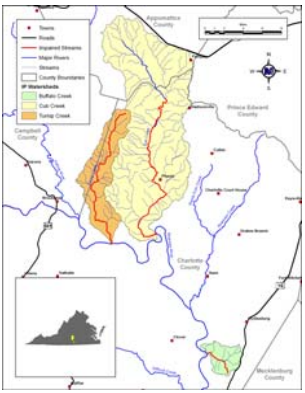
Development of the Bacterial Total Maximum Daily Load Implementation Plan for Cub Creek, Turnip Creek, Buffalo Creek, and Unnamed Tributary to Buffalo Creek in Appomattox, Campbell, and Charlotte Counties, Virginia

Executive Summary



Prepared for:
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Submitted May 2009

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Executive Summary

Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary (UT) to Buffalo Creek are part of the Roanoke (Staunton) River Basin and are located within USGS hydrologic unit code 03010101 (Roanoke River). The Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek watersheds are approximately 95,332; 21,684; 5,793; and 806 acres, respectively.

Cub Creek, Turnip Creek, Buffalo Creek, and UT Buffalo Creek were listed as impaired on Virginia's 303(d) Total Maximum Daily Load Priority List and Reports due to violations of the state's water quality standards for bacteria. The initially listed impaired segment on Cub Creek begins at the confluence with the Big Cub Creek and continues downstream to the confluence with Terry's Creek (14.21 miles). The recently listed downstream segment of Cub Creek was also included in the implementation plan as it was recently listed as impaired. The impaired segment on Turnip Creek begins at the confluence with Buck Branch and continues downstream to the confluence with the Staunton River (2.70 miles). The impaired segment on Buffalo Creek begins at the confluence with an Unnamed Tributary to Buffalo Creek and continues downstream to the confluence with the Roanoke River (2.34 miles). The impaired segment on the Unnamed Tributary to Buffalo Creek begins at the headwaters and continues downstream to the confluence with Buffalo Creek (2.88 miles).

These TMDLs were completed in April, 2006. The TMDLs called for reduction in loadings of bacteria to Cub Creek, Turnip Creek, UT Buffalo Creek and Buffalo Creek. The implementation plan presented in this document deals with translating the reductions called for in the TMDL into needed management practices with a complete cost/benefit analysis.

Agricultural Best Management Practices (BMPs)

The length of livestock fencing required on perennial streams in the Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek watersheds is approximately 22.3, 8.9, 4.0 and 0.6 miles respectively. Streamside fencing is one of the best ways to reduce bacteria levels in the stream. This will remove direct livestock defecation in the stream and prevent the trampling of the stream banks.

Table E.1 shows the fencing systems needed to meet the livestock exclusion goal. Both the grazing land (SL-6) and stream protection

(WP-2T) practices include a 35-foot buffer component. Therefore, these practices will provide some of the best water quality benefits in terms of reducing both direct (cows defacating in the stream) and land-based (runoff of manure into the streams) contributions of fecal bacteria to the stream. The values for Cub Creek include the BMPs needed in the extended segment from Terrys Creek to the Staunton (Roanoke) River.

Table E.1 SL-6 and WP-2T fence exclusion systems required for Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek watersheds.

Watershed	SL-6 systems	WP-2T systems
Cub Creek	43	13
Turnip Creek	34	1
Buffalo Creek	12	1
UT to Buffalo Creek	1	1

Due to the large reductions needed on land-based loads of *E. coli* bacteria, additional Best Management Practices (BMPs) for pasture and cropland are also needed. Estimates of all agricultural BMPs needed in the watershed are provided in Tables E.4, E.5, and E.6.

Residential Best Management Practices (BMPs)

All failing septic systems and straight pipes must be identified and replaced during implementation since a 100 percent load reduction from direct human waste is required to meet the TMDL goals. In addition, straight pipes are illegal in the Commonwealth of Virginia. The estimated numbers of straight pipes and failing septic systems were reported in the TMDL study and are shown in Table E.2.

Table E.2 Estimated houses with septic systems or straight pipes and number of failing septic systems (TMDL Study).

Potential Human Waste Contribution	Cub Creek	Turnip Creek	Buffalo Creek & UT Buffalo Creek
Houses with Standard Septic Systems	994	146	26
Potential Failing Septic Systems	28	2	1
Potential Straight Pipes	8	3	2

The Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek TMDL allocations call for large reductions to land-based residential loads. In order to achieve these reductions, the BMPs in Tables E.4, E.5, and E.6 must be implemented. The values for Cub Creek include the BMPs needed in the extended segment from Terrys Creek to the Staunton (Roanoke) River.

The pet waste education program shown in the table includes distributing information on how pet waste should be disposed. In addition, pet waste composters are proposed to help eliminate pet waste in homeowner's yards along with pet waste disposal units in public dog walking areas. This approach includes the distribution of pet waste composters to households in these watersheds. This could be accomplished through partnerships with local stores selling pet food, the County Animal Shelters, the Society for the Prevention and Cruelty to Animals (SPCA) and the County governments. Riparian vegetated buffers should be utilized whenever possible around commercial and residential land. These are simply vegetated areas along the streambank that are allowed to grow. They slow down the runoff water from the surrounding land and allow the solids containing fecal bacteria to be filtered out before reaching a flowing stream.

The total cost in the Cub Creek, Turnip Creek and Buffalo Creek watersheds is $4.1, $1.7, and $0.81 million, respectively. The total cost for full implementation comes to $6.55 million (Table E.3). These totals include the costs of agricultural and residential BMPs, as well as, the technical assistance for landowners.

Table E.3 Total cost for implementation in the Cub Creek, Turnip Creek, Buffalo Creek and UT Buffalo Creek watersheds.

Impairment	Agricultural BMPs ($)	Residential BMPs ($)	Technical Assistance ($)	Total ($)
Cub Creek	$3,664,827	$196,997	$216,667	$4,078,491
Turnip Creek	$1,393,002	$54,297	$216,667	$1,663,966
Buffalo Creek and UT Buffalo Creek	$557,900	$37,176	$216,666	$811,742
Total	$5,615,729	$288,470	$650,000	$6,554,199

Table E.4 All BMPs recommended for Cub Creek.

Cub Creek BMPs	Unit	Cost/ Unit	Units Needed	BMP Cost
Agricultural Control Measures:				
Grazing Land Protection (SL-6)	System	$18,500	43	$795,500
Improved Pasture Management	Acres	$70	13,849	$969,430
Stream Protection (WP-2T)	System	$3,400	13	$44,200
Streamside Fence Maintenance	Foot	$3.50	8,842	$30,947
Woodland Buffer Filter Area (FR-3)	Acre	$360	97	$34,920
Reforestation of Erodible Crop and Pastureland (FR-1)	Acre	$95	10	$950
Loafing Lot Management (WP-4B)	System	$1,525	1	$1,525
Conservation Tillage	Acre	$85	1,107	$94,095
Farm Retention Ponds	Ac-Treated	$138	12,270	$1,693,260
Agricultural Total				*$3,664,827*
Residential Control Measures:				
Septic Systems Pump-outs (RB-1)	System	$250	100	$25,000
Septic System Repair (RB-3)	System	$4,000	10	$40,000
Septic System Installation/ Replacement (RB-4)	System	$3,500	25	$87,500
On-site Sewage System Installation (RB-5)	System	$22,500	1	$22,500
Pet Waste Education Program	Program	$1,250	0.33	$417
Pet Waste Composters	System	$50	302	$15,100
Vegetated Buffer Filter Area	Acre	$360	18	$6,480
Residential Total				*$196,997*
Total Estimated Cost				**$3,861,824**

Table E.5 All BMPs recommended for Turnip Creek.

Turnip Creek BMPs	Unit	Cost/ Unit	Units Needed	BMP Cost
Agricultural Control Measures:				
Grazing Land Protection (SL-6)	System	$18,500	34	$629,000
Improved Pasture Management	Acre	$70	3,200	$224,000
Stream Protection (WP-2T)	System	$3,400	1	$3,400
Streamside Fence Maintenance	Foot	$3.50	7,020	$24,570
Woodland Buffer Filter Area (FR-3)	Acre	$360	24	$8,640
Reforestation of Erodible Crop and Pastureland (FR-1)	Acre	$95	10	$950
Loafing Lot Management (WP-4B)	System	$1,525	1	$1,525
Conservation Tillage	Acre	$85	391	$33,235
Farm Retention Ponds	Ac-Treated	$138	3,389	$467,682
Agricultural Total				*$1,393,002*
Residential Control Measures:				
Septic Systems Pump-outs (RB-1)	System	$250	100	$25,000
Septic System Repair (RB-3)	System	$4,000	2	$8,000
Septic System Installation/ Replacement (RB-4)	System	$3,500	5	$17,500
Pet Waste Education Program	Program	$1,250	0.33	$417
Pet Waste Composters	System	$50	46	$2,300
Vegetated Buffer Filter Area	Acre	$360	3	$1,080
Residential Total				*$54,297*
Total Estimated Cost				**$1,447,299**

Table E.6 All BMPs recommended for Buffalo Creek and UT to Buffalo Creek.

