through managed rotational grazing.

Other agricultural BMPs that will be available during implementation through Virginia Agricultural BMP Cost-Share include woodland buffer filter area (FR-3), stream crossing and hardened access (WP-2B), and stream bank stabilization in conjunction with WP-2T (WP-2A).

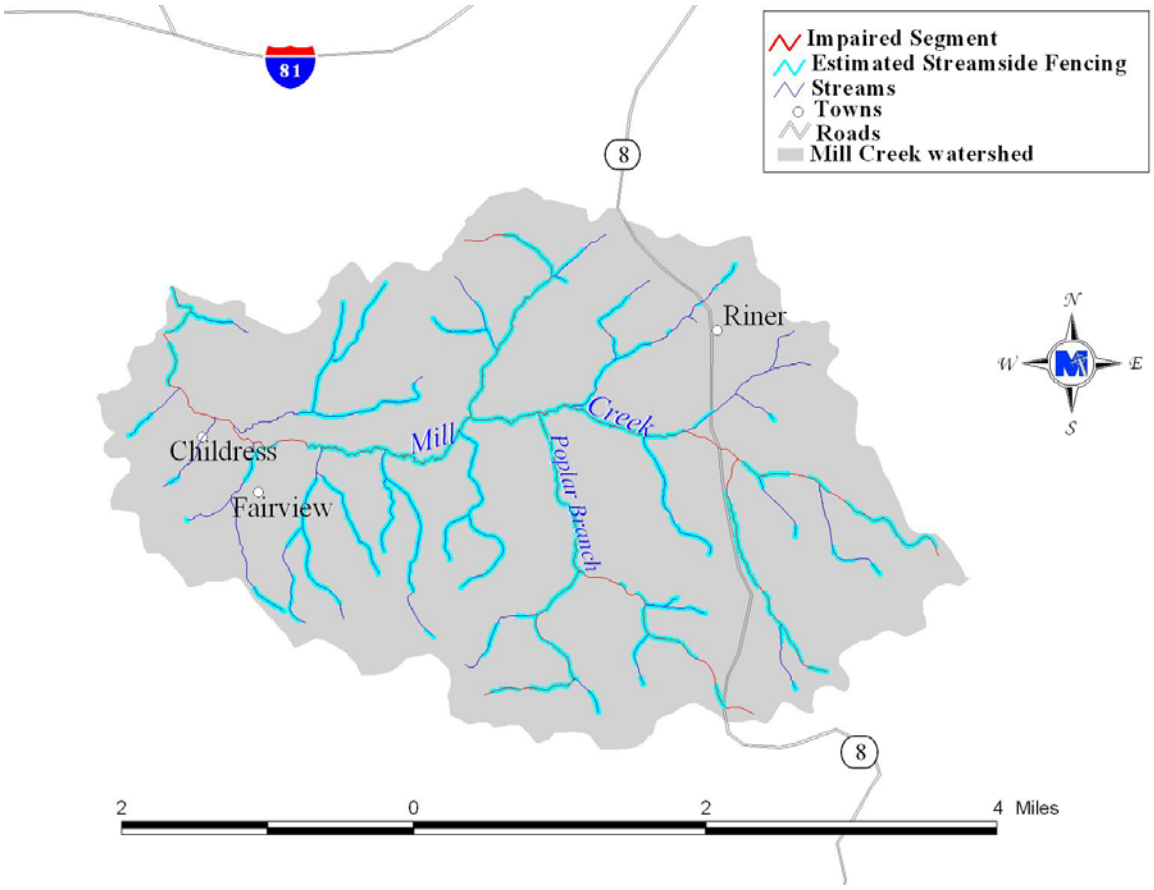

Figure 3: Areas of potential livestock exclusion fencing needs.

Residential Implementation Needs

Residential implementation will focus on identifying and correcting straight pipes and failing septic systems because a 100% load reduction from these sources was deemed necessary to meet the TMDL goal. The number and location of failing septic systems were updated from those reported in the TMDL documents and are based on analysis of U.S. Census data, stream network data and information from VDH. The total number of septic systems and straight pipes was estimated from 1990 and 2000 census data and projected to 2006 using population growth rates for Montgomery County. The number of failing systems is based on a failure rate associated with the age of the homes. For example, the estimates assume a 40% failure rate for systems installed prior to 1964. The number of straight pipes is estimated based on the age of homes and proximity to a stream. It is estimated that 96 failing

septic systems and 15 straight pipes will need to be addressed during implementation. The residential working group recommends correcting all systems identified, with priority given to those within 300 feet of a stream.