Buffalo Creek and UT Buffalo BMPs	Unit	Cost/ Unit	Units Needed	BMP Cost
Agricultural Control Measures:				
Grazing Land Protection (SL-6)	System	$18,500	13	$240,500
Improved Pasture Management	Acre	$70	1,247	$87,290
Stream Protection (WP-2T)	System	$3,400	2	$6,800
Streamside Fence Maintenance	Foot	$3.50	1,822	$6,377
Woodland Buffer Filter Area (FR-3)	Acre	$360	17	$6,120
Reforestation of Erodible Crop and Pastureland (FR-1)	Acre	$95	10	$950
Loafing Lot Management (WP-4B)	System	$1,525	1	$1,525
Conservation Tillage	Acre	$85	282	$23,970
Farm Retention Ponds	Ac-Treated	$138	1,336	$184,368
Agricultural Total				*$557,900*
Residential Control Measures:				
Septic Systems Pump-outs (RB-1)	System	$250	100	$25,000
Septic System Repair (RB-3)	System	$4,000	1	$4,000
Septic System Installation/ Replacement (RB-4)	System	$3,500	2	$7,000
Pet Waste Education Program	Program	$1,250	0.33	$416
Pet Waste Composters	System	$50	8	$400
Vegetated Buffer Filter Area	Acre	$360	1	$360
Residential Total				*$37,176*
Total Estimated Cost				**$595,076**

Introduction

The Federal Clean Water Act (CWA) became law in 1972 and requires that all U.S. streams, rivers, and lakes meet certain water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards. Through this required program, the state of Virginia has found that many stream segments do not meet state water quality standards for protection of the six beneficial uses: fishing, swimming, shellfish, aquatic life, wildlife and drinking.

When a stream fails to meet the water quality standards, it is listed as impaired, or dirty, on the CWA's Section 303(d) list. When this occurs, the CWA and the U.S. Environmental Protection Agency (EPA) both require that states develop a Total Maximum Daily Load (TMDL) for each pollutant. A TMDL is a "pollution budget" for a stream. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. A TMDL accounts for seasonal variations and must include a margin of safety (MOS).

The TMDL process includes three different steps after a stream is listed on the impaired waters or 303(d) list. The first step is to conduct a TMDL study to determine which pollutants are causing the stream to fail at meeting its water quality standards. The second step is development of an implementation plan that contains projects to reduce those pollutants. The third step is implementation of the plan and tracking of the improvements in water quality.

The first step is conducting a TMDL study. This step is complete for the Cub, Turnip, Buffalo, and Unnamed Tributary (UT) Buffalo Creeks and the results are explained below and in the Review of the TMDL Development Study section of this booklet.

Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek are part of the Roanoke River Basin and is located within USGS hydrologic unit code 03010101 (Roanoke River). The Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek watersheds are approximately 95,332; 21,684; 5,793 and 806 acres, respectively. See Figure 1 for a map of the impaired segments.

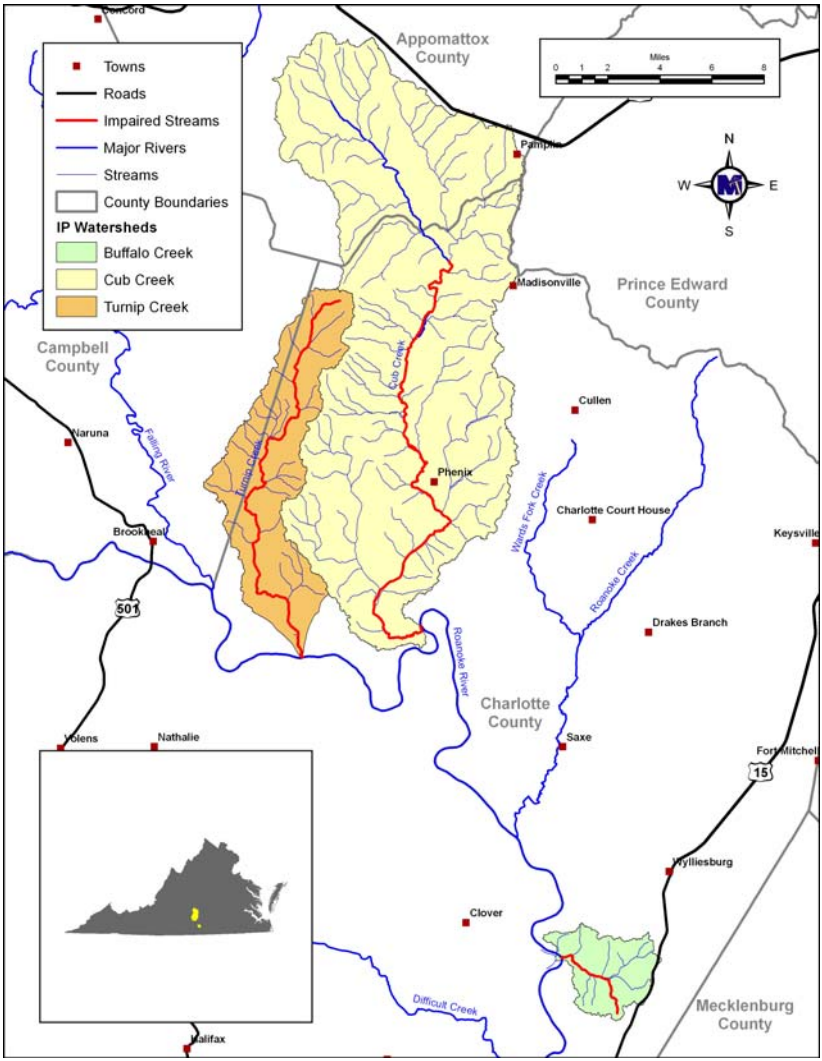

Figure 1 **The locations of Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek impaired segments.**

Cub Creek (DEQ impaired segment ID VAC-L37R-01) was listed as impaired on Virginia's 2002, 2004, 2006 and 2008 303(d) Total Maximum Daily Load Priority List and Reports due to violations of the state's water quality standards for bacteria. Turnip Creek (DEQ

impaired segment ID VAC-L36-01) was also listed as impaired on Virginia's 2002, 2004, 2006 and 2008 303(d) Total Maximum Daily Load Priority List and Reports due to violations of the state's water quality standard for bacteria. Buffalo Creek (DEQ impaired segment ID VAC-L40-06) was listed as impaired on Virginia's 2004, 2006 and 2008 303(d) Total Maximum Daily Load Priority List and Reports due to violations of the state's water quality standard for bacteria. Also, an Unnamed Tributary to Buffalo Creek (DEQ impaired segment ID VAC-L40-05) was listed as impaired on Virginia's 2002, 2004, 2006 and 2008 303(d) Total Maximum Daily Load Priority List and Reports due to violations of the state's water quality standard for bacteria.

This water quality standard changed from fecal coliform to *E. coli* in 2003 because there is stronger correlation between concentrations of *E. coli* bacteria and incidence of gastrointestinal illness, than there is with fecal coliform. The swimming use *E. coli* bacterial standard states that there can be no exceedances of either the calendar-month geometric mean standard (126 cfu/100 ml) if there are 2 or more samples collected in a month, or the instantaneous (235 cfu/100 ml) standard.

The initially listed impaired segment on Cub Creek begins at the confluence with the Big Cub Creek and continues downstream to the confluence with Terrys Creek (14.21 miles). Since the completion of the TMDL project, the downstream segment of Cub Creek has been listed due to violations of the state's water quality standard for bacteria. The working groups and steering committee agreed to include the recently listed downstream segment in the implementation plan and BMP needs calculations as this segment was included in the Staunton (Roanoke) River TMDL allocations.

The impaired segment on Turnip Creek begins at the confluence with Buck Branch and continues downstream to the confluence with the Staunton River (2.70 miles). The impaired segment on Buffalo Creek begins at the confluence with an Unnamed Tributary to Buffalo Creek and continues downstream to the confluence with the Roanoke River (2.34 miles). The impaired segment on the Unnamed Tributary to Buffalo Creek begins at the headwaters and continues downstream to the confluence with Buffalo Creek (2.88 miles).

Now that a TMDL study is developed and approved by the EPA and the State Water Control Board (SWCB), measures must be taken to reduce pollution levels in the stream. This second step in the TMDL process is the development of an implementation plan (IP).

In fulfilling the state's requirement for the development of an implementation plan, a framework has been established for reducing *E. coli* levels and achieving the water quality goals for Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek impaired stream segments. This plan is complete for the *E. coli* impairments in these watersheds, and this booklet is a summary of its information. This plan outlines how the TMDL goals can be accomplished in the watershed to improve water quality. The IP describes corrective actions and the installation of BMPs to be implemented in a staged process.

The third step in the TMDL process is to meet these water quality goals through implementation of the plan. This IP will increase the opportunities for funding for implementation, and will provide residents of these watersheds with a guide to improve water quality in their community and enhance their natural resources. The implementation of this plan will reduce levels of bacteria in Cub Creek, Turnip Creek, Buffalo Creek and an Unnamed Tributrary to Buffalo Creek. The benefits of the implementation of this plan are described in detail in the Cost/Benefit Analysis chapter of this document. In short, the implementation of this plan may provide benefits to homeowners and farmers, as well as those that use the streams for recreation purposes.

State and Federal Requirements for Implementation Plans

State Requirements

The TMDL IP is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA. WQMIRA directs the State Water Control Board to "develop and implement a plan to achieve fully supporting status for impaired waters." In order for IPs to be approved by the Commonwealth, they must meet the requirements as outlined by WQMIRA. WQMIRA requires that IPs include the following:

- Date of expected achievement of water quality objectives,
- Measurable goals,
- Necessary corrective actions, and
- Associated costs, benefits, and environmental impact of addressing the impairment.

Section 303(d) of the CWA and current EPA regulations do not require the development of implementation strategies. The EPA outlines the minimum elements of an approvable IP in its 1999 Guidance for Water Quality-Based Decisions: The TMDL Process. The listed elements include:

- A description of the implementation actions and management measures,
- A time line for implementing these measures,
- Legal or regulatory controls,
- The time required to attain water quality standards, and
- A monitoring plan and milestones for attaining water quality standards.

This booklet is an abbreviated version of the full IP report which can be obtained by contacting the Virginia Department of Conservation and Recreation (DCR).

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

- Review of the TMDL Development Study
- Process for Public Participation
- Assessment of Needs
- Implementation, and
- Cost/Benefit Analysis.

Review of the TMDL Development Study

The Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek watersheds are located in Appomattox, Campbell, and Charlotte Counties in Virginia. These watersheds are part of the Roanoke River Basin and are located within USGS hydrologic unit code 03010101 (Roanoke River). The Cub Creek watershed is approximately 95,332 acres; the Turnip Creek watershed is approximately 21,684 acres; the Buffalo Creek watershed is approximately 5,793 acres; and the Unnamed Tributary to Buffalo Creek is approximately 806 acres.

The *E. coli* bacteria TMDL Study for the Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek watersheds was approved in June 2006 by the EPA and is posted at www.deq.virginia.gov.

This TMDL study was conducted because these four streams were not meeting the state water quality standards for the recreation use (swimming). In order to meet the water quality goals established by the TMDL study, any bacteria water sample from the stream must be equal to or less than 235 colony forming units per 100 milliliters (cfu/100mL) at all times. If multiple samples are collected within a 30-day period, a geometric mean is applied, and it must be equal to or less than 126 cfu/100mL.

During the TMDL study, bacteria source tracking (BST), a water quality analysis method was performed on water samples from Cub Creek, Turnip Creek and Buffalo Creek. BST is intended to aid in identifying the sources of fecal contamination in water bodies (i.e., human, pets, livestock, or wildlife). The BST results provided insight into the likely sources of fecal contamination and the distribution of fecal bacteria in the creeks. The major sources of bacteria are human, livestock, pets and wildlife.

Having this information improves the chances for success in implementing solutions by allowing better targeting of the sources of bacteria in these watersheds. Figures 2, 3 and 4 show the load weighted average BST results for Cub Creek, Turnip Creek and Buffalo Creek respectively. A summary of the final *E. coli* allocations for the different nonpoint sources in these watersheds that resulted from the TMDL study is given in Table 1.

Information from the TMDL study determined the water quality goals and associated pollutant reductions needed in the implementation plan. The TMDL goals for the implementation plan are to address those sources of bacteria that can be attributed to human activities. The correction of straight pipes and failing septic systems are necessary to meet the TMDL goals. In addition, the majority of livestock in the watershed will need to be excluded from the creeks. Runoff carrying *E. coli* into the creeks after rain events must also be addressed. Reductions to wildlife fecal bacteria are not addressed in this implementation plan.

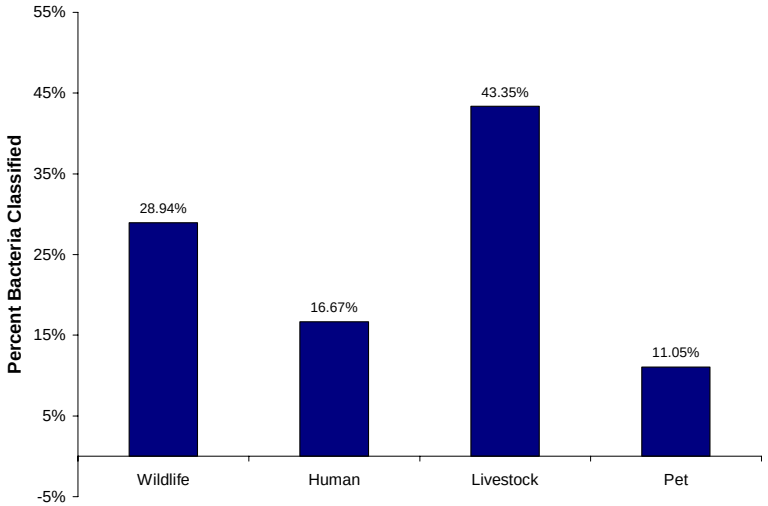

Figure 2 Load weighted averages of *E. coli* concentrations by source for Cub Creek at station 4ACUB010.96.

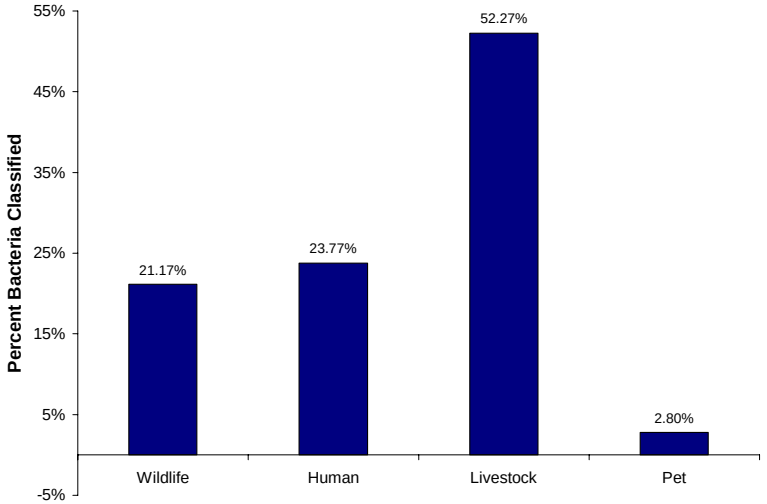

Figure 3 Load weighted averages of *E. coli* concentrations by source for Turnip Creek at station 4ATIP002.55.

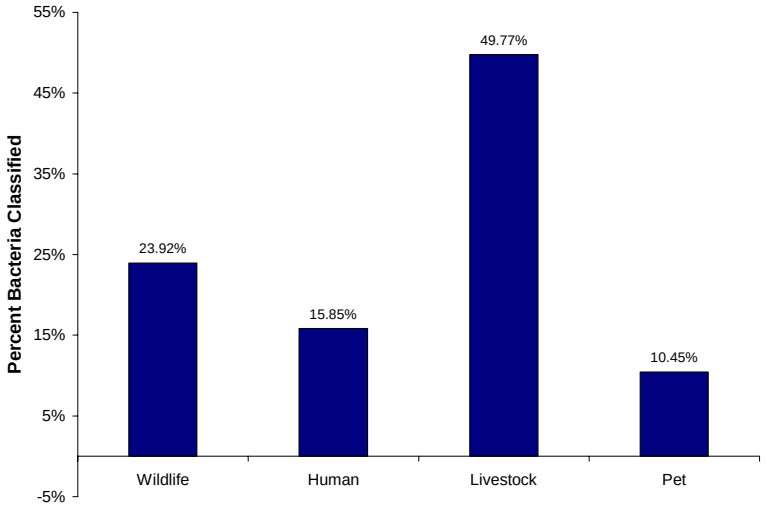

Figure 4 Load weighted averages of *E. coli* concentrations by source for Buffalo Creek at station 4ABNN001.85.