VADCR and the Residential Working Group decided to budget residential implementation based on replacing all straight pipes with either a conventional septic system or an alternative waste treatment system. Failing septic systems will be corrected by repairing the systems if feasible, installing a conventional septic system or installing an alternative waste treatment system. Alternative waste treatment systems are used where soils or groundwater conditions are not suitable for a conventional system. Based on data from implementation projects in Franklin County and consultation with the VDH, it is assumed that 10% of failing septic systems would need new alternative treatment systems installed. Of the remaining failing septic systems, 75% would be corrected with conventional septic systems and 25% would be septic system repairs. It is also assumed that 90% of straight pipe corrections will be conventional septic systems and 10% will be alternative waste treatment systems. It is estimated that 21 septic system repairs, 78 conventional septic systems and 12 alternative waste treatment systems are needed to meet the water quality goal. Based on typical costs in the region, a septic system repair or installation of a conventional septic system is estimated at $4,500 and an alternative waste treatment system is estimated at $22,000. In addition to the repair and installation of treatment systems, the implementation program will offer connection of public sewer when economically competitive with other options. There is a limited area in the Riner area where connection to public sewer is feasible. Based on input from the residential working group, few sites are anticipated to be suitable for this practice. A septic tank pump-out program addressing 100 systems within 300 feet of streams is also planned to identify problems and educate citizens on septic system maintenance.

The TMDL study identified pet waste entering streams through runoff from residential areas as a source of bacteria. A pet waste education program is planned to reduce pet waste as a bacteria source. The education program includes a combination of educational materials distributed to pet owners, signage describing water quality concerns related to pet waste and disposal bags and receptacles in areas of high pet traffic. Residential neighborhoods in the Riner area are recommended locations to focus this effort. Implicit in the TMDL is the need to avoid increased delivery of pollutants from sources that have not been identified as needing a reduction, and from sources that may develop as implementation proceeds. In addition to addressing waste treatment systems and pet waste,

encouraging establishment and maintenance of stream buffers, low-impact development principles and adequate setbacks of treatment systems in new development anticipated in the Riner area could minimize new sources of bacteria.

Assessment of Technical Assistance Needs

The amount of staff (full time equivalents, FTE) necessary for agricultural technical assistance and outreach during implementation was determined through analysis of historical cost-share data from the Skyline SWCD and discussions with the Agricultural Working Group. Based on the amount of BMPs required, it is estimated that a total of 2.5 FTE (0.5 FTE/year over 5 years) will be needed to deliver the agricultural implementation program in the Mill Creek watershed. VADCR anticipates that staff hired to implement agricultural BMPs in Mill Creek will also work to implement agricultural BMPs in the Dodd Creek watershed in Floyd County. Based on the workload, one full time staff person is needed to deliver agricultural implementation in both the Mill and Dodd Creek watersheds for a five-year period. Based on data from other implementation projects and input from local agency staff, it is estimated that in addition to the agricultural staff, one full time staff member will be needed for implementation of the residential implementation program in Mill Creek over a five-year period. The total technical assistance estimated for full implementation in the Mill Creek watershed is equivalent to 7.5 FTE, or 1.5 full time staff members over a five-year period.

Table 1: Estimation of necessary control measures, unit costs and total costs for agricultural and residential implementation programs.

Control Measure	Unit	Estimated Units Needed	Average Unit Cost ($)	Total Cost ($)
Agricultural Program:				
Grazing Land Protection (SL-6)	system	34	$12,500	$425,000
Stream Protection (WP-2T)	system	3	$5,100	$15,300
Loafing Lot Management System (WP-4B)	system	1	$50,000	$50,000
Exclusion fence replacement	feet	4,234	$3.50	$14,819
Waste Storage Facility (WP-4)	system	1	$50,000	$50,000
Improved Pasture Management	acres	1,439	$85	$122,315
Residential Program:				
Septic System Repair (RB-3)	system	21	$4,500	$94,500
Conventional Septic System installation/replacement (RB-4)	system	78	$4,500	$351,000
Alternative Waste Treatment System (RB-5)	system	12	$22,000	$264,000
Septic System pump-out (RB-1)	system	100	$250	$25,000
Pet Waste Education Program	Program	1	$3,750	$3,750
Technical Assistance	man-year	7.5	$50,000	$375,000

Cost Analysis

Data archived in the DCR Agricultural Database and the DCR TMDL Implementation Tracking Program were used to estimate average costs for agricultural and residential BMPs. These costs were also reviewed and revised by the agricultural and residential

working groups (Table 1). The total cost of livestock exclusion practices, fencing maintenance and agricultural practices that will reduce runoff sources of bacteria is $677,434 (Table 2). The majority of this cost, $455,119, is associated with livestock exclusion. It should be noted that the improved pasture management BMP is currently not available through existing cost-share programs. Cost estimates for improved pasture management have varied in areas around the state but $85 per acre is generally accepted as a valid estimate. This would result in a total cost of $122,315 for pasture management. The total cost for residential BMPs to address failing septic systems, straight pipes and pet waste is estimated at $738,250. It was determined in previous TMDL implementation planning efforts and through consultation with Skyline SWCD that the total cost to support the salary, benefits, travel and training of one FTE is estimated at $50,000 bringing the total technical assistance cost for the five-year implementation project to $375,000 (7.5 FTE). The total estimated cost of reaching the water quality goals outlined in the TMDL study is estimated at $1,790,684.

Table 2: Total implementation costs for the Mill Creek watershed

	Agricultural BMPs ($)	Residential BMPs ($)	Technical Assistance ($)	Total ($)
Mill Creek	$677,434	$738,250	$375,000	$1,790,684

Potential funding sources available for implementation were identified during plan development. It is anticipated that funding for agricultural BMPs will be provided through a combination of EPA 319 funds, Virginia Agricultural BMP Program and federal sources including the NRCS CREP program. Residential practices will most likely be funded through EPA 319 funds and grant funds that may be applied for during implementation. Detailed descriptions of each source are included in the technical document and can also be obtained from the Skyline SWCD, VADCR, NRCS, VACES, and VADEQ. Sources include:

- EPA 319 Grant Incremental Funds
- Virginia Agricultural Best Management Practices Cost-Share Program
- Virginia Agricultural Best Management Practices Tax Credit Program
- Virginia Water Quality Improvement Fund
- Conservation Reserve Program (CRP)
- Conservation Reserve Enhancement Program (CREP)
- Environmental Quality Incentives Program (EQIP)
- Wildlife Habitat Incentive Program (WHIP)
- Wetland Reserve Program (WRP)
- Southeast Rural Community Assistance Project (Southeast RCAP)
- National Fish and Wildlife Foundation (NFWF) grants

Benefit Analysis

Clean Water: The primary benefit of implementation is cleaner waters in Virginia. Specifically, fecal contamination in Mill Creek will be reduced to maintain high quality water for downstream uses. It is hard to gage the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions

required, the incidence of infection from fecal sources through contact with surface waters should be reduced considerably. Additionally, because of stream-bank protection that will be provided through exclusion of livestock from streams, restoration of the riparian areas, and the suite of BMPs discussed in this document, the aquatic habitat will be improved in these waters. The vegetated buffers that are established will also serve to reduce sediment and nutrient transport to the stream from upslope locations. In areas where pasture management is improved through implementation of grazing land protection and improved pasture management BMPs, soil and nutrient losses should be reduced. Additionally infiltration of precipitation should be increased, decreasing peak flows downstream.

Economics: An important objective of the implementation plan is to foster continued economic vitality and strength. 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 landowner, as well as, the expected environmental benefits onsite and downstream. Specifically, alternative (clean) water sources, exclusion of cattle from streams, improved pasture management, and private sewage system maintenance or upgrades will each provide economic benefits to individuals.

Taking the opportunity to implement an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase livestock stocking rates by 30 - 40%, and consequently, improve the profitability of the operation. With feed costs typically responsible for 70-80% of the cost of growing or maintaining an animal, and pastures providing feed at a cost of .01-.02 cents/lb of total digestible nutrients (TDN) compared to .04-.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VACES, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition to reducing costs to producers, intensive pasture management can boost profits, by allowing higher stocking rates and increasing the amount of gain per acre. A side benefit is that cattle are more closely confined allowing for quicker checking and handling.