Table 1 Load reduction allocations from the Cub Creek, Turnip Creek, Buffalo Creek and UT Buffalo Creek.

Impairment	Failed Septic Systems and Straight Pipes	Direct Livestock	Ag Land	Res Land	Direct Wildlife*
Cub Creek	100%	100%	95%	95%	70%
Turnip Creek	100%	100%	90%	90%	70%
Buffalo Creek and UT	100%	100%	98%	90%	70%

*Wildlife loads are not explicitly addressed by this implementation plan.

Process for Public Participation

The actions and commitments described in this document are drawn together through input from citizens of the watershed, Charlotte county government, DEQ, DCR, Old Dominion Resource Conservation and Development Council (RC&D), Southside Soil and Water Conservation District (SSWCD), Robert E. Lee SWCD (RELSWCD), Virginia Department of Health (VDH), Natural Resources Conservation Service (NRCS), Virginia Cooperative Extension (VCE), Virginia Department of Forestry (DOF), and MapTech, Inc. Every

citizen in the watershed and interested party is encouraged to become involved in the implementation process and contribute to restoring the health of the streams. Public participation in development of the plan took place on three levels: public meetings, working groups, and a steering committee.

An informational meeting was held on August 26, 2008 to explain the TMDL IP progress and give information about the watersheds and the allocations.

A public meeting was held on October 15, 2008 to inform the public about the water quality impairments in the Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek watersheds and outline the goals for improving water quality through an implementation plan. A second public meeting took place on March 26, 2009 to request feedback from citizens on the draft implementation plan.

Specialized working groups were assembled to discuss specific implementation strategies for different sources of bacteria in these watersheds and recommend actions for the plan. The working groups were divided into three focus areas: residential, agricultural and governmental.

A steering committee was formed with representation from DEQ, DCR, VDH, SSWCD, RELSWCD, Charlotte County Cooperative Extension, Old Dominion RC&D, county government and representatives from the working groups. This meeting was held on March 12, 2009. This committee reviewed recommendations from the working groups and the draft implementation plan before it was made public.

Assessment of Needs: Recommended Actions

Agricultural Best Management Practices

Streamside fencing is one of the best ways to reduce bacteria levels in streams in agricultural watersheds. This will remove direct livestock defecation in the stream and prevent the trampling of the stream banks. The quantity of streamside fencing needed was determined through spatial analyses of land uses, the stream network, and archived data. Additionally, input from local agency representatives and citizens were used to verify the analyses.

Photo of badly eroded streams banks from direct livestock access in Pulliam Branch (Campbell County) 11/2/2000.

The length of fencing required on perennial, flowing year round, streams in the Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek watersheds is approximately 22.3, 8.9, 4.0 and 0.6 miles respectively. In order to assess this goal, the state cost-share program for agricultural best management practices (BMPs) was utilized. The total fencing needed was divided up among the different BMPs offered through the state cost-share program that include a fencing component. The Southside Soil and Water Conservation District has been targetting implementation by assisting in the installation, planning and design of agricultural best management practices in these watersheds. Since 1995, 33 fence exclusion practices were completed in the Cub Creek area, 4 in the Turnip Creek area and 5 were installed in the Buffalo Creek area. Five acres of woodland buffer and 7 alternative water systems have also been installed. The completed fencing practices total approximately 13 miles, out of an estimated 48.4 miles of streamside fencing needed overall. These efforts are a comendable step toward cattle exclusion from the streams. The stream miles currently fenced were taken into account and subtracted from the total estimated fencing needs in each watershed.

Table 2 shows the fencing systems required for the impaired watershed in order to meet the livestock exclusion goal. Both the grazing land (SL-6) and stream protection (WP-2T) practices include a 35-foot buffer along both sides of the stream where livestock exclusion fencing is installed. These riparian vegetated or forested buffers will provide an additional water quality benefit by trapping bacteria moving toward the streams through runoff. Therefore, these practices will provide some of the best water quality benefits in terms of reducing both direct

(cows defacating in the stream) and land-based (runoff of manure into streams) contributions of bacteria to the streams. The values for Cub Creek include the BMPs needed in the extended segment from Terrys Creek to the Staunton (Roanoke) River.

Table 2 Fence exclusion systems required for Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek watersheds.

Watershed	SL-6 systems	WP-2T systems
Cub Creek	43	13
Turnip Creek	34	1
Buffalo Creek	12	1
UT Buffalo Creek	1	1

Due to the large reductions needed on land-based loads of *E. coli* bacteria, additional BMPs for pasture and cropland are also needed. Estimates of all agricultural BMPs needed in these watersheds are provided in Tables 5, 6, and 7.

Residential Best Management Practices

The Cub Creek, Turnip Creek, Buffalo Creek and Unnamed Tributary to Buffalo Creek TMDL allocations call for 100 percent reduction in bacteria sources in the watershed from straight pipes and failing septic systems (see Table 4). Also, large bacteria reductions in runoff from residential areas are required. In order to achieve these reductions, the BMPs in Tables 5, 6, and 7 must be implemented. These BMPs include removing straight pipes and replacing failing septic systems, proper disposal of pet waste by homeowners, kennel owners, hunt clubs, etc.

Septic Systems

All failing septic systems and straight pipes must be identified and replaced during implementation since a 100 percent load reduction from direct and nonpoint source (NPS) human waste is required to meet the TMDL goals. In addition, straight pipes are illegal in the Commonwealth of Virginia. The estimated numbers of straight pipes and failing septic systems reported in the TMDL study are shown in Table 3. The values for Cub Creek include the BMPs needed in the extended segment from Terrys Creek to the Staunton (Roanoke) River.

Table 3 Estimated houses with septic systems or straight pipes and number of failing septic systems (TMDL Study).

Potential Human Waste Contribution	Cub Creek	Turnip Creek	Buffalo Creek & UT Buffalo Creek
Houses with Standard Septic Systems	994	146	26
Potential Failing Septic Systems	28	2	1
Potential Straight Pipes	8	3	2

The VDH has done work in the impaired watersheds to install on-site sewage systems where standard septic systems and sewer connection were not available. The number of installations is shown in Table 4.

Table 4 On-site sewage systems installed within the impaired watersheds.

Impairment	prior to 1971	from 1971 to 1981	from 1981 to 2008
Cub Creek	65	270	549
Turnip Creek	21	65	88
Buffalo Creek and UT	8	84	138

These figures are estimated from records of sewage systems installations inspected by the Charlotte County Health Department. The majority of the systems installed were for single-family residences. However, the totals also include installations for small businesses, churches, social organizations, etc. On-site sewage systems installed prior to regulatory oversight by the Health Department are not reflected by these figures. The portion of Cub Creek and Turnip Creek watersheds located outside of Charlotte County are also not reflected by these figures.

Financial assistance could be provided through grants to provide cost-share for homeowners to pump out their septic tanks. While it is not likely that sufficient grant funds will be available to assist every homeowner in these watersheds with a septic system pump-out, it is expected that this type of outreach will raise local awareness and lead homeowners to assume responsibility for maintaining their systems. In turn, this will help to prevent septic system failures in the future.

Pet Waste

There are a significant number of dogs in the watersheds. The pet waste education program referred to in Tables 5, 6, and 7 includes bacteria-reducing practices including distribution of information on proper disposal of pet waste, to pet owners, kennel operators and hunt clubs; signage regarding proper disposal of pet waste in public areas, along with pet waste disposal stations in public dog walking areas. Consideration should also be given to distributing pet waste information at campgrounds and picnic areas. Pet waste composters are also proposed to help eliminate pet waste in homeowners' yards, in addition to pet waste disposal stations in public dog walking areas. This approach includes the distribution of pet waste composters to households in these watersheds with pets. This could be accomplished through partnerships with local stores selling pet food, the Charlotte County Animal Shelter and the Society for the Prevention of Cruelty to Animals (SPCA).

Tables 5, 6, and 7 below show all BMPs recommended for Cub Creek, Turnip Creek, Buffalo and UT Buffalo Creeks, respectively. These tables are broken down into Stage I and Stage II needs. Stage I refers to the first five years of implementation when the most cost-effective BMPs will be installed. Stage II BMPs will get further bacteria reductions needed to meet the TMDL. Cost estimates are also shown.

Table 5 All BMPs recommended for Cub Creek implementation.