In terms of economic benefits to homeowners, an improved understanding of private sewage systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20-25 years or longer if properly maintained. Proper maintenance includes; knowing the location of the system components and protecting them by not driving or parking on top of them, and not planting trees where roots could damage the system, keeping hazardous chemicals (including water softening chemicals) out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance is relatively inexpensive in comparison to repairing or replacing an entire system. Additionally, improvements to private waste treatment systems can enhance property values.

Livestock Health Improvements: A clean water source has been shown to improve weight gain and milk production in cattle. Healthy cattle consume close to 10% of their body weight during winter and 15% of their body weight in summer in water on a daily basis. Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and haircoat contamination with manure (VACES, 2000). In addition, horses drinking from marshy areas or areas where wildlife or cattle carrying Leptospirosis have access tend to have an increased incidence of moonblindness associated with Leptospirosis infections (VACES, 1998). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills. In addition to reducing the likelihood of animals contracting waterborne illnesses by providing a clean water supply, streamside fencing and well managed loafing areas exclude livestock from wet, swampy environments often found next to streams where cattle have regular access. Keeping cattle in clean dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VACES (1998) reports that mastitis currently costs producers $100 per cow in reduced quantity and quality of milk produced. On a larger scale, mastitis costs the U.S. dairy industry about $1.7-2 billion annually or 11% of total U.S. milk production. Mastitis-causing bacteria can be harbored and spread in environments where cattle have access to wet and dirty areas.

Reduced Exposure to Human Pathogens: The residential programs will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry with it.

5. Measurable Goals and Milestones

The end goals of implementation are improved water quality in Mill Creek and the subsequent de-listing of the stream from the Commonwealth of Virginia's Impaired Waters list within 10 years. In general, Virginia favors a staged implementation approach. Staged implementation is an iterative process that addresses sources that have a large impact on water quality first. Following this approach, implementation will focus on the most cost-effective BMPs first including the exclusion of livestock from streams and correcting straight pipes and failing septic systems. BMPs designed to address runoff sources of bacteria are addressed towards the end of implementation.

Implementation is scheduled to begin in December 2006 with installation of all BMPs expected after five years and de-listing of Mill Creek from the impaired waters list anticipated after ten years. Compliance with the fecal bacteria standard is anticipated within 5 years of installation of all BMPs, allowing for lag time in BMP effectiveness and stabilization of bacteria populations. The first five years of implementation are divided into two stages with anticipated levels of implementation of BMPs for each year (Table 3). Stage I focuses on livestock exclusions, correcting straight pipes and failing septic systems, and pet waste education while Stage II includes the remaining BMPs (including pasture management) needed to meet water quality standards. The agricultural and residential working groups reviewed the goals associated with each year of

Table 3: Timeline, implementation goals, and associated water quality benefits. The percentages listed are the cumulative percent of the total number required for each BMP.

		----------Stage I----------			-------Stage II-------		Stage III
Mill Creek Implementation Milestones	**Existing**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 10**
Cumulative Progress Toward BMP Installation							
Agricultural:							
Grazing Land Protection System (SL-6)	0%	10%	30%	50%	80%	100%	100%
Stream Protection System (WP-2T)	0%	10%	30%	50%	80%	100%	100%
Streamside Fence Maintenance	0%	0%	0%	0%	0%	0%	100%
Improved Pasture Management	0%	20%	40%	60%	80%	100%	100%
Loafing Lot Management System (WP-4B)	0%	0%	0%	0%	100%	100%	100%
Waste Storage Facilities (WP-4)	0%	0%	0%	0%	0%	100%	100%
Residential:							
Septic Systems Pump-out Program (RB-1)	0%	20%	40%	60%	80%	100%	100%
Septic System Repair (RB-3)	0%	20%	40%	60%	80%	100%	100%
Septic System Installation/Replacement (RB-4)	0%	25%	44%	65%	83%	100%	100%
Alternative Waste Treatment System Installation (RB-5)	0%	25%	44%	65%	83%	100%	100%
Residential Education Program	0%	100%	100%	100%	100%	100%	100%
Cumulative Progress Toward Bacteria Load Goal	0%	11.1%	31.1%	51.1%	80.2%	99.9%	100.0%
Cost (% of Total)	0%	18%	36%	55%	78%	99%	100%

implementation. Implementation progress should be assessed by the steering committee following Stage I to determine the best approach for Stage II.

The water quality model developed during the TMDL study was used to determine the anticipated response in water quality corresponding to each year of implementation (Table 3). Water quality response is measured by the expected rate of violation of the instantaneous fecal coliform water quality standard that the TMDL is based upon (1,000cfu/100ml). Water quality modeling showed that excluding all livestock from the stream and correcting all failing septic systems and straight pipes will result in a violation rate of the 1,000cfu/100ml fecal coliform standard approximately 14%, further emphasizing the need to focus early implementation on these practices. The staged approach will allow the steering committee, Skyline SWCD, VADCR and VADEQ to assess water quality improvement during implementation and make any necessary adjustments to the goals.

VADCR and the steering committee will meet to review implementation project after Stage I (3 years) and Stage II (5 years). Potential situations and actions related to these reviews are outlined in Table 4. If water quality improves to the level that Mill Creek can be removed from the impaired waters list prior to the five-year milestone, the steering committee will evaluate the cost-share requests and monitoring data to determine whether the project timeline should be revised. If assessment of water quality monitoring following completion of Stage II BMPs indicates the stream is still above the allowable rate of violations, the steering committee should decide on a course of action for further implementation. Options will include pursuing a use attainability analysis (UAA) in order to change the designated use of the stream from primary contact (swimming) to secondary contact. Secondary contact can be established in the cases that human, livestock and pet sources are addressed to the maximum extent practicable and water quality goals are still not being met. This would basically establish that the stream is suitable for wading and other activities not likely to result in full emersion but is not suitable, or used, for swimming.

Table 4: Potential situations and actions related to implementation reviews.

Project status at review	**Potential actions taken**
Implementation and water quality milestones met	Continue implementation as scheduled
Implementation milestones met, water quality milestones not met	Determine if the anticipated water quality response was in error and make any necessary changes to required BMPs. If the TMDL is determined unattainable following Stage II, the steering committee may elect to pursue a Use Attainability Analysis (UAA).
Implementation milestones not met, water quality milestones met	Revise the milestone schedule to reflect the progressed obtained
Implementation and water quality milestones not met	Determine the issues impacting implementation. Make any necessary changes to required BMPs, the implementation timeline or the outreach approach.

Water Quality Monitoring

Virginia's 1997 Water Quality Monitoring, Information and Restoration Act requires that TMDL implementation plans include measurable goals and milestones for attaining water quality standards. Implicit in those milestones is the requirement of a method to measure progress. Implementation progress will be evaluated through water quality monitoring conducted by VADEQ and any citizen monitoring support that may develop as implementation progresses. VADEQ will monitor 4 locations in the Mill Creek watershed (Figure 4, Table 5). The stations will be sampled bi-monthly beginning in January 2007 and extending throughout implementation. The following parameters will be collected at all stations: *E. coli* and fecal coliform bacteria, temperature, dissolved oxygen, specific conductance, turbidity, total nitrogen, total phosphorus, total solids, and total suspended solids. At the time of the development of the Mill Creek TMDL, fecal coliform was the indicator species for Virginia's bacteria water quality standard. In 2003, Virginia began the transition to an *E. coli* water quality standard. *E. coli* is a subset of fecal bacteria that has been shown to have a stronger correlation to gastrointestinal illness than fecal coliform. Assessment of implementation progress will rely on results of the *E. coli* sampling.