Cub Creek BMPs	Unit	Cost/ Unit	Units Needed	BMP Cost
Agricultural Control Measures Stage I:				
Grazing Land Protection (SL-6)	System	$18,500	43	$795,500
Improved Pasture Management	Acre	$70	13,849	$969,430
Stream Protection (WP-2T)	System	$3,400	13	$44,200
Streamside Fence Maintenance	Foot	$3.50	4,421	$15,474
Woodland Buffer Filter Area (FR-3)	Acre	$360	97	$34,920
Loafing Lot Management (WP-4B)	System	$1,525	1	$1,525
Reforestation of Erodible Crop and Pastureland (FR-1)	Acre	$95	10	$950
Conservation Tillage	Acre	$85	1,107	$94,095
Stage I Agricultural Subtotal				*$1,956,094*
Agricultural Control Measures Stage II:				
Farm Retention Ponds	Ac-Treated	$138	12,270	$1,693,260
Streamside Fence Maintenance	Foot	$3.50	4,421	$15,474
Stage II Agricultural Subtotal				*$1,708,734*
Agricultural Total				*$3,664,827*
Residential Control Measures Stage I:				
Septic Systems Pump-outs (RB-1)	System	$250	100	$25,000
Septic System Repair (RB-3)	System	$4,000	10	$40,000
Septic System Installation/ Replacement (RB-4)	System	$3,500	25	$87,500
On-site Sewage System Installation (RB-5)	System	$22,500	1	$22,500
Pet Waste Education Program	Program	$1,250	0.33	$417
Pet Waste Composters	System	$50	302	$15,100
Vegetated Buffer Filter Area	Acre	$360	18	$6,480
Residential Total				*$196,997*
Total Estimated Cost				**$3,861,824**

Table 6 All BMPs recommended for Turnip Creek implementation.

Turnip Creek BMPs	Unit	Cost/ Unit	Units Needed	BMP Cost
Agricultural Control Measures Stage I:				
Grazing Land Protection (SL-6)	System	$18,500	34	$629,000
Improved Pasture Management	Acre	$70	3,200	$224,000
Stream Protection (WP-2T)	System	$3,400	1	$3,400
Streamside Fence Maintenance	Foot	$3.50	3,510	$12,285
Woodland Buffer Filter Area (FR-3)	Acre	$360	24	$8,640
Loafing Lot Management (WP-4B)	System	$1,525	1	$1,525
Reforestation of Erodible Crop and Pastureland (FR-1)	Acre	$95	10	$950
Conservation Tillage	Acre	$85	391	$33,235
Stage I Agricultural Subtotal				*$913,035*
Agricultural Control Measures Stage II:				
Farm Retention Ponds	Ac-Treated	$138	3,389	$467,682
Streamside Fence Maintenance	Foot	$3.50	3,510	$12,285
Stage II Agricultural Subtotal				*$479,967*
Agricultural Total				*$1,393,002*
Residential Control Measures Stage I:				
Septic Systems Pump-outs (RB-1)	System	$250	100	$25,000
Septic System Repair (RB-3)	System	$4,000	2	$8,000
Septic System Installation/ Replacement (RB-4)	System	$3,500	5	$17,500
Pet Waste Education Program	Program	$1,250	0.33	$417
Pet Waste Composters	System	$50	46	$2,300
Vegetated Buffer Filter Area	Acre	$360	3	$1,080
Residential Total				*$54,297*
Total Estimated Cost				**$1,447,299**

Table 7 All BMPs recommended for Buffalo Creek and UT Buffalo Creek implementation.

Buffalo Creek and UT Buffalo BMPs	Unit	Cost/ Unit	Units Needed	BMP Cost
Agricultural Control Measures Stage I:				
Grazing Land Protection (SL-6)	System	$18,500	13	$240,500
Improved Pasture Management	Acre	$70	1,247	$87,290
Stream Protection (WP-2T)	System	$3,400	2	$6,800
Streamside Fence Maintenance	Foot	$3.50	911	$3,189
Woodland Buffer Filter Area (FR-3)	Acre	$360	17	$6,120
Loafing Lot Management (WP-4B)	System	$1,525	1	$1,525
Reforestation of Erodible Crop and Pastureland (FR-1)	Acre	$95	10	$950
Conservation Tillage	Acre	$85	282	$23,970
Stage I Agricultural Subtotal				*$370,344*
Agricultural Control Measures Stage II:				
Farm Retention Ponds	Ac-Treated	$138	1,336	$184,368
Streamside Fence Maintenance	Foot	$3.50	911	$3,189
Stage II Agricultural Subtotal				*$187,557*
Agricultural Total				*$557,900*
Residential Control Measures Stage I:				
Septic Systems Pump-outs (RB-1)	System	$250	100	$25,000
Septic System Repair (RB-3)	System	$4,000	1	$4,000
Septic System Installation/ Replacement (RB-4)	System	$3,500	2	$7,000
Pet Waste Education Program	Program	$1,250	0.33	$416
Pet Waste Composters	System	$50	8	$400
Vegetated Buffer Filter Area	Acre	$360	1	$360
Residential Total				*$37,176*
Total Estimated Cost				**$595,076**

Technical Assistance

Technical assistance needed for implementing the identified BMPs was measured in full-time equivalents (FTEs), with one FTE being equal to one full-time position. Two FTEs are needed per year during the first five years of the implementation period. It is estimated that only one FTE will be needed in the second three years primarily for the agricultural BMPs needed to complete Stage II.

Implementation

Funding

Potential funding sources available during implementation were identified during plan development. Detailed descriptions can be obtained from the SWCD, DCR, NRCS, and VCE. Sources include:

- Virginia Agricultural Best Management Practices (BMPs) Cost-Share Program
- Virginia Agricultural BMPs Tax Credit Program
- Virginia Agricultural BMPs Loan Program
- Virginia Small Business Environmental Assistance Fund Loan Program
- Virginia Water Quality Improvement Fund (WQIF)
- Community Development Block Grant Program
- Conservation Reserve Program (CRP)
- Conservation Reserve Enhancement Program (CREP)
- Environmental Quality Incentives Program (EQIP)
- Wildlife Habitat Incentive Program (WHIP)
- Wetland Reserve Program (WRP)
- Clean Water State Revolving Fund
- National Fish and Wildlife Foundation Grants

Timeline and Milestones

The intended implementation goal is to restore water quality in Cub Creek, Turnip Creek, Buffalo Creek and the Unnamed Tributary to Buffalo Creek so the bacteria standards can be attained and these streams delisted from Virginia's Section 303(d) impaired waters list. Progress toward end goals will be assessed during implementation through tracking of BMP installations and continued water quality monitoring.

Expected progress in implementation is established with two types of milestones: implementation milestones and water quality milestones.

Implementation milestones establish the amount of BMPs installed each year, while water quality milestones establish the corresponding improvements in water quality that can be expected. The milestones described here are intended to achieve full implementation within 10 years.

The Stage I goal was determined during the TMDL development to be generally close to a 10% violation rate of the instantaneous standard (235 cfu/100mL). The Stage II goal, determined during the TMDL development, is a scenario that meets the two-part *E. coli* standard, which includes the instantaneous maximum (235 cfu/100mL) and the geometric mean (126 cfu/100mL).

Even after removing the bacteria loads from controllable sources in the Cub, Turnip and Buffalo Creek watersheds, the instantaneous standard will be exceeded more than 10% of the time (see Table 8) because of the bacteria loads from wildlife in the three watersheds. The final TMDL load allocations (Stage II goal) require a 70 percent direct wildlife load reduction for all three impairments. The IP does not account for corrective actions to reduce the wildlife loads as explained in chapter six of the TMDL study report. Stage III is a time period set aside to allow BMPs to establish and stabilize to attain maximum treatment efficiencies.

Stage I, Stage II and Stage III timelines extend out to 2019 with expected pollutant reductions shown in Figures 5, 6, and 7. Stage III is a post-implementation period of two years with water quality monitoring and plan evaluation continuing as there will be a lag time between BMP implementation and the actual maximum efficiency of the BMPs being effective.

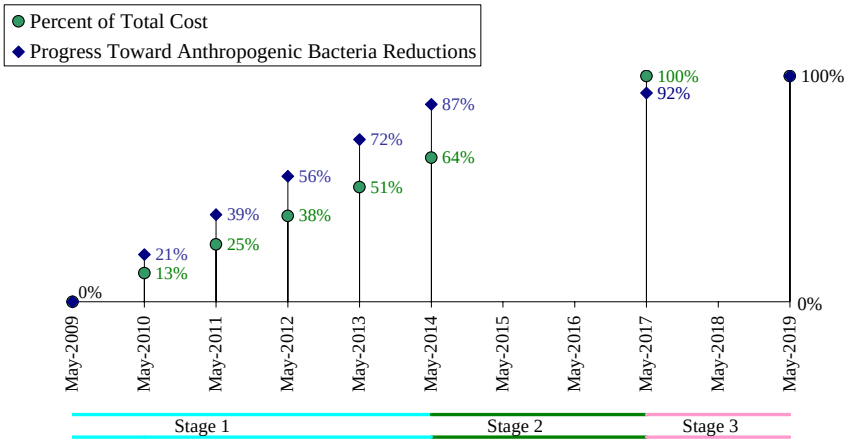

Figure 5 **Timeline for implementation in the Cub Creek watershed.**

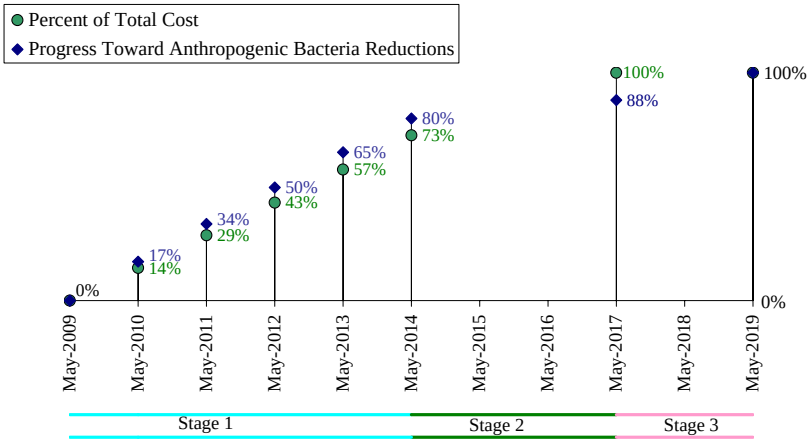

Figure 6 **Timeline for implementation in the Turnip Creek watershed.**

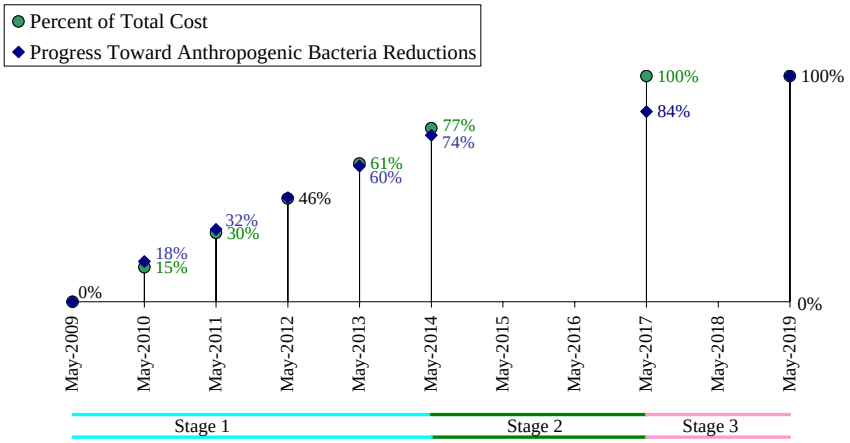

Figure 7 **Timeline for implementation in the Buffalo Creek and Unnamed Tributary to Buffalo Creek watershed.**

Following the idea of a staged implementation approach, resources and finances will be concentrated on the most cost-efficient control measures first. These measures will be the focus of Stage I, the first 5 years. Following Stage I implementation and if a de-listing is not yet attained, the steering committee should evaluate water quality improvements and determine how to proceed to implement additional BMPs during Stage II, the next 3 years. Stage II focuses on BMPs that are necessary for the stream to fully comply with the TMDL allocation requirements. The Virginia *E. coli* swimming use *E. coli* bacterial standard states that there can be no exceedances of either the calendar-month geometric mean standard (126 cfu/100 ml), if there are 2 or more samples collected in a month, or the instantaneous standard (235 cfu/100 ml). Complying with the two-part standard requires BMPs that are more difficult and costly to implement. Tables 5, 6, and 7 show the types and quantities of BMPs to be installed during each stage.

Table 8 shows the percent of total completion goals for Stage I and Stage II. Table 8 also shows the percent exceedances of the *E.coli* instaneous standard for each stream and the overall progress toward bacteria load reductions.

Table 8. Stage I and Stage II BMP installation goals.

Control Measures (BMPs)	Stage I	Stage II
Agricultural:		
Grazing Land Protection (SL-6)	100%	100%
Improved Pasture Management	100%	100%
Stream Protection (WP-2T)	100%	100%
Streamside Fence Maintenance	50%	100%
Woodland Buffer Filter Area (FR-3)	100%	100%
Loafing Lot Management (WP-4B)	100%	100%
Reforestation of Erodible Crop and Pastureland (FR-1)	100%	100%
Conservation Tillage	100%	100%
Farm Retention Ponds	0%	100%
Residential:		
Septic Systems Pump-outs (RB-1)	100%	100%
Septic System Repair (RB-3)	100%	100%
Septic System Installation/ Replacement (RB-4)	100%	100%
On-site Sewage System Installation (RB-5)	100%	100%
Pet Waste Education Program	100%	100%
Pet Waste Composters	100%	100%
Vegetated Buffer Filter Area	100%	100%
Exceedance of Instantaneous EC Standard (235 cfu/100mL):		
Cub Creek	64%	62% (43%*)
Turnip Creek	68%	65% (77%*)
Buffalo and UT Buffalo Creeks	40%	36% (63%*)
Cumulative Progress Toward Controllable Bacteria Load Goals:		
Cub Creek	87%	92%
Turnip Creek	80%	88%
Buffalo and UT Buffalo Creeks	74%	84%
Cost (% of Total)	62%	100%

*Lowest violation rate without addressing existing wildlife loads.

Targeting

The impaired watersheds were divided into subwatersheds for TMDL modeling purposes and this also helps with the targeting of BMP practices (Figures 8 and 9). Targeting of critical areas for livestock fencing was accomplished through analysis of livestock population and the fencing requirements for each subwatershed. The subwatersheds were ranked in descending order based on the ratio of animals per fence length along perennial streams. Failing septic systems and straight pipes were ranked based on the sum of the bacteria loads in each subwatershed. If feasible, effort should be made to prioritize financial and technical resources in the order of subwatersheds (Table 9).

Table 9 Targeting subwatershed order for residential waste BMPs and streamside fencing.

Stream	Failing Septic Systems and Straight Pipes	Streamside Fencing
Cub Creek	32, 29, 30, 27, 31, 28	29, 27, 30, 28, 31, 32
Turnip Creek	36	36
Buffalo Creek and UT Buffalo Creek	3, 5, 4	4, 3, 5
Overall Priority	**36, 32, 29, 30, 3, 27, 31, 28, 5, 4**	**29, 27, 30, 28, 31, 32, 36, 4, 3, 5**

Locations where streamside fencing could be installed to exclude cattle from streams were determined by locating all pasture with adjacent perennial streams. It was assumed all pasture land had the potential for cattle grazing; therefore all pasture land was used in the analysis (Figures 8 and 9). These figures also show the numbered subwatersheds, which are smaller subsections of the entire drainage area.

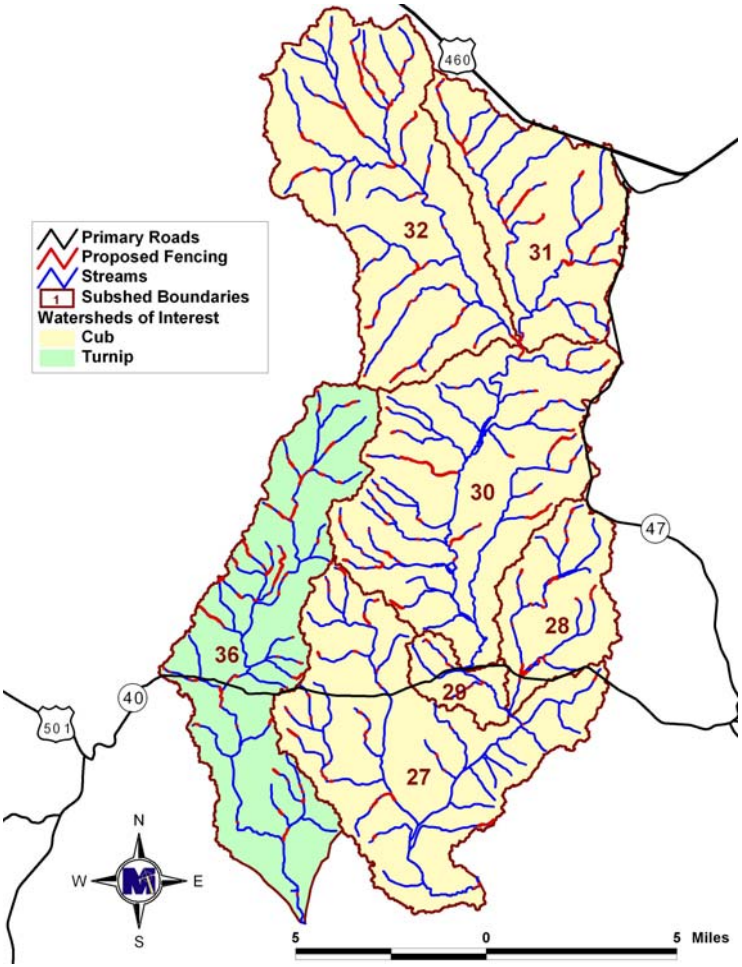

Figure 8 **Potential locations for streamside fencing in the Cub Creek and Turnip Creek watersheds.**