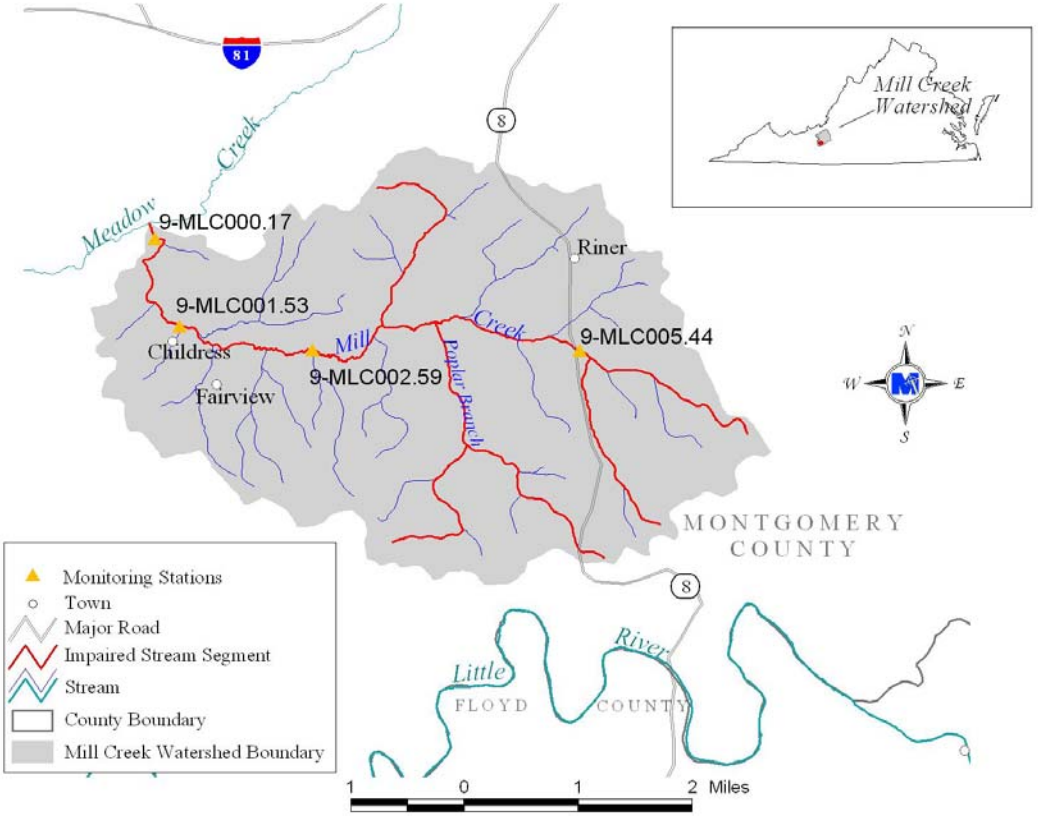

Figure 4: VADEQ water quality monitoring stations in the Mill Creek watershed

Table 7: VADEQ water quality monitoring stations in the Mill Creek watershed

Station ID	Station Location
9-MLC000.17	Route 600 Bridge
9-MLC001.53	Route 693 Bridge in Childress
9-MLC002.59	Route 669 below Riner STP
9-MLC005.44	Route 8 Bridge above Riner STP

6. Integration with Other Watershed Plans

Each watershed in the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographic boundaries and goals. These include but are not limited to TMDLs, Roundtables, Water Quality Management Plans, erosion and sediment control regulations, stormwater management, Source Water Protection Program, and local comprehensive plans. Coordination of the implementation project with these existing programs could result in additional resources and increased participation.

Two notable plans in Montgomery County are the *Montgomery County, 2025 Comprehensive Plan* and the *Riner Village Plan: A Statement of Preferred Future*. During development of the *Montgomery County, 2025 Comprehensive Plan*, a survey identified protecting water quality as a priority among the citizens of the County. Both plans recognize the importance of improving and protecting water quality through methods such as agricultural BMPs, promoting maintenance of on-site waste treatment

systems, ordinances, protecting open space, and minimizing impervious surfaces. Specifically, the *Riner Village Plan* recommends supporting the Mill Creek TMDL, this implementation plan and its implementation as a tool to protect water quality in Mill Creek.

7. Stakeholder's Roles and Responsibilities

Stakeholders are individuals or groups that live or have land management responsibilities in the watershed, including citizens, government agencies, businesses, and special interest groups. Achieving the goals of this effort (i.e., improving water quality and removing these waters from the impaired waters list) relies on stakeholder participation. The primary role falls on local landowners. However, local, state, and federal agencies have a stake in seeing that Virginia's waters are clean and provide a healthy environment for its citizens. The purpose of this section is to identify and define the roles of some of the major stakeholders who will need to work together to implement this plan and improve the water quality of Mill Creek.

Local Stakeholders

Skyline Soil & Water Conservation District (SWCD): The Skyline SWCD is a local government entity providing soil and water conservation assistance to farmers and residents of Montgomery, Floyd, Pulaski and Giles Counties. During the implementation project, the Skyline SWCD will provide outreach, technical and financial assistance to farmers and homeowners in the Mill Creek watershed through the Virginia Agricultural BMP Cost-Share and Tax Credit programs. Their responsibilities will include promoting implementation goals, available funding and the benefits of BMPs and providing assistance in the survey, design, layout, and approval of agricultural and residential BMPs. Education and outreach activities are a significant portion of their responsibilities. Specific education and outreach methods recommended by the working groups are described in Section 3 of this report. The Skyline SWCD will be eligible for technical assistance funding to support their duties.