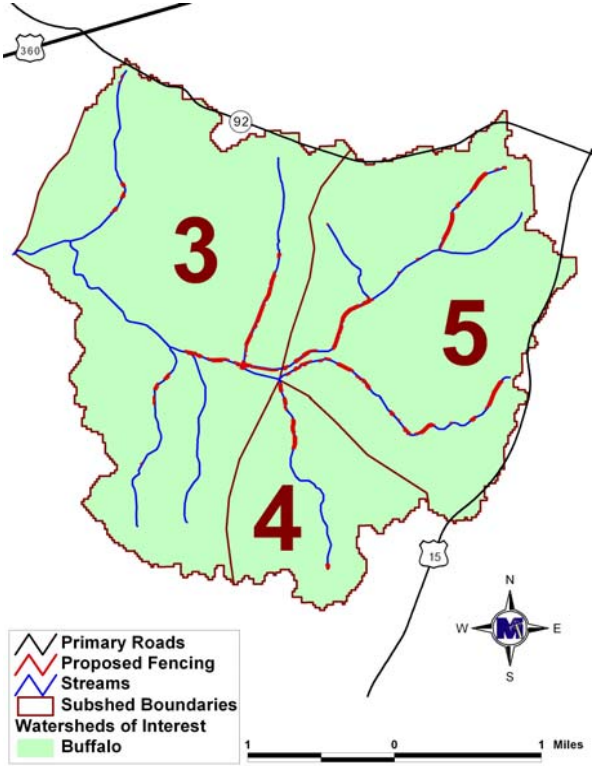

Figure 9 **Potential locations for streamside fencing in the Buffalo and UT Buffalo Creek watershed.**

Cost/Benefit Analysis

In general, many of the agricultural BMPs being recommended will provide both environmental benefits and economic benefits to the farmer. Associated cost estimates of agricultural and residential BMPs were calculated by multiplying the unit cost of each practice by the number of units in each watershed.

Table 10 shows the estimated cost of installing the recommended agricultural and residential BMPs and the technical assistance costs in Stages I and II. The total cost for Stage I for the Cub Creek, Turnip Creek and Buffalo Creek watersheds is $2.3, $1.1 and $0.58 million, respectively.

It was determined that it would require $50,000 to support the salary, benefits, travel, training, and incidentals for education for one technical

FTE. With quantification analysis yielding a need for two FTEs per year for the first five years of implementation and one FTE per year for the subsequent three years, the maximum total cost to provide technical assistance during implementation is expected to be $650,000 (Table 10). Factoring in technical assistance costs, the total cost for full implementation in these watersheds comes to $6.57 million (Table 10).

Table 10 All costs for Stage I, Stage II, and total implementation.

Impairment	Agricultural BMPs ($)	Residential BMPs ($)	Technical Assistance ($)	Total ($)
Stage I				
Cub Creek	$1,956,094	$196,997	$166,667	$2,319,758
Turnip Creek	$913,035	$54,297	$166,667	$1,133,999
Buffalo Creek and UT Buffalo Creek	$370,344	$37,176	$166,666	$574,186
Total	**$3,239,472**	**$288,470**	**$500,000**	**$4,027,942**
Stage II				
Cub Creek	$1,708,734	$0	$50,000	$1,758,734
Turnip Creek	$479,967	$0	$50,000	$529,967
Buffalo Creek and UT Buffalo Creek	$187,557	$0	$50,000	$237,557
Total	**$2,376,257**	**$0**	**$150,000**	**$2,526,257**
Total				
Cub Creek	$3,664,827	$196,997	$216,667	$4,078,491
Turnip Creek	$1,393,002	$54,297	$216,667	$1,663,966
Buffalo Creek and UT Buffalo Creek	$557,900	$37,176	$216,666	$811,742
Total	**$5,615,729**	**$288,470**	**$650,000**	**$6,554,199**

The primary benefit of this implementation is cleaner waters in Charlotte County. Specifically, fecal bacteria contamination in the Cub Creek, Turnip Creek and Buffalo Creek watersheds will be reduced to meet water quality standards and allow for safe recreational use. It is difficult to gauge 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 considerably reduced.

Additionally, because of stream protection that will be provided through exclusion of livestock from streams, the aquatic habitat will be improved in these waters. The vegetated buffers that are established will also serve to reduce bacteria runoff to the stream from upslope locations. In addition, as trees and shrubs in vegetated buffers grow, they serve as excellent shade sources for streams. This in turn reduces water temperature in the stream and increases dissolved oxygen, thereby improving aquatic habitat for numerous aquatic organisms. In areas where pasture management is improved, less bacteria will be washed into streams following precipitation events. Bacteria concentrations in the stream should be at or below the state standards.

Livestock stream exclusion example.

A clean water source has been shown to improve herd health. Many livestock illnesses can be spread through contaminated water supplies. A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills. Beef producers in several Virginia Counties have reported weight gains in cattle after providing alternative water sources. Studies also show increased milk and butterfat production from dairy cattle ingesting water from a clean source (VCE, 2007; Streamside Livestock Exclusion: A tool for increasing farm income and improving water quality, VCE and DCR).

An off stream watering source for cattle.

Taking the opportunity to initiate 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 stocking rates and, consequently, improve the profitability of the operation. 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.

The residential programs will play an important role in improving water quality, since human waste can carry human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry with it. 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. 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 three to five years. The cost of proper maintenance, as outlined here, is relatively inexpensive in comparison to repairing or replacing the entire system.

Implementation of this plan will help to foster continued local economic vitality and strength. This is based on the recognition that

clean water improves 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 are expected to provide economic and environmental benefits to the landowner. Specifically, alternative (clean) water sources, exclusion of livestock from streams, intensive pasture management, and private sewage system maintenance will each provide economic benefits.

Monitoring

Improvements in water quality will be determined in the Cub Creek, Turnip Creek and Buffalo Creek watersheds through monitoring conducted by the DEQ's ambient monitoring program. The monitoring data includes bacteria, physical parameters (dissolved oxygen, temperature, pH, and conductivity), nutrients and suspended and dissolved solids. The VADEQ uses the data to determine overall water quality status. The water quality status will help gauge the success of implementation aimed at reducing the amount of bacteria in the Cub Creek, Turnip Creek and Buffalo Creek watershed.

The DEQ monitoring stations in the Cub Creek, Turnip Creek and Buffalo Creek watersheds are described in Table 11 and shown in Figure 10. Stations are monitored every other month within the monitoring period listed in Table 11.

Up-to-date monitoring results are available to residents online at the department's Web site:
http://gisweb.deq.virginia.gov/monapp/mon_query_form.cfm.
Query information by selecting the watershed from the drop-down menu.

Currently, no volunteer monitoring is occurring in the Cub Creek, Turnip Creek and Buffalo Creek Watersheds. However, stakeholders showed interest in participating in water quality monitoring activities within the impaired watersheds.

Table 11 DEQ's monitoring schedule in the Cub Creek, Turnip Creek and Buffalo Creek watersheds.

Station ID	Stream	Station Location	Monitoring Period
4ACUB010.96	Cub Creek	Route 40 Bridge – Charlotte Co.	Continuously Bi-monthly
4ABNN001.85	Buffalo Creek	Route 608	2013-2018 Bi-monthly
4ATIP002.55	Turnip Creek	Route 619 Bridge	2013-2018 Bi-monthly
4AXMC000.54	UT Buffalo Creek	Route 605	2013-2018 Bi-monthly

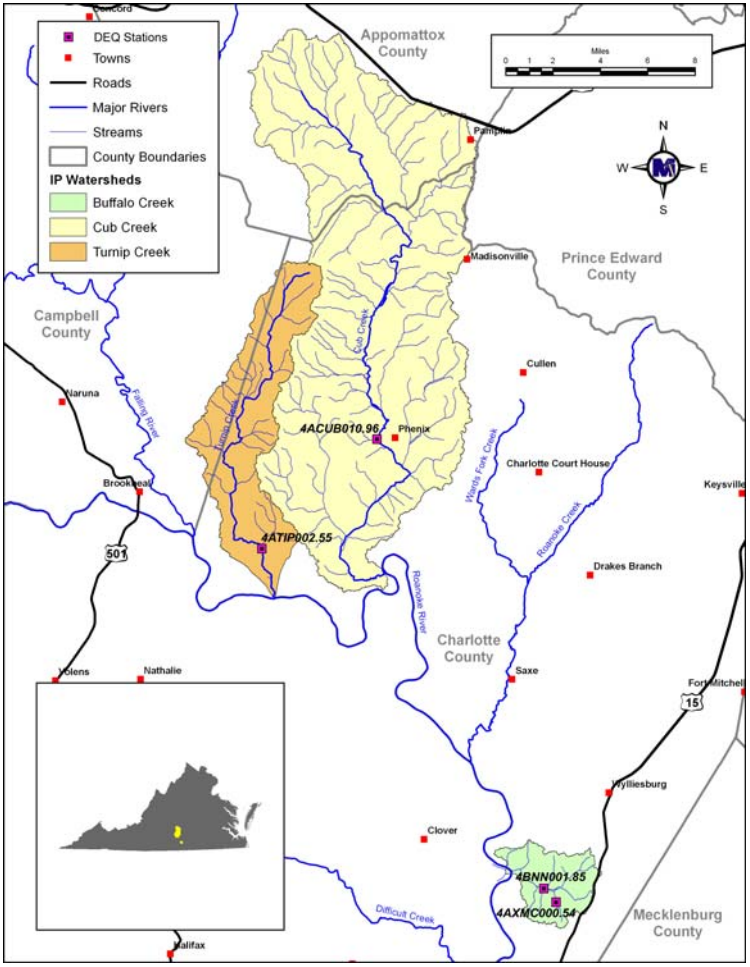

Figure 10 DEQ's monitoring stations in the Cub Creek, Turnip Creek and Buffalo Creek watersheds.

Education

Personnel from the Southside SWCD and Robert E. Lee SWCD will initiate contact with farmers in these watersheds to encourage the installation of agricultural BMPs. This one-on-one contact will facilitate communication of the water quality problems and the corrective actions needed. The technical staff for the IP will conduct a number of outreach activities in the watershed to raise local awareness, encourage community support and participation in reaching the implementation plan milestones. Such activities will include information exchange through newsletters, postcard mailings, field days and, presentations at local Ruritan and Rotary Clubs. The technical staff will work with organizations such as Virginia Cooperative Extension to sponsor farm tours and field days.

Stakeholders' Roles and Responsibilities

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private individuals and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL implementation plan effort.

Environmental Protection Agency (EPA)

The EPA has the responsibility for overseeing the various programs necessary for the success of the Clean Water Act. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are six state agencies responsible for regulating activities that impact water quality with regard to this implementation plan. These agencies include: DEQ, DCR, VDH, VCE, DOF, and Virginia Department of Agriculture and Consumer Services (VDACS).

Department of Environmental Quality (DEQ)

DEQ has responsibility for monitoring the waters to determine compliance with state standards and for requiring permitted point 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. Beginning in 1994, animal waste from confined animal facilities in excess of 300 animal units (cattle and hogs) has been managed through a Virginia general pollution abatement permit. These operations are required to implement a number of practices to prevent groundwater contamination. In response to increasing demand

from the public to develop new regulations dealing with animal waste, in 1999 the Virginia General Assembly passed legislation requiring DEQ to develop regulations for the management of poultry waste in operations having more than 200 animal units of poultry (about 20,000 chickens) (ELI, 1999). On January 1, 2008 the Virginia Department of Environmental Quality (DEQ) assumed regulatory oversight of all land application of treated sewage sludge, commonly referred to as biosolids. DEQ's Office of Land Application Programs within the Water Quality Division to manages the biosolids program. The biosolids program includes having and following nutrient management plans for all fields receiving biosolids, unannounced inspections of the land application sites, certification of persons land applying biosolids, and payment of a $7.50 fee per dry ton of biosolids land applied.

Department of Conservation and Recreation (DCR)
DCR is a major participant in the TMDL process. DCR has a lead role in the development of IPs to address non-point source pollutants such as bacteria from failing septic systems, pet waste, and livestock operations that contribute to water quality impairments. DCR provides available funding and technical support for the implementation of NPS components of IPs.

Southside and Robert E. Lee Soil and Water Conservation Districts (SWCD)
The Southside and Robert E. Lee SWCDs will provide outreach, technical and financial assistance to farmers and property owners in the Cub Creek, Turnip Creek and Buffalo Creek watersheds 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 BMPs. Education and outreach activities are a significant portion of their responsibilities. Currently (2009), there is a full time employee at Southside SWCD funded through WQIF to provide technical assistance to landowners in the Charlotte County TMDL impaired watersheds. Robert E. Lee SWCD is working in the Appomattox County portion of Cub Creek. Robert E. Lee SWCD has a part-time employee providing technical assistance to landowners in upper Cub Creek (Appomattox County) and in the Falling River watershed in Campbell County in addition to working in the western portion of Turnip Creek in Campbell County. The SWCDs and stakeholders will also work to seek funding to implement the residential practices and programs. The WQIF is a

potential funding source for correcting failing septic systems and removing straight pipes.

Virginia Department of Agriculture and Consumer Services (VDACS)

Through Virginia's Agricultural Stewardship Act, the VDACS 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. The enforcement of the Agricultural Stewardship Act is entirely complaint-driven. This Act is considered as a state regulatory tool that can support implementing conservation practices to addresses pollutant sources in TMDL impaired watersheds even though the Act does not specifically reference pathogens as a pollutant.

Virginia Department of Health (VDH)

VDH is responsible for maintaining safe drinking water measured by standards set by EPA. Their duties also include septic system regulation and, in the past, regulation of biosolids land application. Like VDACS, VDH's program is complaint-driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation that may take many weeks or longer to effect compliance. In the scheme of this TMDL IP, VDH has the responsibility of enforcing actions to correct or eliminate failed septic systems and straight pipes, respectively. VDH staff also issue permits for the repair and installation of septic systems and the installation of on-site sewage systems.

Local Governments

Local governments can develop ordinances involving pollution prevention measures and play a very active role in the TMDL implementation process. For example, they could promote a septic system maintenance program. This could be done by handing out literature when individuals apply for a building permit. It is recommended that Charlotte County adopt a reserve area for land

parcels using on-site wastewater treatment of equal size to the approved on-site disposal system for use in the event the on-site disposal system fails. Further, the reserve area shown must be of equal capacity to the primary drainfield using the same technology as the primary system. Nothing shall be constructed within the reserve area.

Local governments could also play an active role in the proper disposal of pet waste. There are many dog kennels in these counties. When licenses for dog kennels are issued, the owners could be required to produce a plan for the proper disposal of waste from the facility.

Regarding future subdivisions, local governments should ensure that they be developed with sustainable growth practices that minimize or eliminate storm water runoff.

Citizens

Successful implementation depends on stakeholders taking responsibility for their role in the process. This could include using pet waste composters if they have dogs, getting septic tanks pumped on a regular basis and talking with friends and neighbors about things they can do to protect water quality. While the primary role falls on the landowner, local, state and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for its citizens. While it is unreasonable to expect that the natural environment (e.g., streams and rivers) can be made one hundred percent free of risk to human health, it is possible and desirable to minimize anthropogenic problems. Virginia's approach to correcting NPS pollution problems has been, and continues to be, encouragement of participation through education and financial incentives. However, if progress is not made toward restoring water quality using this voluntary approach, regulatory controls may be established and enforced.

Water Quality Programs and Activities

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, a 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.

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List of Acronyms

BMP	Best Management Practice
BST	Bacteria Source Tracking
CREP	Conservation Reserve and Enhancement Program
CWA	Clean Water Act
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
DOF	Virginia Department of Forestry
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
FTE	Full Time Equivalent
GWG	Government Working Group
IP	Implementation Plan
NPS	Nonpoint Source Pollution
NRCS	Natural Resources Conservation Service
RWG	Residential Working Group
SL-6	Grazing Land Protection System
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
VCE	Virginia Cooperative Extension
VDACS	Virginia Department of Agriculture and Consumer Services
VDH	Virginia Department of Health
WP-2T	Stream Protection

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