Montgomery County: County staff has assisted in the development of this plan through participation in working group meetings and providing information on existing and planned watershed conditions. VADCR and the Skyline SWCD will continue to involve the County in the implementation project by coordinating on issues related water quality in the Mill Creek area.

Citizens and Businesses: The role of citizens and businesses is to get involved through installation of BMPs, participating in outreach activities or simply passing information about the goals and benefits of the implementation project on to their friends and neighbors.

Federal Government

United States Environmental Protection Agency (USEPA): The USEPA has the responsibility of overseeing the various programs necessary for the success of the Clean Water Act (CWA). However, administration and enforcement of such programs falls largely to the states.

Natural Resources Conservation Service (NRCS): NRCS administers several funding programs identified in this plan including the Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Enhancement Program (CREP). In the context of the implementation project, NRCS will work closely with the Skyline SWCD to provide technical assistance to producers interested in conservation programs.

State Government

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. State government has the authority to establish state laws that control delivery of pollutants to local waters. An example of this authority is a recent addition to the Virginia Code that allows localities to prohibit feeding of waterfowl that are found to exist in populations that threaten public health or the environment (§ 29.1-527.1). Another example is 2005 legislation (§ 10.1-104.1) that requires state lands, including universities that apply fertilizer to develop and implement a nutrient management plan. Currently, there are four state agencies responsible for regulating activities that impact water quality in Virginia. These agencies include: Virginia Department of Environmental Quality, Virginia Department of Conservation and Recreation, Virginia Department of Agriculture and Consumer Services, and Virginia Department of Health.

VADEQ: VADEQ has responsibility for monitoring the waters to determine compliance with state standards, and for requiring permitted, point source dischargers to maintain loads within permit limits. They have the regulatory authority to levy fines and take legal action against those in violation of permits. In addition, DEQ has regulatory responsibility over animal waste from confined animal facilities in excess of 300 animal units of cattle and hogs and 200 animal units of poultry through a Virginia general pollution abatement permit. These operations are required to implement a number of practices to prevent groundwater contamination (ELI, 1999). DEQ will maintain the monitoring stations described in this plan.

VADCR: VADCR holds the responsibility for addressing nonpoint sources of pollution including nutrient management, erosion and sediment control, stormwater, and agricultural BMPs. Most VADCR programs dealing with agricultural NPS pollution historically have been through education and voluntary incentive programs. In Virginia's TMDL program, VADCR has a lead role in developing and implementing plans to address nonpoint source impairments. In terms of the implementation of this plan, VADCR will coordinate agricultural and residential implementation through the Skyline SWCD. VADCR will also work with local, state and federal agencies to identify and direct additional resources to implementation as the project progresses.

Virginia Department of Health (VDH): VDH is responsible for maintaining safe drinking water measured by standards set by the USEPA. Their duties also include septic system regulation and regulation of biosolids land application according to the *Virginia Sewage Handling and Disposal Regulations*. In the scheme of these TMDLs, VDH has the responsibility of enforcing actions to correct or eliminate failed septic systems and straight pipes. In the implementation project, VDH will assist through consultation with property owners, permit writing for new systems, inspection of repairs and installations

of on-site sewage disposal systems and referring customers needing assistance to the Skyline SWCD.

Virginia Cooperative Extension (VCE): VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University). VCE offers educational programs and technical resources for topics including agricultural and residential conservation practices. VCE has published several publications that deal specifically with TMDLs. For more information on these publications and to find information on the local county extension offices, visit www.ext.vt.edu. VCE will assist the Skyline SWCD in the pet waste education effort and provide input on outreach materials developed through the implementation project.

Virginia Department of Agriculture and Consumer Services (VDACS): Through Virginia's Agricultural Stewardship Act, VDACS and the Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken which can include a civil penalty up to $5,000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. It is not the intention of this plan to actively use the Agricultural Stewardship Act to force producers into conservation measures.

Successful implementation depends on stakeholders taking responsibility for their role in the process. An important first step in correcting the existing water quality problem is recognizing that there is a problem. While it is unreasonable to expect that the natural environment (e.g. streams and rivers) can be made 100% free of risk to human health, it is possible and desirable to make what improvements we can. Virginia's approach to correcting many NPS pollution problems has been and continues to be encouragement of participation through education and financial incentives.

List of Acronyms

BMP	Best Management Practice
CLU	Common Land Unit
CREP	Conservation Reserve Enhancement Program
CWA	Clean Water Act
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
FTE	Full Time Equivalent
HSPF	Hydrological Simulation Program-Fortran
IP	Implementation Plan
NPS	Nonpoint Source Pollution
NRCS	Natural Resources Conservation Service
RB-1	Septic tank pump-out
RB-2	Septic connection to public sewer system
RB-3	Septic system repair
RB-4	Septic system installation/replacement
RB-5	Alternative waste treatment system
SL-6	Grazing Land Protection System
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
VADCR	Virginia Department of Conservation and Recreation
VADEQ	Virginia Department of Environmental Quality
VCE	Virginia Cooperative Extension
VDACS	Virginia Department of Agriculture and Consumer Services
VDH	Virginia Department of Health
WP-2T	Stream Protection System
WP-4	Animal Waste Control Facility
WP-4B	Loafing Lot Management System
WQMIRA	Water Quality Monitoring, Information and Restoration Act

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Appendix A: Best Management Practices Selected for the Mill Creek Water Quality Implementation Plan

Control Measure	Description	Target Locations
Streamside fencing	Installation of fencing adjacent to streams in order to exclude livestock along with vegetated buffers and other structures necessary to reduce pollutant delivery to streams. The state cost-share practices associated with streamside fencing on pasturelands are SL-6, WP-2T and WP-4B described in the *Virginia Agricultural BMP Manual*.	Pasture Areas, loafing lots and cropland that provide livestock access to streams. Four SL-6 systems currently exist in the Mill Creek watershed totaling approximately 6,200 feet of exclusion fencing.
Corrected straight pipe	A straight pipe is a discharge of household waste to a stream or drainage without a proper treatment method. The state cost-share program offers 2 practices, RB-4 and RB-5, which can be used to replace a straight pipe with a functioning treatment system. The RB-2 practice corrects a straight pipe through connection to public sewer.	Concentrations of older homes/ businesses in close proximity to streams. Based on analysis of census data, public sewer locations and VDH input, rural areas in the Mill Creek watershed have the highest potential for straight pipes.
Repair/replacement of failing septic system	A failing or malfunctioning septic systems has the potential to deliver waste to the surface, which can then be delivered to a stream by gravity or runoff. The state cost-share program offers 3 practices, RB-3, RB-4 and RB-5, which can be used to repair a septic system or replace it with a functioning alternative waste treatment system.	Concentrations of older homes/ businesses in close proximity to streams. Based on analysis of census data, public sewer locations and VDH input, rural areas in the Mill Creek watershed have the highest potential for failing septic systems. Estimates of failing septic systems by subwatershed that were determined during IP development will be provided to Skyline SWCD.
Pet Waste Education Program	A combination of educational materials distributed to pet owners along with signage describing water quality concerns related to pet waste, disposal bags and receptacles in areas of high pet traffic.	Educational materials such as brochures would be distributed to citizens in residential and urban areas throughout the watersheds. Pet waste signage, disposal bags and receptacles would be focused in other high traffic areas including residential neighborhoods near Riner.
Animal Waste Storage Facility	The storage and proper handling of livestock waste in adequate facilities in order to reduce the amount available for runoff and facilitate die-off of bacteria. Storage facilities include dry stacking, aerobic and anaerobic lagoons, liquid manure tanks, and settling basins. The state cost-share program offers an animal waste control facility practice (WP-4).	Based on information from the Skyline SWCD, there is currently one dairy in the watershed that may need a waste storage facility.
Vegetated Buffers	Establishing vegetated buffers along streams provides a filter of sediment, nutrients and bacteria, reduces streambank erosion, controls water temperature, provides aquatic habitat and establishes a measure of natural flood control. Several state and federal programs provide assistance for buffer establishment in agricultural areas including the NRCS CREP program and Virginia cost-share practice (FR-3).	Establishing vegetated buffers in agricultural, residential and urban areas of these watersheds would serve to reduce bacteria along with nutrients and sediment entering the stream.
Improved pasture management	The establishment of a rotational grazing system along with nutrient management of pastureland. This practice protects vegetation to reduce runoff. The state grazing land protection cost-share practice (SL-6) provides financial assistance for some of these functions.	There are currently four cost-share practices establishing grazing land protection systems in the Mill Creek watershed.

* Specifications for cost-share program eligibility can be obtained from VADCR and the Skyline Soil & Water Conservation District.

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